DRAFT FINAL
UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN (UFP-QAPP)

FOR THE REMEDIAL INVESTIGATION ACTIVITIES AT

FORMER STEWART AIR FORCE BASE, NEWBURGH AND NEW WINDSOR, NEW YORK

THE FORMERLY USED DEFENSE SITE (FUDS), NO. C02NY0704

CONTRACT NO. W912WJ-19-D-0006

Delivery Order No. W912WJ19F0135

Prepared for:

U.S. Army Corps of Engineers

New England District

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Table of Contents

Abbreviations and Acronyms vi
Executive Summary 1
QAPP Worksheet #1 & 2: Title and Approval Page 4
QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution 7
QAPP Worksheet #4, 7, & 8: Project Personnel Sign-Off Sheet 8
QAPP Worksheet #6: Communication Pathways 12
QAPP Worksheet #9: Project Scoping Session Participants Sheet 18
QAPP Worksheet #10: Conceptual Site Model 22
QAPP Worksheet #11: Project/Data Quality Objectives 63
QAPP Worksheet #12: Measurement Performance Criteria 87
QAPP Worksheet #13: Secondary Data Criteria and Limitations 117
QAPP Worksheet #14/16: Project Tasks and Schedule 118
QAPP Worksheet #15: Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits 120
QAPP Worksheet #17: Sampling Design and Rationale 165
QAPP Worksheet #18: Sampling Locations and Methods 175
QAPP Worksheets #19 & #30: Sample Containers, Preservation, and Hold Times 192
QAPP Worksheet #20: Field Quality Control Sample Summary 198
QAPP Worksheet #21: Field SOP References 202
QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection 205
QAPP Worksheet #23: Analytical SOP References Table 207
QAPP Worksheet #24: Analytical Instrument Calibration 216
QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection 233
QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal 237
QAPP Worksheet #28: Analytical Quality Control and Corrective Action 239
QAPP Worksheet #29: Project Documents and Records 262
QAPP Worksheets #31, 32, & 33: Assessments and Corrective Action 265
QAPP Worksheet #34: Data Verification and Validation Inputs 276
QAPP Worksheet #35: Data Verification Procedures 277

QAPP Worksheet #36: Data Validation Procedures..... 279
QAPP Worksheet #37: Data Usability Assessment..... 284
REFERENCES 287
FIGURES
APPENDICES

FIGURES

Figure 1. Site Vicinity Map

Figure 2. Site Location Map

Figure 3. Site Map Showing Current and Previous Landfill Boundaries and Features

Figure 4. Site Map Showing Historical Road Construction Plan

Figure 5. Graphic Depiction of Conceptual Site Model

Figure 6A. Preliminary Human Health Conceptual Site Model for AOC-2 (Former Southern Landfill)

Figure 6B. Preliminary Human Health Conceptual Site Model for AOC-3N (Debris Area)

Figure 6C. Preliminary Human Health Conceptual Site Model for AOC-3S (Unsuitable Fill Area)

Figure 6D. Preliminary Human Health Conceptual Site Model for AOC-FI (Former Incinerator)

Figure 7. Preliminary Ecological Conceptual Site Model

Figure 8. Site Map Showing Topographic Contours

Figure 9. Site Location Map Showing Select Surface Water Features

Figure 10. Site Map Showing Identified Wetland Locations

Figure 11. Bedrock Geology Map

Figure 12. Surficial Geology Map

Figure 13. Fracture Trace Analysis (RRI, 2001)

Figure 14. Overburden Groundwater Elevation Contours (HDR, 2009a)

Figure 15. Historical Soil Sample and Referenced Boring Locations

Figure 16. Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells

Figure 17. Historical Sediment and Surface Water Sampling Locations

Figure 18. Historical Landfill Extent, Contents, and Landfill Gas Sampling Locations

Figure 19. Proposed Surface and Subsurface Soil Sampling Locations

Figure 20. Proposed Groundwater Monitoring Locations

Figure 21. Proposed Sediment and Surface Water Sampling Locations

TABLES

Table 1. Relevant Environmental Investigations 29
Table 2. Known or Suspected Classes of Contaminants 37
Table 3. Calculated Hydraulic Conductivity Ranges for New York Air National Guard Base, Newburgh, New York 52
Table 4. Data Gaps and Approach to Address Data Gaps at AOC 2, AOC 3, and AOC FI 62
Table 5. Information Inputs Required to Achieve Study Goals 65
Table 6. Analyte List for Analytical Laboratory 69
Table 7. Analyte List for Field Measurements 75
Table 8. Analytical Laboratory Analytical Approach by Media 76
Table 9. Field Measurement Analytical Approach by Media 78
Table 10. Sampling Areas and Rationale by Media 167
Table 11. Soil Sampling Locations 176
Table 12. Groundwater Sampling Locations 177
Table 13. Surface Water Sampling Locations 178
Table 14. Sediment Sampling Locations 179
Table 15. Soil Gas Sampling Locations 180
Table 16. Stabilization Criteria for Low-Flow Groundwater Sampling 184
Table 17. Well Details for Placing Intake Pump for Groundwater Sampling 184

APPENDICES

Appendix A – Human Health Risk Assessment and Screening Level Ecological Risk Assessment Draft Work Plan

Appendix B – National Wetlands Inventory Map for Former Stewart Air Force Base Vicinity and Habitat Explanations and 2021 Wetlands Delineation Memo

Appendix C – Historical Data Evaluation and 2021 Geophysical Survey Report

Appendix D – AOC 3 – Figure 2.6 and Test Pit Logs

Appendix E – Laboratory Certifications

Appendix F – Laboratory Standard Operating Procedures

Appendix G – TI-SDC Standard Operating Procedures

Appendix H – Field Forms

Appendix I – Site Safety and Health Plan/Accident Prevention Plan

Appendix J – Community Air Monitoring Plan

Appendix K – QC Inspection Checklists and DQCR

Appendix L – Evaluation of Historical Detections of Analytes with Detection Limits Above Project Screening Levels

Appendix M – Analytical Project Limits

Abbreviations and Acronyms

ADR	Automated Data Review
AFB	Air Force Base
AMSL	Above Mean Sea Level
Aneptek	Aneptek Corporation
AOC	Area of Concern
APP	Accident Prevention Plan
ASTM	American Society for Testing and Materials
bgs	below ground surface
Bluestone	Bluestone Environmental Group, Inc.
B.S.	Bachelor of Science
BH	bore hole
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
°C	degrees Celsius
C & D	construction and demolition
CalEPA	California Environmental Protection Agency
CAMP	Community Air Monitoring Plan
CAS	Chemical Abstract Service
CCV	Continuing Calibration Verification
CEC	Cation Exchange Capacity
CHMM	Certified Hazardous Materials Manager
CI	Closure Investigation
CIT	Certified Instructional Trainer
cm/sec	Centimeters per Second
COB	Close of Business
C-O-C	Chain-of-Custody
CQC	Contractor Quality Control
CQC-M	Contractor Quality Control Manager
CQM-C	Construction Quality Management for Contractors
CSM	Conceptual Site Model
CSP	Certified Safety Professional
CVAA	Cold Vapor Atomic Absorption
D	duplicate
DDD	dichlorodiphenyldichloro-ethane
DDE	dichlorodiphenyldichloro-ethylene
DDT	dichlorodiphenyltrichloro-ethane
DERP	Defense Environmental Restoration Program
DFTPP	Decafluorotriphenylphosphine
Dig Safe	Dig Safe Systems, Incorporated
DO	Delivery Order
DOC	Dissolved Organic Carbon
DoD	Department of Defense
DQO	Data Quality Objective
DPT	Direct Push Technology
DQCR	Daily Quality Control Reports
DRO	Diesel Range Organics
DU	Decision Unit
EB	Equipment Blank
ECD	Electron Capture Detector
EDR	Environmental Data Resources, Inc
EFGS	Eurofins Frontier Global Sciences
EICP	Extracted Ion Current Profile
EIS	Extracted internal standard
ELAP	Environmental Laboratory Accreditation Program
ELLE	Eurofins Lancaster Laboratories Environmental
EM	Engineering Manual

EMP	Environmental Planning and Management
ERA	Ecological Risk Assessor
ESV	Ecological Screening Value
ETM	Expanded Technical Memorandum
EU	Exposure Unit
FD	Formerly delineated
FS	Feasibility Study
FSA	Former Stewart Airforce Base
ft	feet
FUDS	Formerly Used Defense Site
FUDSChem	Formerly Used Defense Site Chemical Database
GAC	General Ammunition Consultations
GC/MS	Gas Chromatograph / Mass Spectrometer
gm	gram
gpm	gallons per minute
GIS	Geographical Information System
GRO	Gasoline Range Organics
GSA	General Services Administration
GW	groundwater
Harza	Harza Engineering Company
HAZWOPER	Hazardous Waste Operations and Emergency Response
HP	Hewlett Packard
HPA	Historical Photo Analysis
HTRW	Hazardous, Toxic, and Radioactive Waste
HHRA	Human Health Risk Assessment
HHRA	Human Health Risk Assessor
HI	Hazard Index
HPA	Historical Photo Analysis
HRMS	High Resolution Mass Spectrometry
HRGC	High Resolution Gas Chromatograph
HSE	Health, Safety and Environment
HTRW	Hazardous, Toxic and Radioactive Waste
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICP AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICV	Initial Calibration Verification
ID	Identification
IDW	Investigation-Derived Waste
INPR	Inventory Project Report
ISM	Incremental Sampling Methodology
ISO	International Organization for Standardization
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LDC	Laboratory Data Consultants
LEL	Lower Explosive Limit
LLC	Low Level Check
LMS	Lawler, Matusky and Skelly Engineers
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	Method Blank
MCC	Metal Container Corporation
MDL	Method Detection Limit

MEC	Munitions and Explosives of Concern
meq	milliequivalents
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
mg/L	Milligrams per Liter
mm	Millimeter
MMYY	two-digit month and two-digit year
M.S.	Master of Science
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MTA	Metropolitan Transit Authority
mV	Millivolt
MW	Monitoring Well
N/A	Not Applicable
NCP	National Contingency Plan
NEG	National Express Group
ng/kg	Nanogram per Kilogram
ND	Not Detected
NE	Not Established
NELAP	National Environmental Laboratory Accreditation Program
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OCP	Organochlorine Pesticides
Ogden	Ogden Environmental and Energy Services Co., Inc.
OPR	Ongoing Precision and Recovery
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PANYNJ	Port Authority of New York and New Jersey
PCB	Poly Chlorinated Biphenyl
PCE	Tetrachloroethylene
PDF	Portable Document Format
PE	Professional Engineer
PESA	Preliminary Environmental Site Assessment
PFAS	Per- and Polyfluoroalkyl Substances
%	Percent
PG	Professional Geologist
PID	Photo-Ionization Detector
PM	Project Manager
PMP	Project Management Professional
PPE	Personal Protective Equipment
ppm	Parts Per Million
PQL	Project Quantitation Limit
PQO	Project Quality Objectives
PSL	Project Screening Level
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual

RF	Relative Frequency
RI	Remedial Investigation
Roux	Roux Associates, Inc.
RPD	Relative Percent Difference
RRF	Relative Retention Factor
RRT	Relative Retention Time
RSD	Relative Standard Distribution
RSL	Regional Screening Level
S&H	Safety and Health
SD	sediment
SEDD	Staged Electronic Data Deliverable
SG	soil gas
SIM	Selective Ion Monitoring
SLC	Southern Landfill Complex
SLERA	Screening-Level Ecological Risk Assessment
SOP	Standard Operation Procedure
SPDES	State Pollution Discharge Elimination System
SPP	Systematic Planning Process
SS	surface soil
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SU	Sampling Unit
SVOC	Semi-Volatile Organic Compounds
SW	surface water
SWF	Stewart International Airport
SWFAA	SWF Airport Acquisition, Inc
SWFF	Southwest Fuel Farm
SWQuadFF	Southwest Quadrant Fuel Farm
TAGM	Technical Administrative Guidance Memorandum
TAL	Target Analyte List
TB	Trip Blank
TCDD	Tetrachlorodibenzo-p-dioxin
TOC	Total Organic Carbon
TPH-D	Total Petroleum Hydrocarbons as Diesel
TPH-G	Total Petroleum Hydrocarbons as Gasoline
TPP	Technical Planning Process
UCL	upper confidence level
UEL	upper explosive limit
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USAGC	United States Army Geospatial Center
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
UV	Ultraviolet
UXO	Unexploded Ordinance
VOC	Volatile Organic Compound
VSP	Visual Sampling Plan

Executive Summary

The United States Army Corps of Engineers (USACE) identified six hazardous waste sites at Former Stewart Air Force Base (AFB) as potential Formerly Used Defense Sites (FUDS) under the Defense Environmental Restoration Program (DERP). These six Areas of Concern (AOCs) were evaluated for their eligibility to be investigated under the FUDS Hazardous, Toxic, and Radioactive Waste (HTRW) Program. Two of the six AOCs (Former Southern Landfill [AOC 2] and Former Half-Acre Landfill or Unsuitable Fill Area [AOC 3]) were determined to be eligible under the FUDS HTRW Program (USACE, 1989; Bluestone, 2019). An additional AOC associated with a Former Incinerator (AOC FI) was later determined to be eligible and AOC 3 was expanded to include a debris area 600 feet (ft) to the north. USACE has initiated Remedial Investigation (RI) activities at these three AOCs.

TI-SDC Joint Venture (TI-SDC) is performing the RI activities at AOC 2, AOC 3, and AOC FI under USACE Contract No. W912WJ-19-D-0006, Delivery Order (DO) No. W912WJ19F0135. The property is identified as FUDS Property No. C02NY0704.

Former Stewart AFB is in Orange County, New York, approximately 2.5 miles west of Newburgh, New York and 35 miles north of New York City (Figure 1 and Figure 2). The AFB was operational from 1947 to 1970. Currently, the Former Stewart AFB property is owned by the New York State Department of Transportation (NYSDOT) and operated by the Port Authority of New York New Jersey (PANYNJ) as Stewart International Airport, a commercial airport and maintenance facility for aircraft and ground vehicles. The property has been developed with buildings, runways, and roadways to facilitate the airport operations. The bounded areas of AOC 2, AOC 3, and AOC FI are undeveloped, wooded, or grassy areas that are not in use. The AOC boundaries are located within a single perimeter fence, with three locked gates located along the northeastern, southeastern, and southwestern perimeters.

The area referred to as the Southern Landfill (AOC 2) was used for waste disposal from 1943 to 1947 by the United States Army and then 1947 to 1970 by the United States Air Force (Harza, 2001). AOC 2 has been characterized by different boundaries and subdivisions over time based on historical investigations, remedial efforts, and lease-related activities. AOC 2 was subdivided into Areas A, B, C, and D for lease-related investigations associated with a privatization agreement with the NYSDOT. A historical, aerial photograph review indicated that non-Department of Defense (DoD) fill operations occurred in Area C from the 1980s through 2000s, which has led Area C to be excluded the boundary of AOC 2 for the purposes of the RI. The AOC 2 boundary relating to potential DoD activity includes portions of Area B and Area D, is based on the results of geophysical surveys completed in 2005 and 2021, and is comprised of an area of approximately 17.4 acres to the southeast of the bend in Recreation Road. AOC 3 is comprised of two areas – AOC 3S Former Half-Acre Landfill (or Unsuitable Fill Area) and AOC 3N Debris Area – and has a combined areal extent of 2.4 acres. AOC 3 is located east of the unnamed tributary to Silver Stream, and is south-southeast of Recreation Pond. AOC FI encompasses an area of 1.7 acres and is located east of AOC 2 along the southern boundary of

the Former Stewart AFB Property, on the east side of Square Hill Road, and north of Walter's Mobile Home Village Trailer Park (Figure 3).

AOC 2 was reported to contain household garbage from Base housing, wastes from food preparation facilities, construction and demolition debris, spent 105-millimeter (mm) shell casings, incinerator ash, and industrial wastes associated with base and aircraft maintenance (Harza, 2001; LMS, 2003c). Additionally, liquid waste is believed to have been disposed in bermed areas on or around the landfill, including hazardous wastes, solvents, and petroleum waste (Harza, 2001; Bluestone, 2019). Bluestone (2019) reports from various sources that several areas of stained soil, berms and pools with dark liquids, disposal pits and trenches, and seeps were observed in the 1950s and 1960s, within formerly delineated subareas Areas B and D of AOC 2. Harza (2001) reported that construction materials and equipment were sporadically staged on the surface of the landfill from 1977 to at least 2001, which may have contributed to contamination at the Site. Review of historical photographic imagery shows mounded materials and open storage areas (containers, etc.) were present in the vicinity of the Former Southern Landfill during September 1980, September 1989, April 1994, November 2006, May 2009, and October 2018 (USAGC, 2019).

Numerous environmental investigations have been performed in and around AOC 2. See Worksheet #10, Section 2.2 for a summary of investigations. Past investigations have evaluated subsurface soil, groundwater, surface water, sediment, and soil gas in and around AOC 2 and identified volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs; specifically, Aroclor 1254), and metals at concentrations greater than screening criteria in at least one media.

Minimal investigation has been performed at the AOC 3S. Based on documented history of AOC 3S, the area received waste relocated from AOC 2 during construction activities for a proposed connector road that was ultimately halted. Based on site history, the same contaminants suspected or known to present at AOC 2 have the potential to be present at AOC 3S. Reports indicate a variety of demolition debris to be present, including industrial equipment, metal containers (drums and pails), vehicle parts, aircraft parts, building construction materials, and residential materials. In 1987, "unsuitable" fill was reported in the landfill, including "a ruptured 55-gallon drum of motor oil, a ruptured 55-gallon drum of odorless black viscous liquid…green odorless material, and black material with a tar-like odor, and several drums of noxious orange material" (Harza, 2001), leading AOC 3S to be referred to as the "Unsuitable Fill Area."

There are no records of past investigations at AOC 3N, which was discovered as part of geophysical surveying conducted in April 2021. The area was observed to have debris and slag materials present at the ground surface consistent with incinerator waste. Records indicate a former incinerator, formerly Building 160, handled all burnable materials and household waste from the Former Stewart AFB. The type and capacity of the incinerator was unknown, and the disposal location of ashes, coke and clinker generated by the incinerator was not known (Golder, 1988). In historical aerial imagery, the area of AOC 3N appears to first be disturbed as early as

1946 with land changes noted through the early 1960s (USAGC, 2019). The earliest aerial photo showing the former incinerator building is 1943. The date Building 160 was demolished was sometime between 1980 and 1983. AOC 3N is being investigated as the location that potential incinerator waste was placed, and AOC FI is being investigated as the location of the former incinerator.

Remedial Investigation

TI-SDC has been contracted by USACE to conduct a RI at AOC 2, AOC 3, and AOC FI which consists of survey investigations, sampling, and analysis of surface soil, subsurface soil, groundwater, surface water, sediment, and soil gas. The RI will provide data that will be used to prepare an RI Report, including a human health risk assessment (HHRA) and a screening-level ecological risk assessment (SLERA). Given that the existing historical data are between 10 and 20 years old, the existing dataset does not capture current conditions at the Site or the nature and extent of contamination. Therefore, a phased sampling approach is planned to complete the RI. The preliminary phase of RI sampling will focus on characterizing the nature and spatial extent of contamination (not extent of risk) within the AOCs by collecting random and biased samples. In addition, during the preliminary phase, sampling will be conducted at a reference area for soil, and upgradient and downgradient locations for groundwater, surface water, and sediment to allow for an assessment of potential background/anthropogenic sources and impacts from historical DoD operations. Data collected during the preliminary phase of RI sampling will be evaluated to identify data gaps, and if they are determined to be present, additional data will be collected during a supplemental phase of sampling from areas and matrices that it is determined to be necessary to adequately characterize the nature and extent of contamination, and complete the HHRA and SLERA.

QAPP Worksheet #1 & 2: Title and Approval Page

(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information

a. Site name/project name: Former Stewart Air Force Base

b. Site location/number: FUDS No. C02NY0704

c. Contract Number: W912WJ-19-D-0006

Contract Title: Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document at Former Stewart Air Force Base Newburgh and New Windsor, New York, FUDS No. C02NY0704

2. Lead Organization: U.S Army Corps of Engineers (USACE), New England District

Lead Organization's Project Manager (PM):

Signature

Ms. Julie Rupp, USACE, New England District

November 14, 2022

3. Investigative Organization: TI-SDC

Investigative Organization's PM:

Keith Fields

Signature

Mr. Keith Fields, P.E., PMP; TI-SDC

November 14, 2022

4. List plans and reports from previous investigations relevant to this project[1]

Title	Received Date	Prepared By
Inventory Project Report – Former Stewart AFB	1989	USACE New York District
Environmental Site Assessment Report Stewart International Airport New Windsor, New York, USA. Project No: 983-6470	October 1998	Golder Associates
Preliminary Geotechnical Report Proposed General Electric Corporate Air Transport Facility Stewart International Airport Newburgh, New York	February 1999	Haley & Aldrich, Inc.
Final Former Stewart AFB HTRW Investigation, Newburgh, New York	March 2000	Ogden Environmental and Energy Services Co., Inc. (Ogden) for Northern Ecological Associates Inc.
Preliminary Site Assessment of the Southern Landfill Area at Stewart International Airport	June 2001	Harza Engineering Company (Harza)
Surface Clearance of Ammunition Scrap & Inspection of the Demolition and Burning Facility.	August 2001	General Ammunition Consultants (GAC)
Phase II Site Investigation Results Stewart International Airport, New Windsor, New York	September 2001	Roux Associates, Inc. (Roux)
Southern Landfill Area A Report	February 2002	Lawler, Matusky & Skelly Engineers (LMS)
Southern Landfill Area – Preliminary Site Assessment Unsuitable Disposal Area Test Pits Locations – Figure 2.6 and Test Pit Boring Logs Files – No Report	April 2002	LMS
Sampling of Private Potable Wells Downgradient of the Southern Landfill Area Stewart International Airport New Windsor, Orange County, New York	February 2003	Environmental Planning and Management. Inc. for LMS
Southern Landfill Area B Report	March 2003	LMS
Southern Landfill Groundwater Monitoring Report – Draft Format Only	September 2003	LMS
Southern Landfill Area C Report	November 2003	LMS
Subsurface Soils and Groundwater Investigation at the Southwest Quadrant Fuel Farm, Stewart International Airport, Town of New Windsor, Orange County, New York	May 2004	LMS

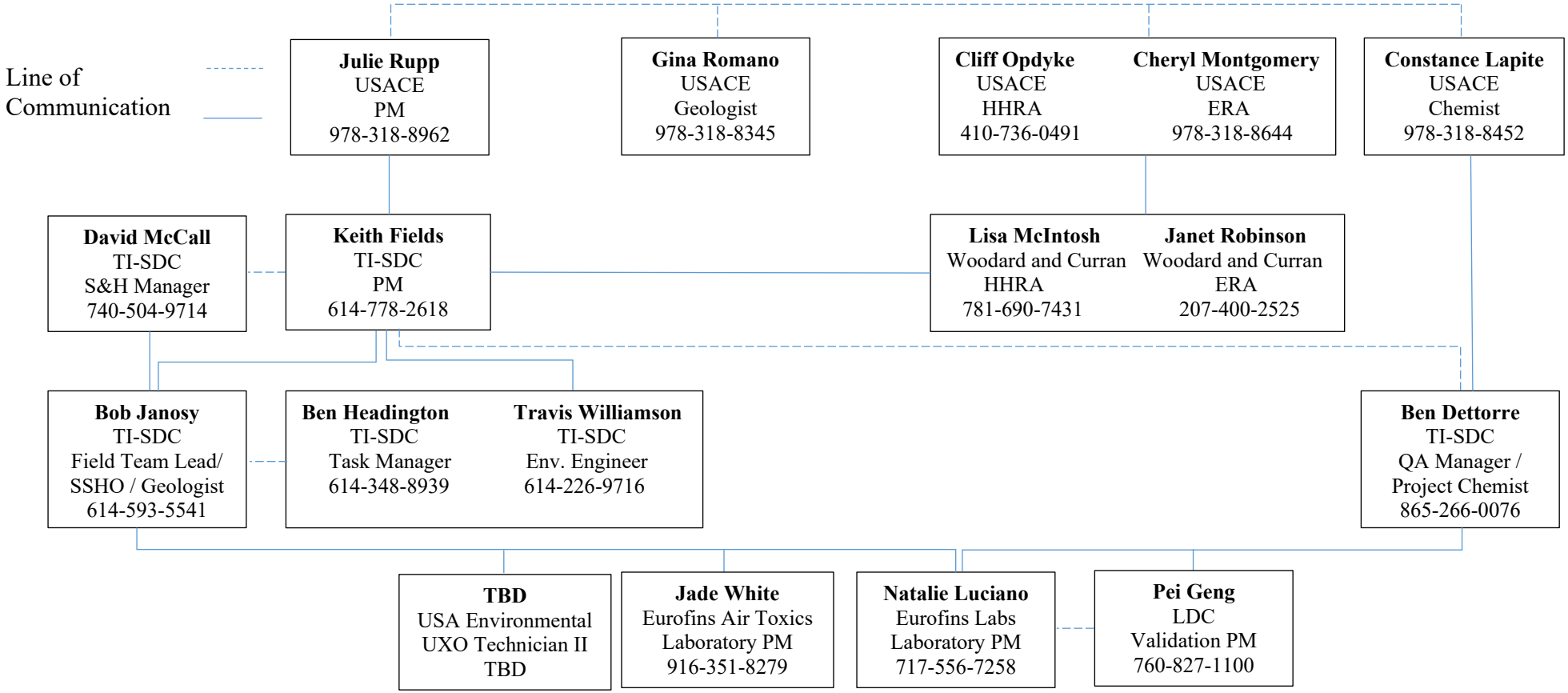
[1] Several historical plans and reports were reviewed to develop an update conceptual site model (see Worksheet #10) and inform the project/data quality objectives (see Worksheet #11) that need to be achieved in relation to the RI sampling activities.

Title	Received Date	Prepared By
Letter Report – Geophysical Survey Results	May 2005	Geomatrix
Letter Report – Southern Landfill Complex – Area D Soil Vapor Sampling Results	June 2007	Henningson, Durham & Richardson (HDR) Architecture and Engineering
Groundwater Investigation Report, Stewart International Airport, Southwest Quadrant Fuel Farm, New Windsor, NY 12553, NYSDEC Spill # 06-11889	October 2007	Miller Environmental Group
Area D Reapportionment Subsurface Investigation Report	March 2009	HDR
Southern Landfill Area Surface Water & Sediment and Area D Groundwater Investigations Report, Stewart International Airport, Town of New Windsor, Orange County, New York	May 2009	HDR
Southern Area Landfill Groundwater & Surface Water/Sediment Investigation Report, Stewart International Airport	August 2011	HDR
Expanded Technical Memorandum, Former Stewart Air Force Base, New York, Formerly Used Defense Site (FUDS), Project Number C02NY0704[2]	April 2019	Bluestone Environmental Group, Inc. (Bluestone)
Draft Historical Environmental Photographic Analysis FUDS DERP C02NY0704	September 2019	U.S Army Geospatial Center (USAGC)
The EDR Radius Map™ Report with Geocheck, Certified Sanborn Maps Report, EDR Historical Topo Map Report with QuadMatch™, DR-City Directory Image Report, and EDR Aerial Photo Decade Package,	April 2020	Environmental Data Resources, Inc (EDR).
Former Stewart Air Force Base Wetlands Delineation and Vernal Pool Survey Memorandum	May 2021	Woodard and Curran
Geophysical Engineering Survey Report, Stewart Airport Recreation Road, New Windsor New York	May 2021	NOVA Geophysical Services

[2] Considered informal document used for historical summary of information. Following the completion of the Bluestone 2019 ETM, reports were made available by the New York State Department of Environmental Conservation (NYSDEC) and NYSDOT that documented additional past investigations that were not known about at the time of the ETM development.

QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution

(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)



Notes: HHRA = Human Health Risk Assessor
ERA = Ecological Risk Assessor
QA = Quality Assurance
PM = Project Manager
SSHO = Site Safety and Health Officer
S&H = Safety and Health
USACE = United States Army Corps of Engineers

QAPP Worksheet #4, 7, & 8: Project Personnel Sign-Off Sheet

(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

Project Personnel	Title	Education / Experience	Specialized Training / Certifications	Telephone Number	Signature / Date
Organization: TI-SDC					
Keith Fields	Project Manager	B.S. Civil Engineering; 25 years of site characterization and remedial action selection, design, and implementation experience	PE; PMP; HAZWOPER 40-hour OSHA	614-778-2618	
David McCall	Safety & Health Manager	B.S. Occupational Safety Management; M.S. Environmental Management; 27 years of experience in HSE Program Management; 6 years teaching HSE Programs	CSP; CIT; HAZWOPER 40-hour OSHA; OSHA Construction 30-Hour; EM385 40-hour Safety & Health Awareness	740-504-9714	
Bob Janosy	Field Team Lead / SSHO / Project Geologist	B.S. / M.S. Geological Sciences; 20 years of site characterization and remediation experience	PG; HAZWOPER 40-hour OSHA	614-593-5541	

Project Personnel	Title	Education / Experience	Specialized Training / Certifications	Telephone Number	Signature / Date
Ben Dettorre	QA Manager / Project Chemist	B.S. Chemistry; >25 years of environmental consulting as a chemist for investigating HTRW sites, as well obtaining services from analytical laboratories, data deliverables, and validation.	HAZWOPER 40-hour OSHA	865-266-0076	
Ben Headington	Task Manager / Alternate SSHO	15+ years of site characterization and remediation experience	PMP; HAZWOPER 40-hour OSHA; OSHA 30-hour Construction; USACE CQM-C	614-348-8939	
Travis Williamson	Engineer	B.S. Civil Engineering; 25 years of site characterization and remedial action selection, design, and implementation experience	PE; PMP; HAZWOPER 40-hour OSHA	614-226-9716	
Field Team Members including UXO Technician II – TBD	Field Team Members	Past experience conducting environmental investigations of similar size and scope of the RI;	HAZWOPER 40-hour OSHA; Minimum Qualifications for Unexploded Ordnance (UXO) Technicians in DDESB TP 18 (December 2004) need to be met by UXO Tech II	TBD	

Project Personnel	Title	Education / Experience	Specialized Training / Certifications	Telephone Number	Signature / Date
Organization: Woodard and Curran					
Lisa McIntosh	Human Health Risk Assessor	B.S. Biology / M.S. Environmental Science; 23 years of human health and ecological risk assessment, site characterization, and wetland science experience	Diplomate, American Board of Toxicology; 40-hour OSHA; 8-hr OSHA Supervisor; Basic Army Corp wetland delineation training	781-690-7431	
Janet Robinson	Ecological Risk Assessor	B.S Biology / M.S. Biology / M.S. Environmental Science and Engineering; 32 years of site investigation, ecological risk assessment, and ecological studies experience	40-hour OSHA; 8-hr OSHA Supervisor	207-400-2525	
Organization: Eurofins Lancaster Laboratories Environmental, Inc.					
Natalie Luciano	Laboratory Project Manager	--	--	717-556-7258	
Dorothy Love	QA Director	--	--	717-556-7327	
Organization: Eurofins Air Toxics, LLC					
Jade White	Laboratory Project Manager	--	--	916-605-3339	

Project Personnel	Title	Education / Experience	Specialized Training / Certifications	Telephone Number	Signature / Date
Organization: Laboratory Data Consultants, Inc.					
Pei Geng	Project Manager, Data Reviewer	B.S. Environmental Chemistry / M.S. Chemistry; Data Validation Experience: 22 years; Overall Laboratory and Data Validation Experience: 29 years	Specialized in hands-on CLP and SW-846 GC/MS methods.	760-827-1100	

Notes:
B.S. = Bachelor of Science
CIT = Certified Instructional Trainer
CQM-C = Construction Quality Management for Contractors
CSP = Certified Safety Professional
GC/MS = Gas Chromatography/Mass Spectrometry
HAZWOPER = Hazardous Waste Operations and Emergency Response
HSE = Health, Safety, and Environment
HTRW = Hazardous, Toxic and Radioactive Waste
M.S. = Master of Science
OSHA = Occupational Safety and Health Administration
PE = Professional Engineer
PG = Professional Geologist
PMP = Project Management Professional
QA = Quality Assurance
SSHO = Site Safety and Health Officer
USACE = United States Army Corp of Engineers

QAPP Worksheet #6: Communication Pathways

(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
USACE Project Manager (PM)	Lead Organization PM	Julie Rupp	978-318-8962	All materials and information about the project will be forwarded to the USACE PM by the TI-SDC PM. The USACE PM is the main point of contact for TI-SDC for all aspects of the project.
Engineering / Design Issues	Engineering Technical Lead/Design Team Lead	Julie Rupp	978-318-8962	Responsible for coordinating with the USACE technical team and guiding TI-SDC in the development of all work plans, field work and reports required to complete the project.
Geological/Hydrogeological Issues	USACE Geologist	Gina Romano	978-318-8052	Geological or hydrogeological issues that arise will be discussed (through the USACE PM) with the USACE Geologist.
Ecological Risk Issues	USACE Ecologist	Cheryl Montgomery	978-318-8644	Ecological Risk Assessment issues related to the RI will be discussed (through the USACE PM) with the USACE Ecologist.
Human Health Risk Issues	USACE Human Health Risk Assessor	Cliff Opdyke	410-736-0491	Human Health Risk Assessment issues related to the RI will be discussed (through the USACE PM) with the USACE Human Health Risk Assessor.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Analytical Data/Sampling Program Issues	USACE Chemist	Constance Lapite	978-318-8452	Laboratory analytical issues or issues related to the sampling program will be discussed (through the USACE PM) with the USACE Chemist. Sampling / analytical issues that negatively affect the objectives of the project will be raised immediately.
Safety	USACE Safety Officer	Sheila Harvey	978-318-8504	Responsible for reviewing all Safety Plans, Accident Prevention Plans, Hazard Analyses, etc., to assure appropriate actions are taken to facilitate the safety of all project personnel during the course of this project.
Disposal of Investigation-Derived Waste (IDW)	USACE Regulatory Specialist	Julie Rupp	978-318-8962	Waste streams generated for off-site disposal, other than trash and disposable personal protective equipment (PPE), will be discussed (through the USACE PM) with the USACE Environmental Scientist. Waste manifests and associated paperwork prepared by TI-SDC will be reviewed and signed by the USACE Environmental Scientist.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Manage all Project Phases	TI-SDC PM	Keith Fields	614-778-2618	Overall management of the project. Maintain lines of communication between USACE and subcontractors. Single point of contact for USACE PM. Notify Julie Rupp of field-related problems by phone, email, or fax by Close of Business (COB) the next business day.
Quality Assurance Project Plan (QAPP) Changes in the field	Field Team Lead	Bob Janosy	614-593-5541	Notify TI-SDC PM by phone (who is responsible to contact USACE PM), and email changes to QAPP made in the field, and the reasons, immediately.
Daily Field Progress Reports	Field Team Lead	Bob Janosy	614-593-5541	Email or fax daily field progress reports to the TI-SDC PM, who will review and distribute the progress reports to the USACE PM within 24 hours.
Reporting Laboratory Data Quality Issues	Laboratory Project Manager	Natalie Luciano Jade White	717-556-7258 916-351-8279	All Quality Assurance (QA) / Quality Control (QC) issues with project field samples will be reported to the TI-SDC Project Chemist immediately. The issue and possible solutions will be identified and communicated by the TI-SDC Project Chemist to TI-SDC's Contractor Quality Control Manager (CQC-M), who will contact the USACE Chemist within 24 hours.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Field and Analytical Corrective Actions	Field Team Lead/Project Chemist	Bob Janosy Ben Dettorre	614-593-5541 865-266-0076	The need for corrective action for field and analytical issues will be determined by the QA Manager. Any corrective actions identified will be communicated to the USACE PM and USACE Project Chemist within 24 hours.
Release of Analytical Data	QA Manager/Project Chemist/USACE Chemist	Ben Dettorre Constance Lapite	865-266-0076 978-318-8452	No analytical data can be released until validation is completed and the Project Chemist and the USACE Chemist has approved the release. Once the validation is complete and data and validation have been approved by the Project Chemist and USACE Project Chemist, the TI-SDC Project Chemist will forward the information to the TI-SDC PM.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Formerly Used Defense Site Chemical Database (FUDSChem) Process	QA Manager/Project Chemist/Data Submitter	Ben Dettorre Bob Janosy	865-266-0076 614-593-5541	The Project Chemist will coordinate sampling event planning, and finalize development of the eQAPP in FUDSChem prior to implementation of sampling events. The project chemist will manage the analytical laboratory's report uploads into FUDSChem for review against the approved eQAPP, the data validation using the Automated Data Review (ADR) functions within FUDSChem, and third-party data validation. Project chemist will coordinate and communicate directly with the laboratory and subcontract validator to resolve issues regarding lab deliverables or associated files and also to coordinate with Synectics if an issue involves FUDSChem and cannot be otherwise resolved with the laboratory and subcontract validator.
QAPP Amendments	Lead Organization Project Manager	Julie Rupp	978-318-8962	Any major changes to the UFP-QAPP must be reviewed by United States Environmental Protection Agency (USEPA) and New York State Department of Environmental Conservation (NYSDEC) and approved by the USACE PM before the change can be implemented.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
State of New York Regulatory Compliance issues	Lead Organization Project Manager	Julie Rupp	978-318-8962	Issues regarding compliance with state regulations will be raised by the TI-SDC PM to the USACE PM, who will contact NYSDEC for discussion.

QAPP Worksheet #9: Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)
(EPA 2106-G-05 Section 2.2.5)

Project Name: Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document at Former Stewart Air Force Base, Newburgh and New Windsor, New York **Projected Date(s) of Sampling:** 2020 and 2021 **Project Manager:** Keith Fields	**Site Name:** Former Stewart Air Force Bases **Site Location:** Newburgh and New Windsor, New York

Date of Session: August 22, 2019

Scoping Session Purpose: Discuss direction of future field activities

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Julie Rupp	Project Manager	USACE	978-318-8962	Julia.M.Rupp@usace.army.mil	PM
Cindy Auld	Risk Assessor	USACE	978-318-8042	Cynthia.A.Auld@usace.army.mil	Risk Assessor
Rose Schmidt	Geologist / Section Chief	USACE	978-318-8345	Rosemary.a.schmidt@usace.army.mil	Geologist
Yixian Zhang	Chemist	USACE	978-318-8730	Yixian.Zhang@usace.army.mil	Chemist
Keith Fields	Environmental Division Manager	TI-SDC	614-792-2896	keith.fields@tideh2o.net	PM
Ben Headington	Task Manager	TI-SDC	614-348-8939	ben.headington@tideh2o.net	Task Manager
Ben Dettorre	Chemist	TI-SDC	865-266-0076	Benjamin.dettorre@tideh2o.net	QA Manager / Project Chemist

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Ryan Wensink	Environmental Engineer	TI-SDC	614-389-6251	Ryan.Wensink@tideh2o.net	Env. Eng.
Bob Janosy	Geologist	TI-SDC	614-593-5541	rj@sdc-ae.com	Field Team Lead / SSHO
Donald Dressler	Geologist	TI-SDC	619-206-0145	Donnie.Dressler@tideh2o.net	Geologist
Lisa McIntosh	Human Health Risk Assessor	Woodard and Curran	781-690-7431	lmcintosh@woodardcurran.com	Risk Assessor
Janet Robinson	Ecological Risk Assessor	Woodard and Curran	207-400-2525	jrobinson@woodardcurran.com	Risk Assessor

Notes / Comments:

- USACE to organize site access and site walk.

- Preparation of planning documents is underway. TI-SDC to prepare Remedial Investigation (RI) Work Plan outline for review.

- Update and revise project schedule.

- Discuss project team lines of communication. USACE to send out contact information.

- Discussed invoicing and definable features of work.

- USACE to share site photos from previous visit.

- Per- and polyfluoroalkyl substances (PFAS) characterization is underway by others at Base, and may affect RI project.

TPP Meeting No. 1 – September 23, 2020

TPP Meeting No. 1 Follow Up – October 6, 2020

The Follow Up meeting was to complete the agenda from the initial meeting.

Meetings were held via Teams.

Participants included:

- Julie Rupp – USACE New England District – Project Manager
- Rose Schmidt – USACE New England District – Geologist / Section Chief
- Yixian Zhang – USACE New England District – Chemist
- Cheryl Montgomery – USACE ERDC – Ecological Risk Assessor
- Cynthia Auld – USACE New England District – Risk Assessor
- Michelle Bourne – USACE ERDC – Ecological Risk Assessor
- Olivia Beaulieu – USACE New England District – Geologist
- Lisa McIntosh – Woodard and Curran – Human Health Risk Assessor
- Janet Robinson – Woodard and Curran – Ecological Risk Assessor
- Ryan Wensink – TI-SDC – Senior Engineer
- Bob Janosy – TI-SDC – Project Geologist
- Sara McGarity – TI-SDC – Project Engineer
- Keith Fields – TI-SDC – Project Manager

Action Items:

- Evaluate boring log quality and determine what the boring logs tell us about landfill contents and overburden/bedrock depths. Also, evaluate types and distribution of Volatile Organic Compounds (VOCs), and develop a plan for evaluating background/upgradient dissolved metals.

- Prepare a fact sheet associated with AOC-3, to support consideration of how to handle this area under FUDS program.

- Discuss with USACE program management staff how to handle AOC-3 under the FUDS program, considering that a subsequent property owner moved landfill contents to a separate location on the property. Determine if AOC-3 is still eligible for funding under the FUDS program.

- Include human health screening levels and additional geology information in updated conceptual site model.

TPP Meeting No. 2 – November 17, 2020

Meeting was held via Teams.

Participants included:

- Julie Rupp – USACE New England District – Project Manager
- Rose Schmidt – USACE New England District – Geologist / Section Chief
- Yixian Zhang – USACE New England District – Chemist
- Constance Lapite – USACE New England District – Chemist
- Cheryl Montgomery – USACE ERDC – Ecological Risk Assessor
- Cynthia Auld – USACE New England District – Risk Assessor
- Michelle Bourne – USACE ERDC – Ecological Risk Assessor
- Olivia Beaulieu – USACE New England District – Geologist
- Lisa McIntosh – Woodard and Curran – Human Health Risk Assessor
- Janet Robinson – Woodard and Curran – Ecological Risk Assessor
- Ryan Wensink – TI-SDC – Senior Engineer
- Bob Janosy – TI-SDC – Project Geologist
- Sara McGarity – TI-SDC – Project Engineer
- Keith Fields – TI-SDC – Project Manager

Action Items:

- Prepare a fact sheet to summarize what is known about the former incinerator. Information reviewed during the TPP meeting seemed to indicate that the incinerator is located outside the footprint of AOC 2 and AOC 3. A determination will need to be made on if/how to address the former incinerator.

- Evaluate the use of Incremental Sampling Methodology (ISM) and discrete sampling for surface soil and subsurface soil and provide a recommendation to USACE.

QAPP Worksheet #10: Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5))

This section presents the conceptual site model (CSM) for the Former Stewart AFB AOC 2 Former Southern Landfill, AOC 3S Unsuitable Fill Area, AOC 3N Debris Area and AOC FI Former Incinerator based on available historical information prior to the planned RI activities. The CSM is meant to convey what is currently known about the Site and will be updated as new data are collected during the RI. Reference to "the Site" includes the areas of AOC 2, AOC 3 (including 3S and 3N) and AOC FI.

The Bluestone 2019 Expanded Technical Memorandum (ETM) presented the first CSM that focused specifically on AOC 2 and AOC 3S bringing together past investigation results and historical information that were known about by Bluestone at the time to understand the potential for risk to ecological and human receptors from historical Department of Defense (DoD) activities at AOC 2 and AOC 3S.

Following the completion of the ETM (Bluestone, 2019), reports were made available by the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Transportation (NYSDOT) that documented additional past investigations that were not known about by Bluestone at the time of the ETM development. In addition, preliminary field work consisting of wetlands delineation and geophysical delineation was completed in Spring 2021. This update to the CSM developed by TI-SDC is the first to incorporate the additional past investigation data, improved understanding of the Site from recent site visits, and preliminary field work results. This CSM also includes AOC 3N, an area that was discovered during the geophysical delineation completed in Spring 2021, and AOC FI that was added to the investigation based on information made available from NYSDEC and NYSDOT. This CSM was prepared in accordance with the guidance provided in the United States Environmental Protection Agency (USEPA) Optimized UFP-QAPP Worksheet guidance for Worksheet #10 Conceptual Site Model (USEPA, 2012).

1. Facility Background Information:

Former Stewart AFB is in Orange County, New York, approximately 2.5 miles west of Newburgh, New York and 35 miles north of New York City. The property spans the boundary between two adjacent communities: Newburgh to the east and New Windsor to the southwest. Figure 1 shows a Site Vicinity Map. The Former Stewart AFB is currently owned by NYSDOT and is operated as Stewart International Airport (SWF) by the Port Authority of New York and New Jersey (PANYNJ).

Prior to 1930, the area that was to become the Former Stewart AFB was primarily used for agricultural purposes (Harza, 2001). Historical aerial photograph analysis indicates agricultural land use within and in the vicinity of AOC 2 included orchards (USAGC, 2019) although the types of orchards were not specified. In 1931, the original tract of land was donated by Samuel L. Stewart to the City of Newburgh for use as a municipal airport (Golder, 1998). In October 1941, the property was purchased by the West Point Military Academy from the City of Newburgh for one dollar (Bluestone, 2019). In 1947, the United States Army transferred much of the airfield to the newly formed United States Air Force (USAF) and the airfield was named Stewart AFB (LMS, 2002a). Structures at Stewart AFB included runways, control towers, family housing, barracks, and other support facilities. Stewart AFB was used by the USAF for military purposes until 1970.

Stewart AFB was excessed to the General Services Administration (GSA) in June 1970, and in October 1970 and March 1974, a total of 1,735.94 acres were conveyed to the Metropolitan Transit Authority (MTA) for use as a public airport. Additionally, in 1971 through 1973, a total of 320.30 acres were transferred to the Department of the Army, which remains under the jurisdiction of West Point. The acreage owned by the MTA was later transferred by state legislature action to the NYSDOT (Golder, 1998). In 1983, the USAF reopened the military side of Stewart AFB with the establishment of the 105th Air Lift Wing of the New York Air National Guard (NYANG). The site location map shown in Figure 2 highlights the portion of Former Stewart AFB currently operated by the NYANG. Today, the NYSDOT leases portions of the airport property to the United States Marine Corps, the United States Military Academy, and to several private companies for aviation and light manufacturing (Bluestone, 2019).

In April 2000, National Express Group (NEG) through its wholly owned subsidiary SWF Airport Acquisition, Inc (SWFAA) began operating the airport under a 99-year lease agreement (LMS, 2003b). In 2007, PANYNJ took over the lease from NEG and currently operates the airport (HDR, 2009b).

2. Site Background Information:

In 2019, six hazardous waste sites at Former Stewart AFB, referred to as AOCs, were assessed for eligibility in the Formerly Used Defense Sites (FUDS) Hazardous, Toxic Radioactive Waste (HTRW) program (Bluestone, 2019). The AOCs evaluated included:

- AOC 1 Former Southwestern Fuel Farm (SWFF)
- AOC 2 Former Southern Landfill
- AOC 3 Former Half-Acre Landfill or Unsuitable Fill Area (now referred to as AOC 3S)
- AOC 4 Former Northern Landfill
- AOC 5 Pesticide Disposal Trench
- AOC 6 Former Aboveground Storage Tank (AST) Area (AOC 6)

The location of the AOCs relative to the Former Stewart AFB facility boundaries is shown in Figure 2. AOC 2 Former Southern Landfill and AOC 3S Unsuitable Fill Area were determined to be eligible under the FUDS HTRW Program (USACE, 1989; Bluestone, 2019), and USACE New England District has initiated RI activities at these sites. AOC 2 and AOC 3S were retained because the AOCs have not been altered, beneficially used, or restored by others since the property was owned by the DoD. Notably, to date, AOCs 1, 4, 5, and 6 have all been remediated. Through additional review of past investigation documentation, the existence and past location of a former incinerator was established. Based on USACE review of available information regarding the former incinerator, the area was determined to be FUDS eligible and a new AOC, AOC Former Incinerator (FI), was incorporated into the RI. AOC 3 was also expanded to include an area 600 ft to the north that was discovered during geophysical surveying activities and appears to contain incinerator debris. The new debris area in AOC 3 is referred to as AOC 3 North (N) and the original Unsuitable Fill Area is referred to as AOC 3 South (S). Figure 2 and Figure 3 show the boundaries AOC 2, AOC 3 (3S and 3N), and AOC FI for the purpose of this RI.

2.1 AOC Specific Background Information

2.1.1 AOC 2

AOC 2 occupies a portion of an area referred to in past investigations as the Southern Landfill area or Southern Landfill Complex (SLC). The area designated and understood be to the Southern Landfill has changed over time. Below is a timeline of the Southern Landfill area designations. Figure 3 also shows the previous boundaries and subdivisions of the Southern Landfill documented in the past.

- The original areal extent of the “Old Base Landfill” was estimated to cover approximately 2.8 acres (USACE, 1989) also shown in E. C. Jordan, 1989.
- In Harza, 2001, the areal extent was redefined to include a larger area bounded by exposed military fill to the south and east and construction and demolition waste

exposures to the north. To the west, Recreation Road served as the limit of waste disposal activities.

- At its largest the Southern Landfill area was shown to cover 142 acres bounded to the north by Recreation Road, east by Recreation Pond and the tributary to Silver Stream, on the south by the airport property fence line and the west by Breunig Road (LMS, 2003b). The Anheuser-Busch property (Metal Container Corporation [MCC] Facility) that was depicted as part of the 142-acre Southern Landfill was included in the 2000 NEG lease and subsequent depictions of the Southern Landfill area exclude the MCC facility property.
- As part of the privatization agreement, the NYSDOT was required to investigate and remediate baseline environmental conditions in the Southern Landfill to allow for commercial or industrial development in that area (Lawler, Matusky, and Skelly Engineers [LMS], 2003b).
- For the lease-related investigations, the Southern Landfill area was defined by LMS to cover an area of 70 acres, subdivided into Areas A, B, C and D. The subdivisions were based partly on Harza, 2001 findings of likely disposal activities as well as intended land use and timing of when areas were to be made available for inclusion in the lease agreement. For example, Areas A and B encompass the footprint of a proposed hanger facility stipulated in the lease agreement (LMS, 2003b). Area A is west of Recreation Road, and Area B is east of Recreation Road and encompasses the areas identified in Harza, 2001 as containing stained soils from historical aerial photograph analysis. Area C, south of Runway 16/34, covers the construction and demolition fill areas as well as a borrow pit area identified by Harza, 2001 and was investigated for the purpose of a possible 2,000-ft runway extension. Area C was referred to as the "Landfill Runway Area" in the lease (LMS, 2003c). Area D was the "Landfill Remainder" and includes areas identified in Harza, 2001 as containing disposal trenches (LMS, 2003c).
- In 2007, PANYNJ took over the lease from NEG and currently operates the airport. Based on the results of environmental samples and available historical information from the Southern Landfill area, Areas A, B and C were included in the lease when it was taken over by PANYNJ (HDR, 2009b).
- At some time prior to 2008, NYSDOT agreed to reapportion parts of Area D of the Southern Landfill and transfer sections to the PANYNJ as part of the leasehold (HDR, 2009b). As such, Area D was further divided into D1, D2, D3 and an Exclusion Area, the exclusion area being the portion of Area D to be retained by NYSDOT.

The Southern Landfill area appears to have undergone three stages of development over time. The description of the three stages provided below is taken directly from LMS, 2003b and LMS, 2003c.

1. Between approximately 1930 and 1943, construction of the airfield resulted in the filling of portions of the Southern [Landfill] Area with regraded native site

soils primarily along what is now Recreation Road. This activity took place under civilian control in the 1930's and was greatly accelerated after transfer to the Federal government after 1940.

2. Between 1943 and approximately 1970, the Southern Landfill was used for waste disposal by the United States Army, and after 1947, the USAF. The Preliminary Environmental Site Assessment (PESA; Harza, 2001) findings indicated that a wide variety of materials were disposed in the Southern Landfill during military use. Materials reportedly disposed in the landfill consisted of construction and demolition (C & D) debris, garbage generated from base housing and food preparation facilities, and industrial wastes associated with base and aircraft maintenance.
3. After base closure in 1970, the State of New York took over operation of the airport first under the MTA and then under the NYSDOT. The PESA reported that materials placed in the Southern Landfill during this time consisted of C & D material made up almost entirely of soil, cobbles and boulders, concrete, and asphalt. Some petroleum-impacted soil, associated with a former petroleum fuel underground storage tank farm, was reported to have been placed in the Southern Landfill during construction of the MCC plant in the late 1980's.

Notably, in 2019, the U.S. Army Geospatial Center (USAGC) prepared a draft report that evaluated historical, aerial photographs (and cartographic records) taken in the vicinity of the Former Stewart AFB between 1940 and 2018 (USAGC, 2019). USACE New England District requested the USAGC perform a Historical Photographic Analysis (HPA) of the Former Southern Landfill and adjacent Unsuitable Fill Area (or Former Half-Acre Landfill), to detail the character, use, and extent of both areas over their lifetime, including previously identified features (disposal trenches and bermed liquid disposal areas) with a high likelihood of contaminating groundwater. Review of the USAGC report determined that the previously utilized Former Southern Landfill boundaries did not accurately define the areal extent of historical DoD landfill activities that should define AOC 2. Specifically, in area C there was a Fill Area where fill operations occurred from the 1980s through 2000s; these activities were not DoD-related and the area is not being included in the RI or considered part of AOC 2. This Fill Area is shown in Figure 3 for reference.

The RI boundary for AOC 2 (see Figure 3) now includes portions of Area B and Area D delineation subdivisions by LMS and is based on the results of geophysical surveys completed in 2005 and 2021. The boundaries for the AOC 2 investigation represent the areas where waste fill from DoD activities is most likely to be present as indicated by historical information and the geophysical surveys suggesting metallic debris and ground disturbance in the area.

2.1.2 AOC 3

AOC 3 is in the eastern portion of Former Stewart AFB and made up of two subareas – AOC 3 North (N) and AOC 3 South (S).

AOC 3S corresponds with the Former Half-Acre Landfill discussed in the Inventory Project Report (INPR) (USACE, 1989), which was believed to cover approximately 0.5 acre but later estimated to cover an area larger than that. Harza (2001) reported that unsuitable fill was in the Half-Acre Landfill (AOC 3S) in 1987 and referred to the area as the Unsuitable Fill Area on construction project drawings and notes in the preliminary site assessment, which is how the area will be referred to during the pending RI. AOC 3S received waste relocated from AOC 2 during late 1980s, when excavation and grading related to the construction of an access road encountered uncontrolled fill along the southwest edge of the military fill area (AOC 2). Historical records document that truckloads of uncontrolled fill were moved from AOC 2 and dumped in the area of AOC 3S. There are no records of further activity at AOC 3S. AOC 3S is bordered to the south by Square Hill Road. The AGC report shows AOC 3S and the surrounding area was disturbed sometime between 1947 and 1952. Additionally, aerial imagery from 1988 and 1989 shows placement of material in AOC 3 during the construction of the access road. In the 1947 to 1952 time period, the AGC report also shows a drainage ditch was established along the western boundary of AOC 3. This drainage ditch would become the unnamed tributary from Recreation Pond, created in 1958, to Silver Stream.

The RI boundary of AOC 3S consists of approximately 1.7 acres and is based on the area originally defined as the Unsuitable Fill Area (Harza, 2001).

AOC 3N and its associated boundary were not known until being discovered as a result of the geophysical survey conducted in April 2021. AOC 3N is located approximately 600 ft due north of AOC 3S and is bounded to the north by the steep slope leading up to Recreation Pond. AOC 3N covers approximately 0.7 acres. There is no specific reference to the area of AOC 3N in previous environmental investigations. The area was observed to have debris and slag materials present at the ground surface. It is suspected that this area may have received material from the former incinerator being investigated as AOC FI. In the AGC report, the area of AOC 3N appears to have first been disturbed as early as 1946 with land changes noted through the early 1960s. The area to the east and near AOC 3N also appears disturbed during the access road construction in 1989. There have been no known environmental investigations of this area.

The RI boundary of AOC 3N is based on the results of the geophysical survey completed in 2021 that delineated areas of metallic debris and ground disturbance.

2.1.3 AOC FI

AOC FI is in the southeastern portion of Former Stewart AFB, along the southern boundary east of Square Hill Road, north of Walter's Mobile Home Village. AOC FI covers approximately 1.7 acres. The former incinerator is noted in the Environmental Assessment Report by Golder Associates Inc. in 1988 as Building 160 that reportedly handled all burnable materials from the

former Stewart AFB. The type of unit and capacity are unknown, and the disposal location of ashes, coke and clinker generated by the incinerator is known (Golder, 1988). Additionally, the PESA by Harza, Inc. in 2001 noted that, "A 1942 War Department memorandum references the proposed construction of a waste disposal incinerator at the facility in the Preliminary Development Plan. A 1953, unit history of the 4,700th Air Base Group states that an incinerator was being used to dispose of household waste (Harza, 2001)." The earliest photo in the AGC report that shows the former incinerator building being present is 1943. The date Building 160 was demolished was sometime between 1980 and 1983. There have been no known environmental investigations of the former incinerator area.

The RI boundary of AOC FI is based on historical aerial imagery from 1957 and encompasses the largest area shown to be cleared surrounding the former incinerator building.

2.2 Summary of Past Environmental Investigations

A significant number of past environmental investigations have taken place at Former Stewart AFB. While data from past investigations is used to inform the CSM and guide the RI, past analytical data will not be used in the RI risk assessment.

2.2.1 Relevant Environmental Investigations

A summary of past environmental investigations that provide information relevant to developing an updated CSM and informing the project/data quality objectives that need to be achieved in relation to the RI sampling activities is provided below in Table 1. Events relevant to the management of the airport are also included in the timeline and noted as such. The table also indicates how information from each investigation is incorporated into the CSM.

Table 1. Relevant Environmental Investigations

Date	Report Title	Prepared By	Summary	Use in CSM
1989	Inventory Project Report	USACE New York District	USACE New York District conducted a site inspection and prepared an inventory project report (INPR) for the Former Stewart AFB which addressed a proposed project of removing 10 underground storage tanks and investigating with an RI/FS three nearby landfills to confirm presence or absence of contamination. The proposed tank project was likely referring to AOC 1 SWFF, located west of AOC 2. The three landfills referred to include AOC 2, AOC 3S and AOC 4. The INPR report also included a Part II Findings and Determination of Eligibility that was included in the Harza 2001 PESA but is absent from the Bluestone 2019 version of the INPR. The Findings of Facts included in Part II noted that AOC 2 was approximately 2.8 acres, that the landfill had been exposed by road construction excavation, and on March 1988, the chief airport engineer had been alerted to the presence of the "Orange Fluid" oozing from the area (USACE, 1989).	Informed site background, sources, and known or suspected contaminants.
October 1998	Environmental Site Assessment Report Stewart International Airport New Windsor, New York, USA. Project No: 983-6470	Golder Associates	Golder Associates completed an Environmental Site Assessment for Stewart International Airport. This appears to have been done in advance of the lease agreement in 2000. This site assessment included database searches, aerial photography review, regulatory file review, personnel interviews, and site visits. There were specific mentions of the Southern Landfill and the Former Incinerator. No sampling was completed (Golder, 1998).	Informed site background and supported inclusion of AOC FI.
February 1999	Preliminary Geotechnical Report Proposed General Electric Corporate Air Transport Facility Stewart International Airport Newburgh, New York	Haley & Aldrich, Inc.	Haley & Aldrich, Inc. completed a geotechnical investigation of two areas for a proposed General Electric Corporate Air Transport Facility at Stewart International Airport. As part of the investigation, two groundwater observation monitoring wells (MWs) were installed just east of Recreation Road at the northern and southern limits of the area identified by LSM as Area B (GWML-01 and GWML-02). Wells were gauged for water elevation only and no laboratory analysis of groundwater was completed. Five test borings and 15 test pits were also advanced for geotechnical purposes in the area of or nearby AOC 2. The exact location of the intrusive activities is not known, nor were any samples collected for laboratory analysis (Haley & Aldrich, Inc., 1999).	Provides origin information for monitoring wells GWML-01 and GWML-02. No well installation logs are provided.
2000	*Not Applicable (NA)*	*NA*	*NEG Operating Lease takes effect.*	*Event relevant to management of the airport.*

Table 1. Relevant Environmental Investigations (continued)

Date	Report Title	Prepared By	Summary	Use in CSM
March 2000	Final Former Stewart Air Force Base (AFB) HTRW Investigation, Newburgh, New York	Ogden Environmental and Energy Services Co., Inc. (Ogden) for Northern Ecological Associates Inc.	Ogden Environmental and Energy Services Co., Inc completed a HTRW investigation at Former Stewart AFB. The investigation included Area One – Former Fuel Tank Farm and Area Two – Older Base Landfill. Area One corresponds to AOC 1 (west of AOC 2), and Area Two is included within AOC 2. Eight soil boring were advanced in Area One and soil samples collected for analysis. Five groundwater samples were collected from existing wells within Area One. In Area Two, three collocated sediment and surface water samples were collected and analyzed. The original scope called for three subsurface soil and groundwater samples in Area Two. However, the hollow stem auger rig was unable to penetrate deeper than 10-ft due to compacted fill and construction debris. Logistics and weather prevented additional attempts with different drilling equipment and no subsurface samples were obtained from Area 2 (within AOC 2) (Ogden, 2000).	Surface water and sediment samples from AOC 2 included analysis of historical data.
June 2001	Preliminary Site Assessment of the Southern Landfill Area at Stewart International Airport	Harza Engineering Company (Harza)	Harza completed a PESA that focused on the Southern Landfill area. The assessment included site inspections, records reviews, personnel interviews, historical aerial photograph analysis and geographical information system (GIS) mapping including topography analysis. No sampling was completed. Appendix D: Harza Files Excerpts 1987-1988 Access Road Construction documented land grading activities related to the construction of a connector road encountered waste in the Southern Landfill and was relocated to the Unsuitable Fill Area.	Informed site background, sources, and known or suspected contaminants.
August 2001	Surface Clearance of Ammunition Scrap & Inspection of the Demolition and Burning Facility.	General Ammunition Consultants (GAC)	GAC performed a review of historical documentation relative to military use, storage, and disposal of ammunition at Former Stewart AFB, as well as a field inspection. This review included the area covered by both AOC 2 and AOC 3S (Bluestone, 2019). No sampling was completed (GAC, 2001).	Informed known or suspected contaminants.
September 2001	Phase II Site Investigation Results Stewart International Airport, New Windsor, New York	Roux Associates, Inc. (Roux)	Roux completed a Phase II Investigation with respect to the environmental conditions present at the Site prior to SWFAA assuming control over and responsibility for the airport (Roux, 2001). Components of the investigation related to AOC 2 included performing a landfill gas investigation along the northern edge of what LMS defined as Area C (northeast of AOC 2). A total of 24, 0.5-inch-diamteter borings were advanced with a punch bar, approximately 200 feet apart. The maximum boring depth achieved was three feet below ground surface (bgs) due to the dense geology, and the study was terminated because a five-foot depth could not be attained. Near the northern portion of the punch bar study, one landfill gas monitoring well was installed, and one soil boring was advanced for landfill gas measurement. Additionally, soil gas vents near the MCC plant (southwest of AOC 2) were screened. While findings from the report had been previously included in the CSM, figures from the report were missing. Figures showing locations of investigation-related activities are new to CSM (Roux, 2001).	Soil gas findings were incorporated into current interpretation of nature and extent of contamination.
February 2002	Southern Landfill Area A Report	Lawler, Matusky & Skelly Engineers (LMS)	LMS advanced two soils borings and subsurface soil samples were collected for analysis in Area A. Both borings were converted to MWs, and groundwater samples were collected for analysis. Area A is west and upgradient of AOC 2 (LMS, 2002a).	Soil and groundwater sampling data included analysis of historical data. Boring logs informed geology.

Table 1. Relevant Environmental Investigations (continued)

Date	Report Title	Prepared By	Summary	Use in CSM
April 2002	Southern Landfill Area – Preliminary Site Assessment Unsuitable Disposal Area Test Pits Locations – Figure 2.6 and Test Pit Boring Logs Files – No Report	LMS	LMS completed eight test pits in the Unsuitable Fill Area (AOC 3S). There is no report to accompany the figure and boring logs. No samples were collected for analysis (LMS, 2002b).	Test pit locations informed current interpretation of nature and extent of contamination.
February 2003	Sampling of Private Potable Wells Downgradient of the Southern Landfill Area Stewart International Airport New Windsor, Orange County, New York	Environmental Planning and Management. Inc. (EMP) for LMS	EMP conducted sampling of eight private wells downgradient of the Southern Landfill Area. The investigation also reviewed regulatory environmental databases, Orange County Department of Health Records, and Orange County Well Construction Records (LMS, 2003a).	Private well sampling informed current interpretation of nature and extent of contamination.
March 2003	Southern Landfill Area B Report	LMS	LMS advanced 11 soils borings and subsurface soil samples were collected for analysis in Area B. Seven borings were converted to new overburden MWs and groundwater samples were collected for analysis. Area B includes portions of AOC 2 (LMS, 2003b).	Soil and groundwater sampling data included in the analysis of historical data. Boring logs informed geology.
September 2003	Southern Landfill Groundwater Monitoring Report – Draft Format Only	LMS	LMS conducted a second round of groundwater sampling at the Area A and B wells installed for the Stage 1 PSA (9 wells) and at five wells from past investigations for a total of 14 wells sampled. The results of this investigation are available in only draft report format. A final version of the report was not available (LMS, 2003d).	Groundwater sampling data included in included analysis of historical data.
November 2003	Southern Landfill Area C Report	LMS	LMS advanced 6 soil borings and subsurface soil samples were collected for analysis. Area C is northeast and cross gradient of AOC 2 (LMS, 2003c).	Boring logs informed geology.
May 2004	Subsurface Soils and Groundwater Investigation at the Southwest Quadrant Fuel Farm, Stewart International Airport, Town of New Windsor, Orange County, New York	LMS	LMS carried out subsurface soil and groundwater investigation at the Southwest Quadrant Fuel Farm (SW Quad FF) located upgradient of AOC 2. Ten soil borings were advanced and soil samples collected. Five of the borings were converted to monitoring wells and groundwater was sampled for analysis (LMS, 2004).	Soil and groundwater sampling data included in the analysis of historical data. Boring logs informed geology.
May 2005	Letter Report – Geophysical Survey Results	Geomatrix	Geomatrix conducted a geophysical investigation over a substantial portion of Area D to characterize the subsurface. The geophysical investigation covered a significant portion of AOC 2.	Delineated portion of RI boundary for AOC 2.
2007	*NA*	*NA*	*PANYNJ Operating Lease takes effect. Areas A, B and C are included in the lease agreement (HDR, 2009b).*	*Event relevant to the management of the airport.*

Table 1. Relevant Environmental Investigations (continued)

Date	Report Title	Prepared By	Summary	Use in CSM
June 2007	Letter Report – Southern Landfill Complex – Area D Soil Vapor Sampling Results	HDR	HDR conducted a soil vapor investigation in portions of Area D that include a large portion of AOC 2. Soil vapor points attempted at 30 locations in Area D within the same area as the geophysical survey; 16 sample points were successful and analyzed with field instruments. Of the 16 successful points, six samples were collected and sent for laboratory analysis (HDR|LMS, 2007).	Soil gas sampling data included in included analysis of historical data.
October 2007	Groundwater Investigation Report, Stewart International Airport, Southwest Quadrant Fuel Farm, New Windsor, NY 12553, NYSDEC Spill # 06-11889	Miller Environmental Group	Miller Environmental Group investigated a fuel spill at the SW Quad FF. The investigation advanced four soil borings and collected soil samples. All four borings were converted to groundwater monitoring wells and the four new MWs plus five existing MWs were sampled for analysis (Miller Environmental Group, 2007).	Soil and groundwater sampling data included in the analysis of historical data. Boring logs informed geology.
March 2009	Area D Reapportionment Subsurface Investigation Report	HDR	HDR conducted subsurface investigations in Area D reapportionment areas to support the transfer of portions of Area D into the lease agreement. The investigation involved advancing eight soil boring and collecting subsurface samples for analysis. Five of the borings were converted to MWs. The five new and two existing wells were sampled for analysis. Reapportionment area D2 is within AOC 2, and portions of D1 and D3 are within AOC 2 (HDR, 2009b).	Soil and groundwater sampling data included in the analysis of historical data. Boring logs informed geology.
May 2009	Southern Landfill Area Surface Water & Sediment and Area D Groundwater Investigations Report, Stewart International Airport, Town of New Windsor, Orange County, New York	HDR	In Area D and along the southeastern property boundary of SWF, in 2001, 14 sediment and surface water samples were collected and analyzed. In 2003, 18 sediment and surface water samples were collected and analyzed, some outside of the SWF property boundary. In 2005, 24 soil borings were advanced and converted to 11 sets of paired monitoring wells (one screened within the shallow overburden aquifer and one open hole in bedrock) and one unpaired well due to absence of groundwater in the over burden aquifer at one location. Soil samples were collected from four soil borings. Groundwater samples were collected from the MWs for analysis in 2006. The 2006 round of groundwater sampling and analysis also included a well survey of groundwater elevations at all known, existing and accessible wells in the vicinity (a total of 60 wells) (HDR, 2009a).	Soil, groundwater, sediment, and surface water sampling data included in the analysis of historical data. Boring logs informed geology.
August 2011	Southern Area Landfill Groundwater & Surface Water/Sediment Investigation Report, Stewart International Airport	HDR	HDR conducted another round of groundwater sampling at 18 of the Area D monitoring wells. A follow up round of surface water and sediment sampling was also completed and included three sediment samples within AOC 2 and six surface water samples (four within AOC 2, two downstream) (HDR, 2011).	Groundwater, sediment and surface water sampling data included analysis of historical data.
April 2019	Expanded Technical Memorandum, Former Stewart Air Force Base, New York, Formerly Used Defense Site (FUDS), Project Number C02NY0704	Bluestone Environmental Group, Inc. (Bluestone)	Bluestone Environmental Group, Inc. completed a review that evaluated six AOCs for FUDS HTRW eligibility and brought together past data for AOC 2 to develop an initial CSM. No sampling was completed (Bluestone, 2019).	Informed site background, sources, and known or suspected contaminants.

Table 1. Relevant Environmental Investigations (continued)

Date	Report Title	Prepared By	Summary	Use in CSM
September 2019	Final Draft Historical Environmental Photographic Analysis FUDS DERP C02NY0704	U.S Army Geospatial Center (USAGC)	USAGC conducted a Historical Environmental Photographic Analysis to evaluate historical, aerial photographs (and cartographic records) taken in the vicinity of the two former landfills between 1940 and 2018. A draft report presenting the findings was prepared (USAGC, 2019).	Informed site background and supported delineation of RI boundaries for AOC 2, AOC 3S, and AOC FI.
April 2020	The EDR Radius Map™ Report with Geocheck, Certified Sanborn Maps Report, EDR Historical Topo Map Report with QuadMatch™, DR-City Directory Image Report, and EDR Aerial Photo Decade Package	Environmental Data Resources, Inc (EDR).	EDR provided report packages for EDR Radius Map™ Report with Geocheck, Certified Sanborn Maps Report, EDR Historical Topo Map Report with QuadMatch™, DR-City Directory Image Report, and EDR Aerial Photo Decade Package.	Informed site background and CSM by providing location of nearby private wells
May 2021	Former Stewart Air Force Base Wetlands Delineation and Vernal Pool Survey Memorandum	Woodard and Curran	Woodard & Curran carried out a wetlands delineation and vernal pool survey for AOC 2 and AOC 3S and the nearby vicinity.	Refine wetlands in the area of AOC 2 and AOC 3S.
May 2021	Geophysical Engineering Survey Report, Stewart Airport Recreation Road, New Windsor New York	NOVA Geophysical Engineering	NOVA Geophysical Services conducted a geophysical survey of AOC 2 and AOC 3 to refine the the RI boundaries of AOC areas. Survey identified AOC 3N as additional area to investigate (NOVA, 2021).	Delineated portions of RI boundary of AOC 2, AOC 3S and discovered AOC 3N.

2.2.2 Additional Nearby Environmental Investigations

In addition to the relevant investigations outlined in Section 2.2.1, several investigations took place at nearby AOCs. These investigations involved borings that provided additional geological information to support the CSM or installed groundwater monitoring wells in the vicinity of the Site. No analytical data from these investigations was incorporated into the CSM. Not all original reports were available for review; therefore, content from unavailable reports is based on references to the material in other available past reports. The referenced report is documented where applicable below:

- 1983 and 1986 – Dames and Moore conducted a series of investigations at the former Air Force Landfill, focusing on the pesticide disposal trench (Ogden, 2000). The Air Force landfill and pesticide disposal sites at the NYANG base were designated as AOC 4 and AOC 5 in Bluestone, 2019.
- 1988 – Greenman Pedersen, Inc. completed a Hillside Contamination Study Investigation that investigated contamination around the MCC building (Bluestone, 2019), which is located within the Southern Landfill and southwest of AOC 2. This investigation installed 12 groundwater monitoring wells in the vicinity of AOC 2.
- 1988 – Greenman Pederson, Inc. completed an abandoned fuel tank decommissioning study (USACE, 1989). This study was likely referring to AOC 6 Former Aboveground Storage Tank, located west of AOC 2.
- 1988 – Dynamac remediated and closed the Former Pesticide Disposal Trench (AOC 5) at the NYANG Base (Bluestone, 2019). AOC 5 is located northeast of AOC 2 and AOC 3.
- 1989 – E. C. Jordan, completed a site inspection at the Stewart Air National Guard Base, which inspected the northern landfill and pesticide disposal sites at the NYANG Base, designated as AOC 4 and AOC 5 in Bluestone 2019. The NYANG subsequently remediated both sites. The investigation consisted of conducting a geophysical survey, surface soil, subsurface soil, and sediment collection, and installation of four groundwater monitoring wells (E.C. Jordan, 1989).
- 1991 – 1992 – Greiner, Inc. completed a preliminary contamination assessment for Lockheed Air Terminal of New York, Inc. The assessment involved installing 11 monitoring wells (MWs) (LMS, 2000). The wells are located within vicinity of AOC 6 and AOC 1, both located west of AOC 2.
- 1994 – 2006 – Bluestone 2019 documented that the ASTs were removed from the AOC 6 Former AST Area sometime between 1994 and 2006.
- 1995 – Lindsay Bullard removed the underground storage tanks, associated piping and 155 tons of contaminated soils at AOC 1 Former SWFF (Bluestone, 2019).
- 1997 – Aneptek investigated and closed the Former Northern Landfill AOC 4 (Bluestone, 2019). AOC 4 is located northeast of AOC 2 and AOC 3.

- 2000 – LMS, in June 2000, attempted to sample 11 groundwater monitoring wells that were installed in 1991 and 1992 by Greiner, Inc. within the vicinity of AOC 6 and AOC 1, both located west of AOC 2. MW-1, MW-4, and MW-6 were not sampled due to product present in the well, the well was unable to be located, or the well was damaged, respectively. In August 2000, LMS sampled nine groundwater monitoring wells installed downgradient of AOC 1 in 1988 by Greenman Pederson, Inc (LMS, 2000).

3. Sources of Known or Suspected Hazardous Waste:

3.1 AOC 2

The Former Southern Landfill that makes up AOC 2 was reported to contain household garbage from Base housing, wastes from food preparation facilities, construction, and demolition debris, spent 105-mm shell casings, incinerator ash, and industrial wastes associated with base and aircraft maintenance (Harza, 2001; LMS, 2003c). Additionally, liquid waste is believed to have been disposed of in bermed areas, including hazardous wastes, solvents, and petroleum waste (Harza, 2001). Bluestone (2019) reports from various sources that several areas of stained soil, berms and pools with dark liquids, disposal pits and trenches, and seeps were observed in the 1950s and 1960s, within formerly delineated Areas B and D of AOC 2. Interviews of NYSDOT personnel in Harza, 2001 indicated other materials that may be present include: engine cleaning products, metals plating materials, waste fuel in barrels, possibly transformers, solvents, oils and grease, carbon tetrachloride, and paint. One interviewee noted large pits and trenches were sometimes excavated to place the waste.

Harza, 2001 reported that construction materials and equipment were sporadically staged on the surface of the landfill from 1977 to at least 2001, which may have contributed to contamination at the Site. Additionally, Harza, 2001 documented that fuel contaminated materials from construction of the MCC facility in the 1980s may have been placed within AOC 2. The level of fuel contamination is unknown, and it is unknown if and how the material was spread, placed, or if it was only temporarily staged. Review of historical photographic imagery shows mounded materials and open storage areas (containers, etc.) present in the vicinity of the AOC 2 in September 1980, September 1989, April 1994, November 2006, May 2009, and October 2018 (USAGC, 2019). Additionally, HDR (2009b) reported old deteriorating amusement park rides and trailers were present in an area of AOC 2, which may have contributed to elevated levels of filtered metals including chromium and lead detected in groundwater monitoring well SLMW-24 as compared with surrounding wells.

3.2 AOC 3

In the late 1980s, excavation and grading related to the construction of an access road encountered uncontrolled fill along the southwest edge of the military fill area (i.e., AOC 2). Materials noted in the cut area included tires, scrap metal, a ruptured 55-gallon drum of motor oil, a ruptured 55-gallon drum of odorless black viscous liquid, household garbage, wire cable, carpet, paint cans, aircraft parts, cinders, green odorless material, and black material with a tar-

like odor, and several drums of noxious orange material (Harza, 2001). Non-construction and demolition materials were reportedly segregated from the fill and disposed of off-site. The remaining material was transported to an on-site disposal area, identified as the "Unsuitable Fill Area" on construction project drawings and notes provided in Appendix D of Harza, 2001. The Unsuitable Fill Area was referred to as AOC 3 Former Half Acre Landfill in the INPR (USACE, 1989) and Bluestone, 2019, and is now referred to as AOC 3S. Based on the documented history of both areas, AOC 3S is believed to have received waste relocated from AOC 2. For this reason, the same contaminants suspected or known to present at AOC 2 have the potential to be present at AOC 3S. The road construction was ultimately halted when the amount of refuse encountered was determined to be a much greater extent than originally thought (Harza, 2001). Figure 4 shows the georeferenced construction plan drawing and the locations of AOC 2 and AOC 3S.

There are no final reports that document investigations performed at AOC 3S, and existing reports do not clearly identify the boundary of the area that received waste. However, site investigation of AOC 3S by USACE as part of the 1989 INPR reported demolished debris could be seen protruding through the Site (USACE, 1989). Additionally, when a site inspection of AOC 3S was inhibited by 1-1.5 feet of snow cover, it was determined that the hummocky ground indicated the presence of individual piles of fill and a wire cable was observed (Harza, 2001). While not documented in an available final report, a figure showing the location of eight test pits at AOC 3S, and test pit logs were made available. The test pit logs documented the presence of scrap metal, degraded drum pieces, household waste, concrete, old carpeting, solidified roofing tar, buckets, plywood, clothing, and glass.

There are no records of past investigations at AOC 3N, which was discovered as part of the April 2021 geophysical investigation. Debris and slag materials consisting predominantly of small glass and metallic fragments were present at the ground surface. It is suspected the debris and slag materials are residual incinerator material and building operation waste from the former incinerator (AOC FI). AOC 3N is located at the end of a roadway that connected the former incinerator with AOC 3N suggesting the former incinerator was likely the source of materials observed at AOC 3N.

3.3 AOC FI

There are no known past environmental investigations at AOC FI, therefore there is only suspected (not known) hazardous waste at AOC FI. The source of suspected hazardous waste at AOC FI is the former incinerator and supporting operations. Details regarding the incinerator size, capacity or operating procedures are unknown. Historical maps indicate the presence of at least one supporting structure, a well house, that was still present on-site as of April 2021.

4. Known or Suspected Contaminants, or Classes of Contaminants:

Past environmental investigations indicate several contaminants or classes of contaminants are known to be present at AOC 2 in one or more media. Based on suspected or known sources of hazardous waste, there are several contaminants or classes of contaminants that are suspected to be present at AOC 3S, AOC 3N, and AOC FI. Table 2 lists the known or suspected classes of contaminants at the Site in each AOC.

Table 2. Known or Suspected Classes of Contaminants

Classes of Contaminants	Potential Sources	AOC 2	AOC 3S	AOC 3N	AOC FI
VOCs	Solvents, paints	Known	Suspected	Suspected	Suspected
SVOCs	Waste materials (carpet, roofing tar)	Known	Suspected	Suspected	Suspected
Organochlorine Pesticides	Pesticides	Known	Suspected	Not suspected	Not suspected
PCBs	Transformers, hydraulic oil	Known	Suspected	Suspected	Suspected
Metals	Metallic waste	Known	Suspected	Suspected	Suspected
Herbicides	Herbicides	Known	Suspected	Suspected	Suspected
Petroleum Hydrocarbons	Motor oil, hydraulic oil, waste fuel, petroleum waste	Known	Suspected	Suspected	Suspected
Dioxins	Incinerator ash	Suspected	Suspected	Suspected	Suspected
Explosive Compounds	Munitions	Known	Suspected	Suspected	Not suspected

PCB = Polychlorinated Biphenyl
SVOC = Semi-Volatile Organic Compound
VOC = Volatile Organic Compound

Historical detections of contaminants within and in the vicinity AOC 2 and AOC 3S and comparison of detections with screening criteria are summarized in Section 11 of this Worksheet and detailed in Appendix C.

5. Primary Release Mechanism:

The primary release mechanism refers to the initial occurrence of contamination to a medium. The primary release mechanism for the Site is direct release to soil following disposal, intentional deposition, and accidental spills.

6. Secondary Release Mechanism to Tertiary Sources of Contamination:

Secondary release mechanism refers to contamination occurring from the secondary source of contamination and creating potential tertiary sources of contamination. For the Site, surface soil is the secondary source of contamination and the secondary release mechanisms consist of the following (see Figure 6A through 6D):

- Wind erosion to ambient air (dust/volatiles).
- The uptake of contamination via food, water and soil/sediment in wildlife and vegetation.
- Leaching to subsurface soil and groundwater.
- Runoff/erosion to surface water and sediment.

Tertiary sources of contamination consist of wildlife, ambient air, subsurface soil, groundwater, surface water and sediments (Figure 6A through 6D). Tertiary release mechanisms consist of wind erosion, vapor intrusion, and discharge to surface water; these release mechanisms characterize the movement of contaminants into the exposure media to which human or ecological receptors are exposed.

7. Fate and Transport Considerations:

The goal of the RI at the Site is to adequately characterize the nature and spatial extent of hazardous substances, the fate and transport of the hazardous substances, and to gather data necessary to assess the extent to which the release from DoD activities poses a threat to human health, safety, or the environment. Data will be gathered to assess the following factors:

- Physical characteristics of the property.
- Characteristics/classification of surface soil, subsurface soil, sediment, surface water, groundwater, and soil gas.
- General characteristics of potential sources/waste (e.g., quantities, concentration, toxicity, persistence, mobility, depth, nature, and extent, etc.).

AOC 2 and AOC 3S have been reported to contain municipal solid waste, construction and demolition debris, munitions debris, and liquid waste of an unknown nature. Analytical data from past investigations indicates that a combination of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) (Aroclors 1254 and 1260), metals, herbicides and/or pesticides have been reported in subsurface soil, sediment, surface water, and/or groundwater within or nearby AOC 2 and/or AOC 3S. Organic vapors in soil gas have also been detected in AOC 2.

Groundwater at AOC 2 and AOC 3S historically has been located at 5 to 10 feet bgs, and travels in a southeasterly direction. Rust colored groundwater has been observed seeping into an ephemeral channel on the east side of AOC 2. Surface waters at AOC 2 and AOC FI generally flow southeast. Surface waters at and AOC 3 generally flow and southwest in ephemeral channels towards tributaries of Silver Stream, which discharges to Lake Washington or Moodna Creek. Surface water, hydrogeology and additional key physical aspects of the Site and nearby are discussed in Section 10. A graphic depiction of several, key CSM attributes described above is provided as Figure 5. Additional data collected as part of this RI will be used to update and refine the current CSM, which will be updated, as needed, in the RI Report.

8. Potential Receptors and Exposure Routes:

A Human Health Risk Assessment (HHRA) and Screening Level Ecological Risk Assessment (SLERA) Work Plan is provided in Appendix A. The human health and ecological risk assessments will be conducted as part of the RI to assess:

- Actual and potential human and ecological receptors.
- Actual and potential exposure routes (e.g., dermal contact, inhalation, and ingestion) for environmental media.
- Other factors such as sensitive populations that pertain to the characterization of the Site, or support the future analysis of potential remedial action alternatives.

Preliminary human health and ecological CSMs are provided as Figures 6A through 6D and Figure 7, respectively. Sections 9 and 10 in Worksheet #10 below identify land use considerations and physical aspects of the Site, respectively, that were considered in developing the CSMs presented in Figures 6A through 6D and Figure 7.

The Preliminary Human Health CSM indicates there are:

- Five potential human receptors[3]: trespassers, hunters, facility workers, construction workers, and off-site residents.
- Potential exposure routes of incidental ingestion, dermal contact, inhalation, and ingestion.
- Potential exposure media of surface soil, volatiles/particulates in ambient air, game meat (see Section 3.2.3 in Appendix A), subsurface soil, indoor air, groundwater, surface water, and sediment.

[3] No portion of the Site is used for residential purposes, and all future redevelop included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and it is assumed it will be prevented through implementation of land use restrictions.

The Preliminary Ecological CSM indicates there are:

- Four potential categories of representative aquatic ecological receptors: benthic invertebrates, aquatic invertebrates, fish, and amphibians.
- Five potential categories of representative terrestrial ecological receptors: soil invertebrates, plants, reptiles, birds, and mammals.
- Potential exposures routes of ingestion and direct contact.
- Potential exposure media of surface soil, terrestrial prey items, terrestrial vegetation, subsurface soil, groundwater seeps, surface water, aquatic prey items, aquatic vegetation, and sediment.

While the ecological CSM indicates generic wildlife receptor groups (e.g., birds, mammals), note that individual wildlife receptor species and feeding guilds are not typically evaluated separately in a SLERA; however, the protection of all feeding guilds is inherent in SLERA benchmarks used to assess potential for risk. In the development of these benchmarks, USEPA and other agencies evaluated several different types of receptors and trophic levels and used the lowest calculated screening level from among all receptors as the final benchmark. Thus, these screening benchmarks are considered to be protective of an array of wildlife receptors representing multiple trophic levels.

9. Land Use Considerations:

As of the January 15, 2020 site visit and the April 2021 field effort, the areas within the boundaries of AOC 2, AOC 3 (3S and 3N), and AOC FI remain undeveloped as forested or grassy areas. Development at AOC 2, as identified from aerial photographs, consists of an area to the east of Recreation Road just north of the sharp bend, where material continues to be stockpiled. Additionally, HDR, 2009b reports an area just east of the sharp bend in Recreation Road, near groundwater monitoring well SLMW-24, where old deteriorating amusement park rides and trailers were stored. No old deteriorating amusement park rides and trailers were observed during the January 15, 2020 site visit. Development at AOC FI includes a structure housing a well pump that is provided with electricity.

A perimeter fence is present that restricts access to most of the Former Southern Landfill area inclusive of Recreation Pond and SWF property. The western boundary of the fence runs along the western side of Recreation Road starting just north of the sharp bend. The northern boundary of the fence is bounded by the NYANG base. The eastern side of the fence follows the SWF property boundary. Along the south, the fence cuts through AOC 2 at the location where the road construction occurred in the late 80s. While all of AOC 3S, AOC 3N and AOC FI are contained within the fenced area, portions of AOC 2 including areas identified as likely used for landfill operations (Geomatrix, 2005) are outside of the perimeter fence. There are three locked gates located along the northeastern, southeastern, and southwestern perimeters.

Additionally, it was observed during a site visit on January 15, 2020 that while the fence and gates were generally sturdy and in good condition, fencing along the southwestern perimeter

boundary, in the vicinity of the MCC facility, contains breaches large enough for human trespassing. Tree stands for hunting were observed during the site visit and the DOT reported that employees at the Site are permitted to hunt on the property. There were several areas where grass was mowed, and recently deposited trash on the ground also provided evidence of people potentially walking off trails. Also observed during the site walk was a residential property that exists in a flat, wooded area located between AOC 2 and AOC 3S. Representatives from the SWF and NYSDOT present during the site walk indicated the house was inhabited until 2008 and has remained uninhabited since.

Based on the Town of Windsor Zoning District Map, the entire Site and the area of the uninhabited house is in an area zoned as Airport (AP). The SWF and NYSDOT have confirmed that during their lease period, operations of the airport would not include use of the uninhabited house for residential purposes. It is reported that all tenants of SWF must be a commercial operation so a lease would never be set up with an individual or residence. Currently, there are no plans to demolish or reuse the structure. The heating oil tank that serviced the house was taken out of service in 2022, and is being removed from the facility's permit without plans to put it back into use.

There are no future land use changes planned for the areas within and nearby AOC 3 (3S and 3N) and AOC FI. Future land use plans for AOC 2 included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. The area of the Former Southern Landfill was originally excluded from the NEG operating leasehold in 2000. However, in 2007, when PANYNJ took over the leasehold, Areas A, B, and C were included (HDR, 2009b), suggesting these areas had been made available for industrial and commercial development. Additionally, while NYSDOT has elected to retain much of Area D, they have agreed to reapportion parts of Area D to transfer a few sections to the PANYNJ leasehold to allow for potential development in the future (HDR, 2009b). The reapportionment areas D1 and D2 are wholly within AOC 2 and portions of D3 are within AOC 2. The status of the reapportionment areas is unknown.

10. Key Physical Aspects of the Site

10.1 Climate:

Former Stewart AFB is located within the humid continental climate zone, which experiences hot to mild summers and cold winters with precipitation occurring year-round (NWS, 2020; Plantmaps, 2020). According to the Walden 1 ESE, NY NOAA weather station located approximately 5.5 miles to the northwest of the AOC 2, seasonal averages data from 1981 to 2010 indicate winter temperatures average 27.1°F and summer temperatures average 69.3°F. Average annual precipitation is 44.74 inches. Monthly precipitation varies from approximately 3.5 inches to 4.5 inches per month except in January and February which experience slightly less than 3 inches (NOAA, 2020).

10.2 Topography:

Figure 8 provides a Site map that includes topographic contours. The area of Former Stewart AFB is within a topographic region characterized by knobby, small, almost conical hills (Golder, 1998). Within the boundaries of AOC 2, AOC 3, and AOC FI, elevation ranges from approximately 340 to 440 ft above mean sea level (AMSL). There are three topographic high points located in the immediate vicinity of Site; one is located in the south-southwestern portion of AOC 2 at approximately 420 ft AMSL, one is located southeast of AOC 3S at approximately 440 ft AMSL, and one is located northeast of AOC 3N at approximately 420 ft AMSL. These three topographic high points form a triangular shape around the Site, with the middle area of the triangular shape at approximately 340 ft AMSL, the lowest elevation in the immediate vicinity. This lowest elevation sits near AOC FI and between AOC 2 and AOC 3S.

A majority of the surrounding airport property and areas adjacent reside between 450 to 460 ft AMSL with a higher elevation location (approximately 545 ft AMSL) near the control tower located to the north/northwest of AOC 2. The main airport property is located at an elevation of 491 ft AMSL (Golder, 1998). The highest natural point in the vicinity is a man-made treated water reservoir at approximately 600 ft AMSL (Golder, 1998). The topographic slope of the area decreases to the southeast.

Historical topography was evaluated in detail in the PESA (Harza, 2001). Harza created 2D and 3D models from 1942, 1957 and 2000 topographic data, and prepared two profiles that fall within AOC 2 that compared topography from 1942 (pre-filling) and 2000 (approximate current topography). One profile running perpendicular to Recreation Road in the northern portion of AOC 2 suggests a maximum fill thickness in the area of 8 ft. Another profile extending from the sharp bend in Recreation Road east into the middle of AOC 2 suggests a maximum fill thickness of 24 ft.

10.3 Surface Water and Other Site Features:

The main surface water features in the vicinity of the Site are shown in Figure 9 and include the following:

- Recreation Pond (located just south of the NYANG Base) that receives runoff from airport property via stormwater drainage system outfalls.
- Lake Washington (located East of I-87).
- Brown's Pond also known as Silver Stream Dam Reservoir, the headwaters of Silver Stream (located south of Route 207 and Moore's Hill Road).
- Unnamed Tributary from Recreation Pond that flows south to Silver Stream.
- Silver Stream which flows from Brown's Pond north to the unnamed tributary from Recreation Pond and then travels east, where it eventually discharges into either Lake Washington or Moodna Creek.
- A diversion basin and turn valve is located southeast of the intersection between Route 207 (Little Britain Road) and Interstate 87 is used to divert Silver Stream flow north to

Lake Washington, or south to Moodna Creek. Moodna Creek flows east and discharges into the Hudson River.

- An unnamed tributary south of Former Stewart AFB originating at an Unnamed Pond that flows east-northeast, where it converges with Silver Stream approximately 250 feet south of the Walter's Mobile Home Village trailer park.
- The Catskills aqueduct runs west to east through the southernmost portion of the SWF property just north of Route 207.

Surface water runoff in the areas of the Site follows topography and flows generally to the south and east (Bluestone 2019). There is an intermittent (ephemeral) stream that conveys surface water to the south from the central portion of AOC 2. Runoff from the southwestern portion of AOC 2 is conveyed via an identified wetland and drainage channel to the southwest of AOC 2 that also receives runoff from the MCC Facility. AOC 2 surface water flows to the unnamed tributary south of Former Stewart AFB that joins Silver Stream. Surface runoff from AOC 3 flows west to the unnamed tributary from Recreation Pond that flows south to Silver Stream. Surface runoff from AOC FI flows east to the adjacent wetland and unnamed tributary from Recreation Pond that flows south to Silver Stream.

Surface runoff from the SWF facilities and NYANG base are controlled by two stormwater drainage systems. In total, the SWF permitted system includes 15 outfalls and the NYANG base permitted system includes 10 outfalls. The location of outfalls in the vicinity of AOC 2 and AOC 3 are shown in Figure 8, Figure 9, and Figure 10. SWF Outfall 011 is the only outfall that drains directly to portions of AOC 2. SWF Outfall 011 drains to the southwest portion of AOC 2 that includes an identified wetland area and would flow to the drainage channel to the southwest of AOC 2. According to the NYSDEC State Pollution Discharge Elimination System (SPDES) Discharge Permit effective starting in 2007, Outfall 011 is identified as a 24" pipe draining paved and vegetated area though an oil/water separator at the SW Fuel Farm (NYSDEC, 2007). Activities in the drainage area include the fuel farm, Breunig Road, and the Anheuser Busch facility (NYSDEC, 2007). As part of the SPDES permit, Outfall 011 is sampled monthly for pH, flow, oil and grease and total suspended solids (TSS) and quarterly for benzene, toluene, ethylbenzene, and total xylenes. There are no outfalls draining directly to AOC 3.

SWF Outfalls 012 and 013 that receive runoff from the aircraft parking apron, hangars, operations building, and anti-icing drain to the formerly delineated Area C of the Former Southern Landfill area located north of AOC 2. Based on topography, stormwater from these outfalls would flow east/southeast to the unnamed tributary from Recreation Pond and is not believed to impact the area of AOC 2 or AOC 3. Additionally, SWF Outfall 014 and NYANG Outfalls 002, and 006 direct runoff into Recreation Pond and is not believed to impact the area of AOC 2 and AOC 3.

Three drinking water reservoirs exist in the vicinity of Newburgh, New York — Chadwick Lake, Lake Washington, and Brown's Pond (OCWA, 2014). Lake Washington has been the City of Newburgh's primary water supply, with Brown's Pond serving as a secondary supply. In 2016,

Lake Washington was discontinued as the City of Newburgh's primary water supply source due to the presence of per- and polyfluoroalkyl substances (PFAS) contamination. Since then, Brown's Pond has been utilized as the City of Newburgh's primary water supply, with the Catskills Aqueduct as a secondary source, when water level in Brown's Pond decreases and requires recharge (Times Herald-Record, 2016). The City of Newburgh recently transitioned their drinking water source from Brown's Pond to the Catskills Aqueduct in January 2020 (City of Newburgh, 2020).

On the site visit performed January 15, 2020, it was observed that SWF Outfall 011 was discharging directly into a known, existing wetland area and that SWF Outfall 013 was discharging to Silver Stream. These observations confirm the interpretation of drainage based on topography. The water discharging from SWF Outfall 013 into Silver Stream appeared to be cloudy gray with a faint odor and seemed to contain potential contamination from chemicals that are known to be used at SWF (e.g., de-icer and roadway treatment chemicals, etc.). Several pieces of iron-made equipment were observed at the surface of AOC 2, presumably from historical dumping in the landfill. Apparent groundwater seeps were observed in the area of AOC 2 with a rusty, reddish color that was trickling into the unnamed tributary from Recreation Pond. The surface landscapes of AOC 2 and AOC 3S were observed to be hummocky from sporadic dumping of apparent construction materials. The surface landscapes may present potential ecological concerns with the creation of vernal pools in the low-lying areas. Evidence of drainage swales running between the road and the stream were observed, and significant undercutting and highwater lines were noted along the stream bed.

It is believed to be unlikely that fish of suitable size exist for recreational fishing to occur on any routine basis in any of the on-site streams given: 1) the relatively small size of these streams result in shallow stream depths of only a few inches, 2) the intermittent status of portions of the streams, and 3) the fact that the Site is fenced with restricted access.

10.4 Wetlands:

Wetlands, streams, and vernal pools within and in the nearby vicinity of AOC 2 and AOC 3 (3S and 3N) were field delineated in April 2021 in accordance with methodology described in the *Regional Supplement to the 1987 Corps of Engineers Wetlands Delineation Manual: Northcentral and Northeast Region Version 2.0* (USACE, 2012). The memo documenting the April 2021 wetland delineation is included in Appendix B.

Wetlands in the nearby vicinity of AOC FI are mapped according to the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping tool. Figure 10 shows the location of field delineated wetlands and include the NWI wetlands in the vicinity of AOC FI. The USFWS NWI Wetlands Map is included in Appendix B.

The USFWS-NWI identifies wetlands based on analysis of high-altitude imagery evaluating vegetation, visible hydrology, and topography (USFWS, 2020c). It is expected that on-the-ground inspection of any site will result in some revisions of wetland boundaries or classification

(USFWS, 2020c). This is consistent with results of the field delineation within and in the nearby vicinity of AOC 2 and AOC 3 (3S and 3N). A wetland delineation survey for the area nearby AOC FI is included as part of the RI.

Field delineated wetlands within and in the nearby vicinity of AOC 2 and AOC 3 (3S and 3N) include:

- An approximately 2.7-acre wetland area (habitat classification PFO) located southwest and between the discontinuous portions of AOC 2, near SWF Outfall No. 011.
- Three wetland areas along the eastern boundary of AOC 2
    - 1.3 acres (habitat classification PFO) at the location of the intermittent/perennial stream within AOC 2.
    - 0.8 acres (habitat classification PSS)
    - 0.6 acres (habitat classification PEM and PFO)
- An approximately 12.9-acre wetland (habitat classification PSS) north and west of AOC 3 (3S and 3N) along existing perennial streams. The western boundary of AOC 3N borders this wetland.
- An approximately 0.2-acre wetland area (habitat classification PFO) located just west of AOC 3S. The wetland is adjacent to the western boundary of AOC 3S.
- An approximately 3.1-acre wetland area (habitat classification PFO) located south of AOC 3S and north of NWI mapped wetlands.

NWI identified wetlands in the nearby vicinity of AOC FI include:

- An approximately 3.17-acre freshwater emergent wetland area (habitat classification PEM1/SS1E) and an approximately 6.76-acre freshwater forested/shrub wetland (habitat classification PFO1E) located near the confluence of the unnamed tributary from Recreation Pond and Silver Stream along a southeast portion of the SWF property boundary.

Habitat classification codes describe the specific wetland habitat (ex. P – Plaustrine, FO – Forested, 1 – Broad-Leaved Deciduous, E – Seasonally Flooded) and additional code explanations are provided in Appendix B. Freshwater forested/shrub wetlands are commonly found in the eastern United States in locations where moisture is relatively abundant (e.g., along rivers and in the mountains), and typically “possess an overstory of trees, an understory of young trees or shrubs, and a herbaceous layer (USFWS, 2020a).” Freshwater emergent wetlands are characterized by rooted, herbaceous, perennial plants that only grow in or on water (excluding mosses and lichens) and maintain the same appearance year after year in areas with relatively stable climatic conditions (USFWS, 2020b).’

Two vernal pools were identified during the April 2021 field delineation. Both vernal pools were located south of AOC 3S. No vernal pools were located within AOC 2 or AOC 3 (3S and 3N).

10.5 Unique and Special Value Resources:

Unique and special value resources are areas that provide unique or special ecological value and may require specific protective measures during ground-intrusive activities as part of the RI. Unique and special value resources can include wetland areas, riparian and other habitats, nesting areas or areas with other evidence of inhabitants, areas with endangered and/or protected species habitats, protected vegetation, vernal pools, and items of historical value.

Wetlands, streams, and vernal pools have been delineated within and in the nearby vicinity of AOC 2 and AOC 3 (3S and 3N). See the previous section. Wetlands, streams, and vernal pools within and in the nearby vicinity of AOC FI will be further delineated as part of the RI.

There have been no specific ecological studies conducted at the Former Stewart AFB (Bluestone, 2019). Identification of special value resources is included as part of the RI and any newly identified resource features will be described and mapped, and protective measures to minimize impacts to these areas will be implemented as necessary.

10.6 Regional and Site Geology:

The geology present in the State of New York has been sculpted by various periods of mountain building, erosion, and glaciation. The Taconian, Acadian, and Alleghanian Orogenies occurred during the Ordovician, Devonian, and Pennsylvanian-Permian periods as island arcs and continents collided at subduction and transform boundaries. The predominantly marine and non-marine sediments were folded and faulted during these mountain building events, which initiated metamorphism and intensified erosional processes. Later during the Pleistocene Epoch, continental glaciation transformed the geologic landscape into what is observed in present day New York (NYSDOT, 2013).

Former Stewart AFB lies within the Hudson-Mohawk Lowlands Physiologic Province of New York. The Hudson-Mohawk Lowlands extend almost the entire length of eastern New York, and generally contain low relief due to glaciation, except for three ridges present in the southern lowlands (NYSDOT, 2013). The three ridges include Schunemunk Mountain located approximately 6 miles to the south-southwest of Former Stewart AFB, Marlboro Mountain located approximately 14 mile north-northeast of Former Stewart AFB, and the Shawangunk Mountains located approximately 17 miles to the west-northwest of Former Stewart AFB. The southern lowlands in the vicinity of Former Stewart AFB are composed of the valleys of the Wallkill River, Roundout Creek, the Hudson River, Fishkill Creek, and Wappinger Creek (NYSDOT, 2013). The Former Stewart AFB is located within the Wallkill River basin (Golder, 1998).

The primary landforms in the Former Stewart AFB region are ground moraines and drumlins derived from advancing glaciers. Ground moraines consist of rolling, hilly terrain composed of till deposited on top of bedrock, and drumlins are tear-drop or elliptically-shaped hills that align parallel to glacial flow. Numerous drumlins, with thicknesses ranging from 75 to 200 feet, are found in this area (Aneptek, 1997).

The Site geology at the Former Stewart AFB consists of surficial glacial deposits overlying bedrock, specifically, surface topsoil and disturbed glacial till overlying undisturbed glacial till. Underlying the glacial till is bedrock consisting mostly of shales. The regional bedrock structure consists of isoclinal folds trending north-northeast, with overturned folds observed to the west (E.C. Jordan, 1989). Bedrock and surficial geological maps are provided in as Figure 11 and Figure 12, respectively.

Many soil borings have been advanced within and in the nearby vicinity of the Site (see Figure 15). The following boring logs were reviewed to describe the site geology:

- JTB-100 through JTB 110 advanced in 1987 (E. C. Jordan, 1989).
- B-1 through B-13, advanced 2001 through 2002 in formerly delineated Area A and Area B of AOC 2 (LMS, 2002; LMS, 2003). Nine borings were converted to monitoring wells SLMW-01 through SLMW-09.
- SLMW-10S and -10D through SLMW-20S and -20D; SLMW-21S(wt), SLMW-21SI advanced in 2005 in Area D and the vicinity for the purpose of installing groundwater monitoring wells with same identification (HDR, 2009a).
- BD-1 through BD-8, advanced in 2008 in the exclusion areas of formerly delineated Area D, in the mid to southwestern portions of AOC 2. BD-7 is outside of AOC-2 but within formerly delineated Area D. Five borings were converted to monitoring wells SLMW-22 through SLMW-26 (HDR, 2009b).

Surficial Geology

The surficial geology at the Former Stewart AFB is primarily Pleistocene-aged, glacial till consisting of poorly sorted sediments with varying clast sizes (e.g., clay to boulders) and textures. The till was deposited as ground moraine material during successive glacial retreats (United States Geological Survey [USGS], 1992), and tends to be clay-rich due to its primarily shale bedrock parent material (Aneptek, 1997). Review of the historical boring logs generally characterized the till as: “poorly sorted and well-graded glacial tills comprise of brown to gray clays, silts, sands, and gravels based on grain-size analyses.” In general, a brown weathered till overlies a deeper grey unweathered till. Disturbed glacial till, likely from airport construction projects, was encountered to depths ranging from 10 to 20 feet bgs, with undisturbed glacial till extending below the disturbed till down to the weathered bedrock of the Normanskill Formation (E. C. Jordan, 1989; LMS, 2003b).

Former stream channels and other surface features in the vicinity of the Site may have been buried during disposal of construction debris or placement of fill material, which potentially create preferential flow pathways in the subsurface. Native soil types in the vicinity of the Site were mapped by the Natural Resources Conservation Service (NRCS), and are described as well to moderately well-drained, gravelly, sandy loam (Wood, 2018).

Bedrock Geology

The bedrock geology underlying the glacial till deposits consists of the Middle Ordovician shales, argillites, and siltstones of the Normanskill Formation (Fisher et al., 1970). The Normanskill Formation is overlain by the Middle Ordovician graywacke and shales of the Austin Glen Formation, which is present below the overburden in the western portion of the Wallkill and Roundout Creek valley lowlands. Beneath the Normanskill Formation lies the Middle Ordovician Balmville Limestone. To the east of Former Stewart AFB are the limestone and dolostone formations of the Upper Cambrian to Lower Ordovician Wappinger Group, which has been exposed via faulting (Fisher et al., 1970).

The Normanskill Formation in the site vicinity is composed of "green and black siliceous argillite layers that are interbedded with green and black chert, black shale, and gray mudstone with marine graptolite fossils found in the black and siliceous shale layers" (RRI, 2000). Overall, the bedding was observed to dip approximately 45 degrees from vertical (E. C. Jordan, 1989). The upper 10 feet of the Normanskill Formation is highly fractured, and the formation slopes in the east-southeast direction. The fractured shales are typically encountered from 22 to 28 feet bgs and is characterized as a weathered surface of the Normanskill Formation (LMS, 2003b). A review of boring logs advanced to depths of 200 feet bgs described the Normanskill Formation as a dark gray/medium gray claystone, argillaceous, finely bedded with bedding paralleling foliation (cleavage) with discontinuous calcite-filled strain cracks (HDR, 2009a). Top of bedrock in the central portion of Area D ranged from 6 to 24 feet bgs due to the variability of overlying fill material while bedrock was not encountered in borings advanced in the vicinity of AOC 3. During a site walk conducted January 15, 2020, the Normanskill (shale) Formation was observed at the surface grade in areas of the unnamed tributary from Recreation Pond that flows to Silver Stream.

Bedrock Fracturing

Although the State of New York is not located along an active plate boundary, it has had the third highest earthquake activity among states east of the Mississippi River, experiencing greater than 400 recorded earthquakes between 1730 and 1986 with a magnitude of 2.0 or higher (Isachsen et al, 2000). An evaluation of earthquake epicenters located in southeastern New York from 1534 to 1980 demonstrate a north-south trend centered along the Hudson River, and a prominent northwest-southeast trend (Nottis, 1983). Seismic activity in the region may have contributed to the known bedrock fracturing within the site vicinity (RRI, 2000). The community is utilizing the groundwater resources in the area via production wells (LMS, 2003a). Therefore, understanding how a fracture system can affect groundwater flow, contaminant transport, and well yield is important for successful utilization of groundwater resources (RRI, 2000).

As part of the PESA in 2001, a fracture trace analysis was performed in the vicinity of the Site that evaluated aerial photographs for lineaments, surface features caused by underlying fractures or faults that have been propagated from bedrock to the surface through unconsolidated sediments and soil. The regional fracture trace analysis performed on the photograph taken in

1986 indicates two main sets (for a total of four joint sets) of fracture trends: a north-south/east-west set, and a northeast-northwest conjugate set (RRI, 2000). Several lineaments were observed within and surrounding the former landfill areas, indicating the presence of extensive fracturing in the subsurface. Figure 13 shows the site-specific fracture trace analysis figure (RRI, 2000). The report concluded that the fracture trace analysis data was to be combined with a two-dimensional seismic survey of the area to make recommendations for placement of up and down gradient monitoring wells (RRI, 2000).

10.7 Hydrogeology:

Groundwater in the area of the Site resides in both the Pleistocene-aged glacial till and the underlying, Middle Ordovician Normanskill Formation. The aquifers are primarily recharged via precipitation (RRI, 2000), and regional groundwater generally flows east-southeast towards the Hudson River (E.C. Jordan, 1989). In the vicinity of the Former Stewart AFB, groundwater in the till discharges under unconfined conditions into Silver Stream. In general, the upper portion of the bedrock in the vicinity of the Former Stewart AFB has a higher permeability due to its fractured nature and tends to serve as a higher-yielding aquifer than the glacial till. Most groundwater flow in bedrock occurs through fractures, while flow through the till occurs across the unit. Groundwater in both the glacial till and fractured bedrock aquifers tends to be more abundant in the shallow subsurface and decrease with depth. The permeability of the glacial till and bedrock is heterogeneous, and the bedrock fracturing is highly variable, so locating and developing groundwater resources can be difficult (RRI, 2000). The USGS indicated that groundwater yields for bedrock wells (shale) in Orange County, New York range from zero to 400 gallons per minute (gpm), with an average of 22 gpm (Hammond et al., 1978).

Groundwater Elevations

Groundwater elevations have been evaluated in wells within and in the nearby vicinity of AOC 2 and AOC 3 during numerous sampling events and dedicated groundwater elevation surveys. Groundwater elevations recorded from individual sampling events can be found in the corresponding reports and are not included in this discussion.

Three significant groundwater elevation surveys have taken place and are described below.

- In August 2000, LMS investigated groundwater in 27 MWs near AOC 1 and AOC 6, west of AOC 2. Information regarding the well depths was not available. Groundwater elevations ranged from 428.3 to 406.6 feet AMSL and demonstrated a general groundwater flow direction toward the south-southeast. Notably, survey data for the 27 groundwater wells gauged came from two or more sources which contained discrepancies, and LMS reported that groundwater contours may not be correct as presented (LMS, 2000).
- In 2009, HDR conducted a depth to water measurement survey from all overburden monitoring wells in the area (approximately 60). Water depth in the overburden wells installed in 2005 ranged from 3.71 ft bgs at SLMW-21WT to 21.98 ft bgs at SLMW-10S.

HDR created a figure illustrating overburden groundwater contours (Figure 2-3, HDR, 2009a), which is shown as Figure 14. Groundwater elevations ranged from 420 ft elevation above vertical datum near AOC 1 and AOC 6, west of AOC 2, to 330 ft near AOC 3. Overburden groundwater elevations range from 400 ft to 370 ft across AOC 2 decreasing to the southeast. The 2009 sampling event also gauged bedrock wells. Depth to water in bedrock wells ranged from 3.78 ft bgs in SLMW-12D to 37.4 ft bgs in SLMW-37D. No contours were developed for the bedrock groundwater elevations.

- In November 2017, Wood Environment & Infrastructure Solutions, Incorporated (Wood) performed a large-scale sampling event at the NYANG base as part of a Site Investigation for PFAS contamination. Groundwater depths were measured in 27 groundwater monitoring wells across the base, with a majority installed in the shallow glacial till and weathered bedrock. Groundwater depths and elevations ranged from 4.64 to 39.11 feet below top of well casing (feet btoc), and from 320.94 to 449.51 feet AMSL, respectively. The groundwater elevation data demonstrates the general groundwater flow direction across the NYANG base is toward the south-southeast but does have an eastern component in the eastern portion of the base. Additionally, the data collected by Wood indicates a groundwater flow direction toward the southeast across AOC 2 and AOC 3 (Wood, 2018).

In 1995 and 1996, Aneptek Corporation (Aneptek) implemented Closure Investigation (CI) activities for Site 1 (AOC 4) at the NYANG Base, which included collecting groundwater elevation data from 38 wells over multiple events and performing in-situ aquifer testing. While not inclusive of the Site, the proximity of the investigation and similarity in geology suggests the hydrogeologic information gathered may provide insights for conditions at the Site. Aneptek utilized the data collected to evaluate site hydrogeology, including, but not limited to: 1) horizontal and vertical hydraulic gradient; 2) effective porosity; 3) hydraulic conductivity; 4) and average linear velocity (Aneptek, 1997). The Aneptek results were compared with results from E. C. Jordan, 1989 as available.

Horizontal Gradients

Aneptek collected groundwater elevation data from 38 wells screened both in the glacial till and bedrock units, over four events (December 1995; March, April, and August 1996). It was determined that groundwater flow can be separated into two interconnected systems, an upper and lower flow system in the overburden and underlying weathered and fractured shale bedrock. In general, groundwater flowed toward the east-southeast in both hydrogeologic units, toward the lower topographic elevations. The interpreted horizontal groundwater gradient for both the glacial till and bedrock units were approximately 0.11 beneath the steep slopes of Site 1; however, the horizontal gradient was approximately 0.06 farther to the east, beneath the wetland area. These values are consistent with a previous site investigation at AOC 4 and AOC 5, which calculated a horizontal hydraulic gradient of 0.07 (E.C. Jordan, 1989).

Vertical Gradients

Aneptek reported that vertical downward gradients (0.1 to 0.01) were exhibited in well pairs located in the western portion of the study area at higher elevations, and to a lesser extent in the eastern portion of the study area west of the wetland boundary. Vertical upward gradients (0.1 to 0.01) were exhibited in well pairs located within the wetlands boundary, in the southern portion of the study area, suggesting that the wetlands area receives recharge from the underlying glacial till and bedrock units (Aneptek, 1997). Similarly, E.C. Jordan (1989) evaluated vertical downward hydraulic gradients between the glacial till and bedrock, and within the glacial till, during their site investigation at AOC 4 and AOC 5, which determined downward gradients ranging from 0.005 to 0.239 and 0.515 to 0.878, respectively. Additionally, E.C. Jordan determined a vertical upward gradient measured between the till and the bedrock ranging from 0.01 and 0.03, also within the wetland boundary. Identified seeps in the vicinity of the Site may be caused by vertical upward gradients of groundwater from the bedrock to glacial till unit.

Effective Porosity

Aneptek evaluated effective porosity, the portion of the total void space of a porous material that is capable of transmitting a fluid (Gibb et al., 1984), for the glacial till and bedrock units. Direct measurements of effective porosity were not collected; however, estimates were derived from available data. The effective porosity of the glacial till unit was estimated by reviewing available grain size distribution data and comparing with published measurements to similar grain size distributions. The effective porosity of the fractured bedrock unit was assessed by inspecting the bedrock cores, estimating the average quantity of fractures per foot and average aperture width, and applying those variables to a published equation. The effective porosity of the glacial till and bedrock units were estimated to fall within the ranges of 1 percent (%) to 10% and 1% to 8%, respectively (Aneptek, 1997). E.C. Jordan (1989) evaluated effective porosity in the glacial till to be 20%.

Hydraulic Conductivity

Aneptek utilized seven groundwater wells installed as part of the CI field program, and additional data collected from four groundwater wells at other NYANG sites, to provide a more complete set of data points for evaluating aquifer hydraulic conductivity. All data were analyzed by the Bouwer and Rice method (Bouwer, 1989) using the BRISTA (Smith, 1995) computer software. Table 3 below lists the hydraulic conductivity ranges calculated for weathered and unweathered glacial till, and bedrock (Aneptek, 1997).

Table 3. Calculated Hydraulic Conductivity Ranges for New York Air National Guard Base, Newburgh, New York

Geologic Unit	Hydraulic Conductivity Range		Mean Hydraulic Conductivity	
	(cm/sec)	(feet/day)	(cm/sec)	(feet/day)
Weathered Glacial Till	2.27×10^{-5} to 1.58×10^{-4}	0.06 to 0.45	1.23×10^{-4}	0.35
Unweathered Glacial Till	4.09×10^{-5} to 6.64×10^{-4}	0.12 to 1.88		
Weathered/Fractured Bedrock	2.27×10^{-5} to 6.29×10^{-4}	0.06 to 1.78	7.84×10^{-5}	0.22

cm/sec = centimeters per second

Hydraulic conductivity values varied across the NYANG base; however, comparison of the mean hydraulic conductivity values for glacial till and bedrock indicate an insignificant difference between the two geologic units (Aneptek, 1997). For comparison, E.C. Jordan (1989) calculated an average horizontal hydraulic conductivity of 4.2×10^{-5} centimeters per second in the glacial till unit.

Average Horizontal Linear Velocity

Aneptek evaluated average horizontal linear velocity, the rate of groundwater movement through the subsurface, for the glacial till and bedrock units using hydraulic conductivity, horizontal gradient, and effective porosity values. Average horizontal linear velocity estimates in the glacial till and bedrock units ranged from 0.21 to 0.64 feet per day, and from 0.30 to 2.42 feet per day, respectively. The relatively high average horizontal linear velocity estimates are due to both the low formation effective porosity and high horizontal gradient values. Vertical hydraulic conductivity was not evaluated but is likely lower than horizontal hydraulic conductivity by one to two orders of magnitude; therefore, one would expect the average vertical linear velocities would be correspondingly lower, since both vertical and horizontal hydraulic gradients exhibited similar values (Aneptek, 1997). In comparison, E.C. Jordan (1989) calculated an average horizontal linear velocity of 15 feet per year, or 0.04 feet per day, in the glacial till unit.

10.8 Downgradient Drinking Water Wells:

A desktop survey was carried out to identify downgradient drinking water wells. The following resources were reviewed:

- Environmental Planning and Management. Inc. for LMS, February 2003 report "Sampling of Private Potable Wells Downgradient of the Southern Landfill Area Stewart International Airport New Windsor, Orange County, New York"
- Environmental Data Resources, Inc (EDR) April 2020 Radius Map™ Report with Geocheck
- NYSDEC Water Well Information – Search Wizard
  Provides basic information for water wells that have been drilled in New York State since the start of the reporting program in April 2000.
  https://www.dec.ny.gov/cfmx/extapps/WaterWell/index.cfm?view=searchByCounty
  Coordinate Search with 1 minute radius (1.15 miles): Latitude 41° 29' 28"
  Longitude 74° 05' 22"

The 2003 report of private potable wells sampled in 2002, identified and successfully sampled eight wells downgradient of the Site that are also north of Little Britain Road and West of I-57. These seven wells include: Stewart Mall Laundromat, Hill-N-Dale mobile home park (MHP), Walter's MHP, Newburgh SPCA, and four private residences at 21, 90, and 100 Silverstream Road, and 26 Weather Oak Hill Road.

The EDR RadiusMap™ confirmed there are community water systems at the Hill-N-Dale MHP (NY3501325) and Walter's MHP (NY3501317) but did not identify any new wells.

The NYSDEC Water Well Information Search identified a new well at the Jet Wash Auto Spa at 912 Little Britain Road.

The approximate locations of the eight downgradient drinking water wells identified through the desktop survey are shown on Figure 16.

11. Current interpretation of nature and extent of contamination to the extent that it will influence project-specific decision-making:

The current interpretation of nature and extent is based on documented site history, as well as the results from the numerous past environmental investigations that have occurred within and nearby the Site.

Historical data from 10 unique past environmental investigation reports was digitized and evaluated collectively. The historical data analyzed was collected over a span 12 years from 1999 to 2011. Due to age of the data, between 10 to 20 years old, uncertainty and variability of data validation, and advancements in laboratory methods that provide lower detection limits it was determined the historical data would not be incorporated into the RI or used for risk assessment. The historical data evaluation was also not intended to screen out potential investigation analytes. The goal of evaluating the historical data was to inform the CSM and

identify data gaps by determining if there were obvious indications of contaminant plumes or source areas, document the presence of specific contaminants shown to be present at the Site, and evaluate concentrations of contaminants in relation to screening criteria.

The evaluation of historical data is documented in detail in Appendix C and the results are summarized here. Notably, the screening criteria used in the historical analysis was different than the current Project Screening Levels (PSLs) provided in WS#15 as explained in Appendix C. The historical data analysis did not indicate the presence of obvious plumes or source areas that would have altered the planned RI activities. The historical data analysis did identify soil gas as an additional media requiring additional investigation in the RI.

Current interpretation of nature and extent of contamination is summarized for each AOC by media and landfill extent and contents as appropriate.

The locations of historical soil samples and historical groundwater wells are provided in Figure 15 and Figure 16, respectively. Locations of historical surface water and sediment samples are shown in Figure 17. Figure 18 illustrates investigations informing landfill extent and content as well as soil gas.

A general understanding of ammunition related contamination with project-specific decision-making conclusions applicable to all AOCs is discussed briefly prior to AOC specific discussions.

11.1 Ammunition

General Ammunition Consultations (GAC) was contracted by Harza to perform a review of historical documentation relative to military use, storage, and disposal of ammunition at Former Stewart AFB, as well as a field inspection (GAC, 2001).

In October 2000, following GAC's review of historical documents, a field inspection was performed to confirm relevant information discovered during their document review. GAC determined the ammunition history at Former Stewart AFB indicated the base had small arms storage facilities located on the property, and used small pyrotechnic devices (e.g., flares, survival equipment, etc.), but the base was too small to have artillery or bombing ranges. GAC found no evidence indicating systems were in place that would have resulted in approved disposal of ammunition in the landfill (GAC, 2001; Harza, 2001). No live ammunition was discovered prior to or during GAC's field inspection (GAC, 2001), and to date, no live ammunition has been discovered at the base (Bluestone, 2019).

The only ammunition items that were discovered are expended 105-mm M14 series cartridge casings, which were classified as inert scrap, containing no energetic materials. GAC concluded that unexploded ordinance (UXO) risk appeared negligible in the southern landfill (AOC 2) for the following reasons: 1) all ammunition items found to date fit within the history of the establishment; 2) ammunition items found to date were inert scrap; 3) ammunition items found were sporadic, and not systemic; 4) the land area of the former base was not large enough to

accommodate the firing of large-caliber weapons; and 5) histories of the establishment found to date make no mention of the firing of dud-producing ammunition (GAC, 2001).

There is no specific information available regarding potential for munitions at AOC 3S, AOC 3N and AOC FI. Since it is known that waste at AOC 3S was relocated from AOC 2, conclusions summarized above for AOC 2 are assumed to hold for AOC 3S as well. As a precaution, any ground intrusive activities at the Site will be supported by screening using appropriately trained UXO staff.

11.2 AOC 2

Numerous efforts have investigated contamination within portions of AOC 2 in soil, groundwater, surface water, sediment, and soil gas. Additionally, the AOC 2 landfill content boundaries have been delineated from the combined results of the 2005 and 2021 geophysical surveys which established the extent of the area disturbed during landfilling and containing metallic debris.

Landfill extent was investigated over a significant portion of the southern half of AOC 2 in formerly delineated Area D in May 2005 by Geomatrix. Geomatrix performed a geophysical survey of apparent terrain conductivity and metallic objects in the vicinity of the suspected trench locations. The survey was able to identify a portion of the southern boundary of the fill material. While there was some evidence of east-west trending linear anomalies that would be expected based on the reported trenching, the results suggest a more widespread burial of material (Geomatrix, 2005).

The remainder of AOC 2 was investigated by Nova Geophysical Services in March and April 2021. Nova performed a geophysical engineering survey consisting of a frequency domain electromagnetic survey. The survey was able to identify the remaining boundaries of the fill material and also identified a trench anomaly in the western portion of AOC 2. The report documenting the 2021 geophysical survey is included in Appendix C. In addition to a main area of 17.2 acres another small discontinuous area of 0.2 acres to the immediate southwest was also delineated and is included in AOC 2. The results from both geophysical surveys are shown in Figure 18.

Within AOC 2 subsurface soil samples collected during three unique investigations conducted between 2002 and 2008 indicate the presence of numerous VOCs, numerous SVOCs, pesticides (4, 4’-DDD, 4, 4’-DDE, 4, 4’-DDT, aldrin, dieldrin), PCBs (Aroclors 1248 and 1260), and metals. See Appendix C for an evaluation and discussion of historical detections of contaminants within the vicinity AOC 2. The highest detection in subsurface soil was 15 mg/kg of 4, 4’-DDD at BD-1. Most detections were less than 1 mg/kg. No VOCs were detected above the screening criteria. Several SVOCs exceeded the ecological soil screening criteria, but only six maximum detections of benzo(a)pyrene and one maximum detection benzo(b)fluoranthene exceeded the human health soil screening criteria. Pesticides 4, 4’-DDD, 4, 4’-DDT, aldrin, and dieldrin were detected above the human health and ecological screening criteria, and 4, 4’-DDE was detected

above only the ecological screening criteria. No PCBs were detected above screening criteria. Numerous metals were detected at levels exceeding the human health and/or ecological screening criteria.

No surface soil samples have been collected within AOC 2 so nature and extent of contamination in surface soil is unknown.

Within AOC 2 groundwater has been sampled from 24 wells installed at various times from 2002 to 2011 and with differing combinations of wells sampled during five unique events (see Appendix C). Numerous VOCs, numerous SVOCs, pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, aldrin, dieldrin, beta-DHC, and delta-BHC), GRO, DRO, herbicide 2,4-D, and several explosive compounds were detected. The highest values and most frequent detections of organic contaminants occurred at SLMW-04, SLMW-09, and SLMW-10S. Several VOCs were detected above the screening criteria, with benzene detected over the screening criteria at 8 different locations. The locations with the highest number of different VOC detections above the screening criteria were SLWM-04, SLMW-05, and SLMW-09, all located in the northern portion of AOC 2. Similarly, several SVOCs exceeded the screening criteria, with naphthalene detected over the screening criteria at 7 different locations. SLMW-10S has the highest number of different SVOCs detected above the screening criteria. Of the pesticides, 4,4'-DDD was detected most frequently above the screening criteria, and SLMW-08 has the highest number of different pesticide detections above the screening criteria. Explosive compounds were detected above the screening criteria at SLMW-04, SLMW-08, and SLMW-09. Numerous metals exceeded the human health screening criteria. Most of the highest metals concentrations were located at SLMW-25, centrally located within AOC 2.

Surface water and sediment within AOC 2 has been investigated at several locations along the central intermittent stream during three unique investigations spanning 1999 to 2011 (see Appendix C). For sediment, only two VOCs, 2-butanone and chloromethane, were detected and only at the same two locations. Numerous SVOCs were detected at many locations up to levels of 19,000 µg/kg of pyrene at S2-3. A combination of pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and dieldrin) were detected at most locations, and PCB Aroclor 1254 was detected at S2-3 only. Only one VOC, 2-butanone a common laboratory contaminant, was detected above the ecological screening criteria. Numerous SVOC detections exceeded the ecological screening criteria by several orders of magnitude and several SVOCs, many of which are polycyclic aromatic hydrocarbons (PAHs), exceeded the human health screening criteria as well. The highest SVOC detections were at S3-2, SLSED-07A, SED-07, and S2-1. All three locations are in relatively close proximity to each other. Both the human health and ecological sediment screening criteria were exceeded for pesticides 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and dieldrin, again by several orders of magnitude. Numerous metals exceeded ecological and/or human health screening criteria.

For surface water, only one VOC, chlorobenzene, was detected. Only one SVOC, bis(2-ethylhexyl)phthalate, was detected at one location. Pesticides 4,4'-DDD, 4,4'-DDE, alpha-BHC,

beta-BHC, delta-BHC, dieldrin and heptachlor were detected at one or more locations. All SVOC detections were less than 0.1 µg/L. DRO and GRO were also detected. The pesticide 4,4'-DDD was detected above the ecological screening criteria at several locations and the human health screening criteria was exceeded at two locations. Pesticides, alpha-BHC, dieldrin, endosulfan sulfate, and heptachlor exceeded the human health screening criteria at one or more location, and alpha-BHC and heptachlor also exceeded the ecological screening criteria at one or more locations. Several metals exceeded ecological screening criteria and a few metals exceeded the human health screening criteria.

Soil gas was investigated at 16 sample points spread over a significant portion of the southern half of AOC 2 in 2005. Oxygen was below standard atmospheric conditions of 20.9% at SG-1 through SG-10, SG-12, and SG-16, and below 7% at SG-4, 5, 10 and 12. The percent lower explosive limit (LEL) for methane was 81% at SG-4 and 12% at SG-10. Laboratory analysis detected tetrachloroethylene (PCE) at 0.7 ug/L in SG-8. Methane was detected at 1.8 mg/L at SG-10 and 140 mg/L at SG-4. The locations with methane detections in the laboratory analysis were the same locations with the lowest oxygen reading in the field. Methane at SG-10 was significantly below the LEL at 5% LEL. Methane at SG-4 was above both the LEL and upper explosive limit (UEL). Available guidance indicates methane above 20% LEL warns of potentially hazardous conditions (Ministry of the Environment, Conservation and Parks, 2020).

Past investigations within AOC 2 suggest VOCs, SVOCs, pesticides, PCBs, herbicides, explosive compounds are present in at least one or more media. Past historical data also indicates higher levels of SVOCs and pesticides in sediment and higher levels of pesticides in surface waters at AOC 2. The past investigations at AOC 2 were designed primarily to support specific future development efforts in portions of AOC 2 related to the transfer to the airport property. As such, while the investigations identify contaminants present at AOC 2, the investigations did not fully characterize the nature and extent of contamination or evaluate potential risk to human health and ecological receptors. Therefore, the investigation approach for AOC 2 includes the full suite of analytes (i.e., VOCs, SVOCs, pesticides, PCBs, metals, explosives, and dioxins) applicable for each media. Notably, historical SVOC analyses did not include 1,4-dioxane for any media in any AOCs. Data will be obtained for 1,4-dioxane as part of all the SVOC analysis in the RI due to solvents as a potential source.

In addition to sample locations within AOC 2, there were several past investigations which looked at potential contamination both upgradient and downgradient of AOC 2 in certain media. Both subsurface soil and groundwater were investigated upgradient of AOC 2 related to two fuel spills at the Southwest Quadrant Fuel Farm and within formerly delineated Area A. The soil investigations showed several VOC, SVOC, and pesticide detections. One PCB, Aroclor 1248 was also detected. Several detections exceeded the ecological screening criteria, but no detections exceeded the human health screening criteria. The groundwater investigations showed upgradient wells SLMW-01 and -02 had detections of SVOC bis(2-ethylhexyl)phthalate, pesticide dieldrin, and GRO and DRO. At upgradient well MEG-2, VOCs 1,2,4-

trimethylbenzene, and benzene, and SVOC naphthalene were detected. All upgradient detections were less than 10 µg/L, with the exception of GRO and DRO. The past investigations suggest that at the time of the investigations, there was not a significant upgradient source of contamination with the potential to migrate into AOC 2.

Downgradient of AOC 2, there are also numerous groundwater monitoring wells. Contaminants detected in groundwater downgradient of AOC 2 included the two VOCs acetone and methylene chloride, both common laboratory contaminants. SVOCs included bis(2-ethylhexyl)phthalate and di-n-butylphthalate, and pesticide dieldrin. Herbicide 2,4-D was also detected at two downgradient locations. All downgradient detections were less than 10 µg/L and most less than 1µg/L. The past downgradient groundwater investigations suggest that at the time of the investigations, there was not a significant source of contamination within AOC 2 that was migrating off site in groundwater. This conclusion is also supported by an effort to sample private potable wells downgradient of AOC 2 (then referred to as the Southern Landfill) in 2003. The sampling of eight private potable indicated one detection of the VOC chloroform and one detection of methyl tert-butyl ether (MTBE) considered to be more likely attributable to a nearby gas station than the Southern Landfill. Low level detections of one SVOC, bis(2-ethylhexyl)phthalate, was shown at two water supply wells and several metals (copper, iron, manganese, sodium, and lead) were detected with concentrations above their respective NYSDEC Class GA Groundwater Standards in at least one water supply well. Pesticides were not detected in any samples (LMS, 2003a).

Surface water and sediment was also sampled in areas surrounding AOC 2, at nearby outfalls as well as downstream. For sediment, similar to samples within AOC 2, numerous SVOCs were detected at many locations. Pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, dieldrin, endrin, and methoxychlor) were detected at most locations. Pesticides 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and dieldrin had the highest values at SED-08, which is immediately downstream of the SED-07 location within AOC 2. In general, compared with pesticide values within AOC 2, pesticide detections downgradient but still within Former Stewart AFB boundaries (SED-01, -02, -03, -04, -05, -10, -11, -12) have relatively lower concentrations. Additionally, the sampling locations off Former Stewart AFB property (SED-15 through SED-21) generally have pesticide values higher than the downgradient locations within the Former Stewart AFB and lower than those within AOC 2. For surface water, numerous SVOCs were detected with the highest being bis(2-ethylhexyl)phthalate at 15 µg/L at SW-02 and most other SVOC detections less than 5 µg/L. The SVOC detection locations are those closest to the MCC facility (SW-01, 02, 03, 04, and 05). Those same five locations had no detections of pesticides. Pesticides were detected at SW-08, downstream of SW-07 within AOC 2 and at SW-09, -10, -11 which are north of AOC 2 and receive runoff from two outfalls. GRO and DRO were detected in many of the surface water samples.

It will be important to determine the origin of pesticide contamination at the Site. The presence of pesticides at AOC 2, AOC 3S (see below) and the surrounding area may be from when the

area was used for agriculture (specifically orchards), from correct application by DoD during its use of the Site. The potential for a DoD release of pesticides is limited to a release from disposal of containers in the landfill, such as a potential buried drum of pesticides. Pesticides applied according to their labeling would not be considered a DoD release. As such, pesticides are included in the investigation, but will only be considered a DoD-chemical if it is determined there is evidence of a release from disposal in the landfill.

11.3 AOC 3S

There have been no soil investigations at AOC 3S and historical groundwater, surface water and sediment sampling within and nearby AOC 3S was very limited. The AOC 3S landfill content boundaries are known from the results of the 2021 geophysical engineering survey which established the extent of the area disturbed during landfilling and containing metallic debris. The report documenting the 2021 geophysical survey is included in Appendix C. The AOC 3S boundary delineated by the survey matches well with past estimated extents of the area. The geophysical survey results are shown in Figure 18.

In addition, landfill contents at AOC 3S were investigated with eight test pits (TP) (TP-1 through TP-8) in 2002 by LMS. Significant waste materials and/or debris was encountered in TP-1, TP-3 and TP-4. Minimal waste was encountered in TP-6 and TP-8. No waste or debris was encountered in TP-2, TP-5 and TP-7. The test pit logs documented the presence of scrap metal, degraded drum pieces, household waste, concrete, old carpeting, solidified roofing tar, buckets, plywood, clothing, and glass. The location of the tests pits is shown in Figure 18 and the Test Pit Logs are provided in Appendix D.

Current knowledge of nature and extent of contamination in soil is informed only by the history of AOC 3S. Given that waste material from AOC 2 was relocated to AOC 3S, the same contaminants shown to be present in soil at AOC 2 have the potential to be present at AOC 3S.

Groundwater was investigated via four wells at two locations along the southern boundary of AOC 3S. Two VOCs, acetone and methylene chloride, both common laboratory contaminants, were detected. Chloroform was also detected. A single SVOC bis(2-ethylhexyl)phthalate was also detected. Metals were detected at lower concentrations with only manganese and thallium exceeding the New York State Class GA standards.

Surface water and sediment were investigated twice at a single sampling location (SED/SW-13) very near the southwest corner of AOC 3S. In sediment, four SVOCs, benzo(b)fluoranthene, chrysene, fluoranthene and pyrene exceeded both the human health and ecological screening criteria by several orders of magnitude. Pesticides 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and dieldrin were also detected above the ecological and/or human health screening criteria. There were no PCBs detected. For surface water, VOCs or SVOCs were detected. The pesticide dieldrin exceeded the human health screening criteria and GRO and DRO were detected. The sediment at surface water detections at AOC 3S seem consistent with patterns observed at AOC 2 and downgradient.

Past investigations within AOC 3S suggest VOCs, SVOCs, and pesticides are present in at least one or more media at AOC 3S. Past investigations at AOC 3S were very limited and therefore, the investigation approach for AOC 3S includes the full suite of analytes applicable for each media except for pesticides. Based on the Site history, if pesticides were disposed at the Site, it most likely would have been in AOC 2. Therefore, the preliminary phase of sampling will include pesticides sampling and analysis in AOC 2, and if there are no issues associated with pesticides in AOC 2, it can be reasonably concluded that there are no issues with pesticides in AOC 3S and other AOCs.

11.4 AOC 3N

There have been no known past environmental investigations at AOC 3N involving soil, groundwater, surface water or sediment.

The 2021 geophysical survey is the only investigation in this AOC. The geophysical survey confirmed the area extent to the south and west. However, the survey stops before the results taper off to the north. The survey was stopped to the north at the toe of the significant slope leading up to Recreation Pond. The northern boundary of the area may require refinement if a data gap is identified following the primary investigation phase of the upcoming RI. The survey delineated area is consistent with the area over which debris was visually observed.

The current interpretation of nature and extent of potential chemical contamination at AOC 3N is informed only by visual observations of the AOC. Nothing is known about the AOC history other than what can be deduced from visual observations. While conducting the survey, molten debris, slag, and rusted drums were observed. The molten debris and slag suggest the nature of potential contamination may include waste from the former incinerator that could contain SVOCs, heavy metals, and dioxins. Additionally, it is possible waste from other unknown sources was also dumped at AOC 3N.

Very little is known about current nature and extent of contamination at AOC 3N. Therefore, the investigation approach for AOC 3N includes the full suite of analytes applicable for each media except for pesticides. Based on the Site history, if pesticides were disposed at the Site, it most likely would have been in AOC 2. Therefore, the preliminary phase of sampling will include pesticides sampling and analysis in AOC 2, and if there are no issues associated with pesticides in AOC 2, it can be reasonably concluded that there are no issues with pesticides in AOC 3N and other AOCs.

11.5 AOC FI

There have been no known past environmental investigations at AOC FI involving geophysics, soil, groundwater, surface water or sediment.

The current interpretation of nature and extent of potential chemical contamination at AOC FI is informed only by the known history of the AOC. It is known that an incinerator operated at AOC FI starting in the early 1940's. The wastes from the operation of the incinerator as well as

potential contaminants that may have been used in operations to support the incinerator suggest the nature of potential contamination may include VOCs from fuels, SVOCs, heavy metals, and dioxins from incinerator waste. Since there is no indication that the AOC was used as a dumping area, the potential for explosive compounds is unlikely.

Very little is known about current nature and extent of contamination at AOC FI. Prior to any intrusive activities, geophysical surveying will be performed to confirm no buried utilities or infrastructure exist in the area. Based on the AOC history, the investigation approach for AOC FI includes collection of surface soil, subsurface soil, groundwater, surface water, sediment, and soil gas. The samples will be analyzed for full suite of analytes including VOCs, SVOCs, PCBs, and metals (not pesticides or explosives).

11.6 PFAS

Based on the points outlined below related to the historical use of PFAS and the existence of a known PFAS release from the NYANG base located northeast of the Site, sampling and analysis of PFAS in samples collected from the Site during the RI is not proposed:

- PFAS is not believed to be associated with Former Stewart AFB. DoD activities at the Former Stewart AFB occurred from 1940 up until the property was excessed in 1970, and the wide-spread use of PFAS-based products by DoD did not start until the 1970s. While consumer and commercial use of PFAS began in the 1950s, it was not until the 1970s that the DoD started using aqueous film-forming foams (AFFF) for fighting petroleum-based fires (DoD, 2017).
- PFAS has been detected in both groundwater and surface water emanating from a release at the NYANG property to the northeast. While the property was originally part of the Former Stewart AFB, NYANG took ownership and so that investigation and cleanup is being managed under a different DoD program.

Investigation-derived waste (IDW) produced during the RI sampling activities will be analyzed for PFAS as per the requirements of the disposal facility receiving the waste, but individual samples of Site media will not be analyzed for PFAS because it is not a chemical believed to be associated with DoD activities at the Former Stewart FUDS property. QA/QC requirements that are consistent with the DoD Quality Systems Manual (QSM) Version 5.4 for PFAS analysis of IDW have been incorporated into this UFP-QAPP.

12. Data Gaps:

Data gaps for AOC 2, AOC 3, and AOC FI have been identified via historical document review; site visits; evaluation of historical sampling data, and continuing discussions with the USACE team.

Table 4 below identifies the data gaps and describes the general planned approach for addressing each data gap. Details of specific number of samples and analytical parameters are provided in Worksheets #17 and #18.

Table 4. Data Gaps and Approach to Address Data Gaps at AOC 2, AOC 3, and AOC FI

Data Gap	Approach to Address Data Gap
Wetland locations present in the vicinity of AOC FI may be outdated and/or inaccurate.	A wetlands delineation survey will be conducted in accordance with USACE guidance.
Surface water and sediment analytical data is limited in the vicinity of AOC 3 and AOC FI and is outdated.	Co-located surface water and sediment samples will be collected from drainage channels, seep and wetland locations, and Silver Stream and its tributaries.
Subsurface soil analytical data is outdated for AOC 2 and none exist for AOC 3 and AOC FI.	Soil borings will be advanced to the groundwater table and subsurface soil samples collected from the vadose zone.
No surface soil data exists for AOC 2, AOC 3, and AOC FI.	Discrete, surface soil samples will be collected from utilizing a hand auger or hand trowel.
Groundwater analytical data is limited and outdated.	Groundwater samples will be collected from existing, suitable groundwater monitoring wells within and in the vicinity of the Site. Additional monitoring wells be installed as needed at AOC 3 and AOC FI.
Soil gas analytical data is limited for AOC 2 and outdated. No soil gas data exists for AOC 3.	Sample soil gas within AOC 2 and AOC 3.
Solvents are a potential source of contamination at the Site. However, historical SVOCs analyses did not include 1,4-dioxane.	1,4-dioxane will be included as part of the SVOC analyses for which data will be obtained.
Current reference and upgradient analytical data do not exist or is limited and outdated.	Collect reference samples for surface and subsurface soil within a designated background area. Collect upgradient groundwater, surface water, and sediment samples to serve as comparison for Site and downgradient samples.
Incinerator wastes were not recognized previously, and so not sampled/delineated.	Sampling will be done in the vicinity of prior incinerator (AOC FI) and at AOCs 2 and 3 where incinerator waste is suspected of being placed. Dioxin has been added to analyte list if ash is observed to be present.

QAPP Worksheet #11: Project/Data Quality Objectives

(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

This worksheet develops and documents the data quality objectives (DQOs) using a systematic planning process (SPP). For the Former Stewart AFB RI, the sampling design is comprised of a judgmental, phased sampling approach with the preliminary phase focused on assessing the presence and absence of contamination based on the spatial extent of contamination (not the extent of risk). Therefore, a SPP as well as the USACE Technical Planning Process (TPP) were followed. The outcomes of the TPP meetings are documented in Worksheet #9. The DQOs identified using the SPP are documented below.

Step 1: State the Problem

AOC 2, AOC 3, and AOC FI (the Site) are being investigated under the FUDS HTRW Program to determine if historical DoD-related activities at the Site caused environmental releases of contamination that present unacceptable levels of risk to human or ecological receptors. A RI is needed to fully characterize the nature and spatial extent of contamination from DoD-related activities at the Site and to generate a dataset to support a human health risk assessment and screening level ecological risk assessment.

Step 2: Goals of the Study

The overall objectives of the RI activities for the Site are as follows:

- Determine the nature and spatial extent of contamination from DoD-related activities at the Site.
- Determine whether there are continuing sources of DoD-related chemicals at the Site, if so, define the nature and vertical/horizontal extent of those sources.
- Determine concentrations of organic compounds and naturally occurring inorganic compounds in reference surface and subsurface soil, upgradient groundwater, upgradient sediment, and upgradient surface water.
- Update and refine the current CSM, including actual and potential exposure routes.
- Collect data of sufficient quantity and quality to support preparation of baseline HHRA and SLERA.

The goals of the study are to answer the following investigation-specific questions:

1. Where are wetlands located within, or in the vicinity of, AOC FI in addition to those identified by the USFWS NWI (see Worksheet #10)? Does the presence of wetlands in addition to those identified by the USFWS impact actual or potential exposure routes?

2. What are the current depths/elevations of shallow and/or bedrock groundwater in the vicinity of the Site? Does comparison with historical data verify the CSM or indicate significant differences in groundwater depths/elevations that would suggest a change in

the vertical extent of DoD-related chemicals at the Site or impact actual or potential exposure routes?

3. What are current flow directions of the shallow and deep aquifers in the vicinity of the Site? Does comparison with historical data verify the CSM or indicate significant differences in groundwater flow directions that would suggest a change in the horizontal extent of DoD-related chemicals at the Site or impact actual or potential exposure routes?

4. Is geology within areas across the Site consistent with the information presented in historical investigations to verify the CSM?

5. What are the reference concentrations of DoD-related chemicals in surface soil (0-1 ft) and subsurface soil and what are the concentrations of DoD-related chemicals in groundwater, surface water and sediment upgradient of the Site?

6. Are chemicals identified in media in the vicinity of AOCs 2, 3, and FI associated with the Site related to DoD activities or are they instead attributable to reference or sources upgradient of the Site?

7. Are concentrations of DoD-related chemicals in surface and subsurface soil, groundwater, surface water, sediment, and/or soil gas within, or in the vicinity of AOCs 2, 3, and FI greater than PSLs – See Worksheet #15?

8. Are there any data gaps determined to exist following the collection of analytical data during the preliminary phase of RI sampling activities that need to be filled through a supplemental phase of RI sampling to adequately characterize the nature and extent of contamination and complete the HHRA and SLERA?

9. Do the concentrations of DoD-related chemicals in surface soil, subsurface soil, surface water, sediment, or groundwater at the Site present unacceptable risk to human and/or ecological receptors?

10. What is the extent of waste and potential subsurface utilities at the Site (including AOC FI) that may serve as preferential pathways?

Step 3: Information Inputs

Table 5 presents the types of information required to achieve the study goals presented above.

Table 5. Information Inputs Required to Achieve Study Goals

Use	Information	Source
Confirm all existing wetlands boundaries in the vicinity of AOC FI, to better understand ecological resources in the area, and further understand groundwater-surface water interactions.	Delineated wetlands	Wetlands delineation survey
Assess groundwater flow directions, horizontal and vertical gradients, and preferential contamination pathways.	Shallow groundwater and bedrock groundwater elevations	Well gauging
Determine concentrations of organic compounds and naturally occurring inorganic compounds in reference and upgradient locations to compare with Site concentrations	Reference and upgradient sample analytical results	Data results from analytical laboratory for reference surface and subsurface soil samples and upgradient groundwater, surface water and sediment samples
Determine concentrations of organic compounds and naturally occurring inorganic compounds in AOCs at the Site to compare with reference and upgradient locations and to use in risk assessments	Site associated sample analytical results in the vicinity of each AOC	Data results from analytical laboratory for surface soil, subsurface soil, groundwater, surface water, sediment, and soil gas samples collected from each AOC
Assess water quality during groundwater sampling, understand surface water and groundwater interactions, and identify differences in surface water quality across the Site	Water quality data	Field measurements collected during groundwater and surface water sampling
Understand geology across the Site and reference area in greater detail to supplement historical geologic data	Geological data	Soil logging from existing boreholes as well as new ones that will be installed during the preliminary and supplemental RI sampling events
Determine soil boring locations and intervals to focus soil gas sampling such that a representative dataset of vadose zone soil gas concentrations exists across the AOCs present at the Site	Field soil vapor screening data	Field measurements of organic vapors collected as soil borings are advanced and screened during the preliminary and supplemental RI sampling events

Table 5. Information Inputs Required to Achieve Study Goals (continued)

Use	Information	Source
Refine topographic contours, create drainage delineation for upgradient airport areas to understand upgradient surface runoff to the Site	Topographic data	USGS New York State 2014 3 County Lidar dataset 0.535 m horizontal accuracy at 95% confidence level, based on RMSEr (0.309 m) x 1.7308 0.25 m supplemental vertical accuracy at 95th percentile in the brush land and trees land cover category.
Aid in the identification of potential contamination source areas by comparing with geophysical survey results	Historical aerial photographs and satellite imagery	USAGC HPA (see Worksheet #10), GIS files from Harza, 2001.
Determine the presence of subsurface utilities and extent of waste at the Site (including AOC FI)	Utility locating and electro-magnetic data	Geophysical survey

Step 4: Define the Boundaries of the Study

The target population and spatial boundaries are described below by unique media.

Surface Soil

The target depth interval for surface soil is 0-1 ft bgs within the spatial boundaries of AOC 2, AOC 3, AOC FI and the proposed reference area. The interval of 0-1 ft bgs was selected as it represents the interval of greatest interest when evaluating excess risk to human and ecological receptors from surface soil.

Subsurface Soil

The target depth interval for subsurface soil is 1 ft bgs to the depth of the water table (i.e., the vadose zone). Historical groundwater elevation surveys summarized in Section 10.7 of Worksheet #10 indicate that groundwater depth in overburden wells ranges from approximately 4 ft to 22 ft bgs. Additional constraints include the variable nature of large boulder locations at the Site, and the variable drilling equipment options that will be required to optimize boring advancement. Spatial boundaries are the spatial boundaries of AOC 2, AOC 3, AOC FI, and the proposed reference area and the vertical depth of the soil boring advancement.

Groundwater

The target population for groundwater is groundwater within the spatial boundaries of AOC 2, AOC 3, AOC FI and upgradient and downgradient areas near the Site. The vertical boundaries for groundwater sampling are defined by the well screening of the monitoring wells and geologic units where groundwater is present, including shallow and deep glacial till, and shallow fractured bedrock.

Surface Water and Sediment

The target population for surface water is waters within 2 ft of the bottom of the water body. The target population for sediment is sediments within the upper 0-0.5 ft bgs interval. These intervals are of greatest interest in evaluating excess risk to ecological receptors through the selected exposure routes (ingestion and dermal contact/uptake) for benthic and aquatic invertebrates, fish, aquatic plants, reptiles, amphibians, birds, and mammals. The spatial boundaries include the surface water areas such as intermittent and perennial streams, vernal pools, seeps, or wetlands within AOC 2, AOC 3, AOC FI, and nearby upgradient and downgradient areas bounded upgradient by Recreation Road and downgradient by the boundary of the airport. Surface water and sediment samples will be co-located so a selected location must allow for collection of both a surface water and sediment sample.

Soil Gas

The target population for soil gas is subsurface soil vapors within the vadose zone in the spatial boundaries of AOC 2, AOC 3, and AOC FI.

Other Practical Constraints

Other practical constraints on the spatial boundaries for sampling include challenging site topography, exposed waste, fencing, and steep banks along surface water features.

Temporal Boundaries

The preliminary phase of RI sampling activities will be performed as part of a single mobilization during the 2023 calendar year; fieldwork is expected to take approximately 5 weeks to complete. The supplemental phase of RI sampling will be performed as a single mobilization after data from the preliminary phase of sampling are received, evaluated, and data gaps that need to be filled are identified and documented in an addendum to this QAPP.

Specify the Scale of Inference for Decision Making

The analytical results from surface soil, subsurface soil, groundwater, surface water, sediment, and soil gas from each AOC, reference, and upgradient/downgradient locations will be combined by exposure unit (EU) after each phase of investigation and be compared to PSLs and reference or upgradient/downgradient analytical data to evaluate the lateral and vertical extent of DoD-related chemical contamination within the various media, and to assess potential risks to human and ecological receptors. An evaluation will be performed after the preliminary phase of

sampling to identify data gaps (if they exist) that would be filled during a supplemental phase of sampling.

Sampling Areas for Remedial Decision Making

Unique sampling areas for which remedial decisions will be made at the Site include:

- AOC 2
- AOC 3S
- AOC 3N
- AOC FI
- Groundwater in the vicinity of AOC 2, AOC 3S, AOC 3N, and AOC FI
- Surface waters and sediment within and in the vicinity of AOC 2
- Surface waters and sediment in the vicinity of AOC 3 and AOC FI.

Sampling Approach

See Worksheet #17 for a summary of the sampling design and rationale, and Worksheet #18 for a detailed discussion of the planned sampling locations and method for soil, groundwater, surface water, sediment, and soil gas during the preliminary phase of RI sampling. Regarding sampling approach, the project team evaluated the use of discrete sampling versus the Incremental Sampling Method (ISM) procedure, and it was determined that discrete surface and subsurface soil sampling would be more appropriate for the Site. See Worksheet #17 for additional discussion of ISM with regard to the Site.

Target Analyte List

Based on the CSM, the specific constituents reasonably known or suspected to be present at the Site and analytes for which additional data is required to address identified data gaps and study goals include the analytical laboratory and field measurements shown in Table 6 and Table 7, respectively.

Table 6. Analyte List for Analytical Laboratory

Analyte/Media of Interest	Rationale for Inclusion	Planned Data Use
VOCs in soil, sediment, groundwater, surface water, and soil gas	• Potential contaminants reasonably known or suspected to be present within AOCs at the Site based on historical data and Site history. VOCs have been detected in historical soil, groundwater, sediment, and surface water samples collected from AOC 2.	• Evaluate presence or absence. • Assist in defining nature and extent. • Use in developing the CSM by understanding contaminant fate and transport among media. • Use in characterizing exposure in the HHRA and SLERA.
SVOCs including 1,4-dioxane in soil, sediment, groundwater, and surface water	• Potential contaminants reasonably known or suspected to be present within AOCs at the Site based on historical data and Site history. SVOCs have been detected in one or more types of media during historical sampling activities performed at the Site. • Past investigations of SVOCs did not evaluate 1,4-dioxane. Since potential sources include solvents, data will be obtained for 1,4-dioxane as part of the SVOCs analysis.	• Evaluate presence or absence. • Assist in defining nature and extent. • Use in developing the CSM by understanding contaminant fate and transport among media. • Use in characterizing exposure in the HHRA and SLERA.
Organochloride pesticides (OCPs) in soil, sediment, groundwater, and surface water within AOC 2	• Potential contaminants reasonably known to be present in AOC 2 based on historical data and Site history. OCPs have been detected in historical soil, groundwater, sediment, and surface water samples collected from AOC 2.	• Evaluate presence or absence. • Assist in defining nature and extent. • Use in developing the CSM by understanding contaminant fate and transport among media. • Use in characterizing exposure in the HHRA and SLERA.

Table 6. Analyte List for Analytical Laboratory (continued)

Analyte/Media of Interest	Rationale for Inclusion	Planned Data Use
PCB Aroclors in soil, sediment, groundwater, and surface water	• Potential contaminants reasonably known or suspected to be present at the Site based on historical data and Site history. PCBs have been detected in one or more types of media during historical sampling activities performed at the Site.	• Evaluate presence or absence. • Assist in defining nature and extent. • Use in developing the CSM by understanding contaminant fate and transport among media. • Use in characterizing exposure in the HHRA and SLERA.
Target Analyte List (TAL) Metals including mercury in soil, sediment, groundwater, and surface water	• Potential contaminants reasonably known or suspected to be present at the Site based on historical data and Site history.	• Evaluate presence or absence. • Assist in defining nature and extent. • Use in developing the CSM by understanding contaminant fate and transport among media. • Use in characterizing exposure in the HHRA and SLERA.
Explosives compounds in soil, sediment, groundwater, and surface water	• Potential contaminants reasonably suspected to be present at the Site based on Site history. • The ammunition history at Former Stewart AFB indicated the base had small arms storage facilities located on the property, and used small pyrotechnic devices (e.g., flares, survival equipment, etc.), but the base was too small to have artillery or bombing ranges. No evidence indicating systems were in place that would have resulted in approved disposal of ammunition at the Site, and	• Evaluate presence or absence. • Assist in defining nature and extent. • Use in developing the CSM by understanding contaminant fate and transport among media. • Use in characterizing exposure in the HHRA and SLERA.

Table 6. Analyte List for Analytical Laboratory (continued)

Analyte/Media of Interest	Rationale for Inclusion	Planned Data Use
	no live ammunition has been discovered, at the base (GAC, 2001; Bluestone, 2019).	
Dioxins in subsurface soil if ash is observed during RI sampling	• Potential contaminants suspected to be present at the Site based on Site history and presence of a former incinerator. • Dioxins have not previously been investigated and will be analyzed only in random or biased subsurface soil samples collected within any AOC where ash is observed to be present, because buried ash is the primary suspected source of dioxins at the Site. If dioxins are sampled within any AOCs, they will also be analyzed in reference area subsurface soil samples.	• Evaluate presence or absence. • Assist in delineating nature and extent and determine need for additional dioxin sampling during supplemental phase of RI sampling. • Potentially used in characterizing exposure in the HHRA and SLERA.
Methane in soil gas	• Potential contaminant reasonably known or suspected to be present at the Site based on Site history. Methane makes up approximately 50% of landfill gas, which is a natural byproduct of the decomposition of organic material in landfills.	• Evaluate presence or absence. • Assess landfill gas migration pathway. • Assist in defining nature and extent. • Use in characterizing exposure in the HHRA.
Grain size distribution in soil and sediment	• Used to define site geology and interpret soil boring logs.	• Verify geologic description represented in soil boring logs and the CSM.

Table 6. Analyte List for Analytical Laboratory (continued)

Analyte/Media of Interest	Rationale for Inclusion	Planned Data Use
		• May be used to support future ecological study development, if determined to be necessary
Total organic carbon (TOC) in soil and sediment	• Used to define site geology and fate and transport of organic compounds in the subsurface. • To be analyzed in 20% of soil and 100% of sediment samples to provide a sufficiently representative dataset for the Site.	• Support development of the CSM, potential fate and transport modeling of contamination, and evaluation of potential remedial options if it is determined to be necessary in the future. • Data to be used in the SLERA to adjust organic carbon-dependent soil and sediment benchmarks.
Cation exchange capacity (CEC) in soil and sediment	• A measure of the number of cations that can be retained on soil particle surfaces and can affect the soil chemistry at a site.	• Supplemental parameter that may be used along with other field information in understanding the presence of reducing conditions in media. • May support evaluation of potential remedial options if it is determined to be necessary in the future.
Oxidation reduction potential (ORP) in soil and sediment	• A measure of the tendency of a chemical species to acquire electrons from or lose electrons to an electrode and can affect the soil chemistry at a site.	• Supplemental parameter that may be used along with other field information in refinement of the SLERA to inform a line of evidence evaluation of risk from specific contaminants of concern. • May support evaluation of potential remedial options if it is determined to be necessary in the future.
pH in soil and sediment	• Used to make qualitative and quantitative assessments of	• Support development of the CSM and potential

Table 6. Analyte List for Analytical Laboratory (continued)

Analyte/Media of Interest	Rationale for Inclusion	Planned Data Use
	soil characteristics and chemistry.	modeling/calculations needed as part of the SLERA. Some ecological benchmarks are intended for soils within a certain pH range; therefore, it is important to understand what the pH is in shallow subsurface soil.
Moisture content in soil and sediment	• Water content of the soil/sediment used to define site geology and convert soil and sediment concentrations between wet and dry weight basis.	• Support development of the CSM and potential fate and transport modeling if it is determined to be necessary in the future. • Use in SLERA food chain modeling to convert between dry and wet weight
Hardness in groundwater	• A characteristic of water caused mainly by calcium and magnesium that can assist with understanding water chemistry, and geologic and hydrogeologic aspects of the site CSM.	• Necessary in SLERA for site-specific adjustments to surface water benchmarks. • Support development of the CSM, potential fate and transport modeling of contamination, and evaluation of potential remedial options if it is determined to be necessary in the future.
Alkalinity in groundwater and surface water	• The capacity of water to neutralize acids that can assist with understanding water chemistry and site CSM. • To be analyzed in 50% of groundwater and surface water samples to provide a sufficiently representative dataset for the Site.	• Necessary in SLERA for site-specific adjustments to surface water benchmarks. • Support development of the CSM, potential fate and transport modeling of contamination, and evaluation of potential remedial options if it is determined to be necessary in the future.

Table 6. Analyte List for Analytical Laboratory (continued)

Analyte/Media of Interest	Rationale for Inclusion	Planned Data Use
Sulfide in groundwater and surface water	• Needed to understand water chemistry. • To be analyzed in 50% of groundwater and surface water samples to provide a sufficiently representative dataset for the Site.	• Necessary in SLERA for site-specific adjustments to surface water benchmarks. • Support development of the CSM, potential fate and transport modeling of contamination, and evaluation of potential remedial options if it is determined to be necessary in the future.
Anions (chloride and sulfate) in groundwater and surface water	• An atom or molecule with a negative charge that is needed to understand water chemistry. • To be analyzed in 50% of groundwater and surface water samples to provide a sufficiently representative dataset for the Site.	• Necessary in SLERA for site-specific adjustments to surface water benchmarks. • Support development of the CSM, potential fate and transport modeling of contamination, and evaluation of potential remedial options if it is determined to be necessary in the future.
Dissolved organic carbon (DOC) in surface water	• The fraction of organic carbon that can pass through a standard sized filter and assist with understanding water chemistry.	• Necessary in SLERA for site-specific adjustments to surface water benchmarks. • Support development of the CSM, potential fate and transport modeling of contamination, and evaluation of potential remedial options if it is determined to be necessary in the future.

Herbicides are not included in the target analyte list. Given that 2-4-dichlorophenoxy, a widely used herbicide to control broad leaves, was only detected in five monitoring wells at the Site at a maximum concentration of 1.8 µg/L (compared to a USEPA Regional Screening Level [RSL] for Resident Tapwater [USEPA, 2021a] of 170 µg/L) during historical sampling, (see Appendix C), it was determined during TPP Meeting #2, that herbicides would not be included for further investigation. There is no specific reference to herbicide disposal at the Site in past historical

investigations and the Bluestone 2019 ETM also did not include herbicides as a potentially DoD-related chemical.

Table 7. Analyte List for Field Measurements

Analytes	Purpose/Rationale for Inclusion
• Dissolved oxygen • ORP • Turbidity • Specific conductivity • Temperature • pH	• To establish groundwater parameters have stabilized during groundwater sampling, to document surface water characteristics, and support risk assessments. In addition, if necessary, water quality parameters are useful in characterizing groundwater conditions to support fate and transport modeling and evaluation of potential remedial options in the future.

The analytical approach specifying which analytes apply to specific media is developed in the next step.

Step 5: Develop the Analytical Approach

A summary of the analytical approach for each type of media is provided in Table 8. The method listed is an USEPA Method unless otherwise noted (e.g., 8260C refers to USEPA Method SW-846-8260C). The number and locations of samples including field quality control samples were developed based on a judgmental sampling design and is addressed in Worksheets #17, #18 and #20.

All RI samples will be analyzed by Eurofins Lancaster Laboratories Environmental (ELLE), Eurofins Corpus Christi, Eurofins Frontier Global Sciences (EFGS; Seattle), or Eurofins Air Toxics. All three laboratories have DoD Environmental Laboratory Accreditation Program (ELAP) certification in accordance with DoD QSM Version 5.3 and New York National ELAP certification. Laboratory certifications and standard operating procedures (SOPs) are provided in Appendix E and Appendix F, respectively.

Table 8. Analytical Laboratory Analytical Approach by Media

Target Analyte	Method	Surface Soil	Reference Surface Soil	Subsurface Soil	Reference Subsurface Soil	Ground water (All)[1]	Surface Water (All) [1]	Sediment (All) [1]	Soil Gas
VOCs	8260C/Selective Ion Monitoring (SIM)	-	-	X	X	X	X	X	-
VOCs	TO-15	-	-	-	-	-	-	-	X
SVOCs including 1,4-Dioxane	8270D/SIM	X	X	X	X	X	X	X	-
Organochlorine Pesticides	8081B	X (AOC 2)	X	X (AOC 2)	X	X (AOC 2)	X (AOC 2)	X (AOC 2)	-
PCBs	8082A	X	X	X	X	X	X	X	-
Explosive Compounds	8330B[2]	X (excludes AOC FI)	X	X (excludes AOC FI)	X	X (excludes AOC FI)	X	X	-
Total and Dissolved Metals including Mercury	6020B/7470A/7471B	X (total only)	X (total only)	X (total only)	X (total only)	X (total and dissolved)	X (total and dissolved)	X (total only)	-
Dioxins	8290A	-	-	X (if burn ash observed in AOC)	X (if dioxins are analyzed in samples from any AOC)	-	-	-	-
PFAS	LC/MS/MS in accordance with QSM, Table B-15	X (IDW only)	X (IDW only)	X (IDW only)	X (IDW only)	X (IDW only)	-	-	-

Table 8. Analytical Laboratory Analytical Approach by Media (continued)

Target Analyte		Method	Surface Soil	Reference Surface Soil	Subsurface Soil	Reference Subsurface Soil	Ground water (All) [1]	Surface Water (All) [1]	Sediment (All)	Soil Gas
Grain Size Distribution		American Society for Testing and Materials (ASTM) D422	X	X	X	X	-	-	X	-
TOC		9060A	X (20% samples)	X (20% samples)	X (20% samples)	X (20% samples)	-	-	X	-
CEC		9081	X	X	X	X	-	-	X	-
ORP		ASTM D1498	X	X	X	X	-	-	X	-
Moisture Content		SM 2540G	X	X	X	X	-	-	X	-
pH		9045D for soil and sediment	X	X	X	X	-	-	X	-
Alkalinity		SM 2320B	-	-	-	-	X (50% samples)	X (50% samples)	-	-
Anions	Sulfide	SM 4500 S2 D	-	-	-	-	X (50% samples)	X (50% samples)	-	-
	Chloride/ Sulfate	9056A								
DOC		SM 5310C	-	-	-	-	-	X	-	-
Hardness		SM 2340B	-	-	-	-	X	-	-	-
Methane and Helium		Modified ASTM D-1946	-	-	-	-	-	-	-	X

1. Groundwater, surface water, and sediment samples will be collected at random locations within each applicable AOC as well as areas upgradient and downgradient of the Site to support an understanding of the nature and spatial extent of contamination and risk to human health and the environment associated with historical operations at the Site. The RI sampling will be implemented using a phased approach. Data collected during the preliminary phase of sampling will be evaluated, and additional data will be collected during the supplemental phase of sampling from areas and matrices that it is determined to be necessary to adequately characterize the nature and extent of contamination and complete risk assessments.
2. Modifications to Method 8330B will be made because discrete soil samples and not ISM soil samples are being collected in the field (see Worksheet #17 for additional discussion of ISM with regard to the Site). ISM-related sample processing in the laboratory including drying, sieving, grinding, and subsampling will not be done.

Table 9. Field Measurement Analytical Approach by Media

Target Analyte	Field Equipment	Surface Soil	Reference Surface Soil	Subsurface Soil	Reference Subsurface Soil	Groundwater (All)	Surface Water (All)	Sediment (All)	Soil Gas
Dissolved Oxygen	Horiba U-52	-	-	-	-	X	X	-	-
ORP	Horiba U-52	-	-	-	-	X	X	-	-
Turbidity	Oakton 100	-	-	-	-	X	X	-	-
Specific Conductivity	Horiba U-52	-	-	-	-	X	X	-	-
Temperature	Horiba U-52	-	-	-	-	X	X	-	-
Field pH	Horiba U-52	-	-	-	-	X	X	-	-

The analytical results will be utilized to answer the investigation-specific questions developed in Step 2. The following decision rules will be used to answer questions and evaluate the study goals identified in Step 2:

1. **IF** potable water supply wells are located downgradient from the Site, and groundwater data collected during the preliminary and supplemental phases of RI sampling indicate the possibility of downgradient potable water wells being contaminated, **THEN** water quality in downgradient potable water wells will be identified as a data gap and addressed during a future phase of investigation.

2. **IF** existing groundwater monitoring wells located in the vicinity of the Site are determined suitable (e.g., physically intact) for collecting groundwater samples, **THEN** groundwater wells will be sampled during RI activities. **IF** existing groundwater monitoring wells located in the vicinity of the Site are determined suitable (e.g., physically intact) for collecting groundwater samples, but required redevelopment due to sediment accumulation, **THEN** groundwater wells will be redeveloped during RI activities. **IF** existing groundwater monitoring wells located in the vicinity of the Site are determined to require repair of the surface completion to allow for collecting groundwater samples, **THEN** the surface completion will be repaired, and groundwater wells will be sampled during RI activities. **IF** any existing groundwater monitoring wells located in the vicinity of the Site are determined unsuitable for collecting groundwater samples, **THEN** those groundwater monitoring wells will be abandoned per applicable regulations.

3. **IF** new wetlands are identified within, or in the vicinity of, AOC FI during a wetlands delineation survey, **THEN** their locations will be recorded and mapped.

4. Depths/elevations of shallow and/or bedrock groundwater in the vicinity of the Site will be measured during RI activities to evaluate flow directions, horizontal and vertical groundwater gradients, and groundwater-surface water interactions.

5. Flow directions of the shallow and deep aquifers measured in the vicinity of the Site during the preliminary phase of RI sampling will be used to evaluate potential contaminant fate and transport pathways and aid in selecting sample locations during the supplemental phase of RI sampling.

6. Reference or upgradient/downgradient concentrations of DoD-related chemicals in related media will be evaluated against corresponding reference or upgradient/downgradient analytical data collected during the preliminary and supplemental phases of RI sampling.

7. **IF** concentrations of DoD-related chemicals in surface soil, subsurface soil, groundwater surface water, or sediment within or attributable to the AOCs 2, 3, or FI are greater than reference or upgradient media concentrations at levels of statistical significance (e.g., p-value less than 0.05), **THEN** those DoD-related chemicals will be evaluated as source area contaminants.

8. **IF** concentrations of DoD-related chemicals in surface soil, subsurface soil, groundwater surface water, sediment, or soil gas within or attributable to the AOCs 2, 3, or FI are

greater than project PSLs, **THEN** analytical data collected during the preliminary and supplemental phases of RI sampling will be used to evaluate excess risk to human and ecological receptors in a HHRA and SLERA, respectively.

9. **IF** the assessment of analytical data completeness from the preliminary phase of RI sampling indicates critical data gaps which must be addressed to complete adequate characterization of the nature and extent of contamination and the necessary risk assessments, **THEN** additional data gap sampling including the collection of random and/or biased samples will be performed during a supplemental phase of RI sampling and an addendum to QAPP Worksheets #11, #17, and #18 will be prepared to address DQOs and sampling design for additional samples.

10. **IF** excess risk to human and/or ecological receptors is determined to require mitigation, **THEN** a Feasibility Study will be performed to evaluate remedial options.

Step 6: Specify Performance or Acceptance Criteria

The nature of field investigations lends itself to uncertainties, and because data are being collected on a judgmental basis, limits on decision errors cannot be quantified. However, potential errors that may be encountered in the field can be mitigated through the use of established sampling procedures.

One type of decision error, referred to as a false negative error, may arise if sampling or analyses fail to detect contamination that is present at levels of concern. This type of error would result in incorrectly concluding that soil, sediment, surface water, groundwater, or soil gas contamination does not exist at levels in excess of those that are protective of human or ecological receptors in each medium (i.e., screening criteria). This type of error will be reduced by developing a judgmental sampling design that includes samples being collected in the area(s) where contamination is most likely to exist as well as areas upgradient and representative of background/reference to discern Site-impacts from background conditions. The background/reference data means will be compared to sampling unit (SU) data means at the Site using statistical hypothesis tests described in Section 3.1.4 of Appendix A. Additionally, sample data from each location will be compared to existing data from previous sampling locations to check the results for consistency.

Incorrectly concluding that contamination is present at levels above the PSLs, when in fact it is not, is another type of potential decision error. This type of error may result if analytical results of soil or groundwater samples overestimate actual contaminant concentrations, if samples are cross-contaminated, or if contaminants are misidentified. To minimize the potential for this type of error, appropriate sampling and analytical methods (including thorough decontamination procedures, sampling lesser contaminated wells first, etc.) will be employed, and all laboratory data will undergo third-party validation to identify any problems that could lead to this type of decision error.

See Worksheet #36 for data validation procedures. Data that is validated and non-qualified will be considered acceptable for use in risk assessment. Qualified data will be handled in the risk

assessment according to the procedures in the Human Health Risk Assessment and Screening Level Ecological Risk Assessment Work Plan provided as Appendix A.

Project Screening Levels

PSLs are identified in Worksheet #15. Regulatory guidance documents followed to derive PSLs are shown below by media for human health and ecological PSLs. The selected human health and ecological PSLs in Worksheet #15 were based on the lowest values between the available human health and ecological benchmarks.

Human health risk-based benchmarks were obtained from the USEPA Residential Regional Screening Levels (RSLs) for soil and groundwater based on the lower value derived using a target cancer risk of $1x10^{-6}$ or a hazard quotient of 0.1. For ecological receptors, most values were USEPA Region 4 Ecological Screening Values (ESVs) obtained from their 2018 ecological risk guidance, cited in the table below. For VOCs in particular, this source contains screening values derived from toxicity estimates updated by USEPA's Great Lakes Water Quality Initiative program in 2013, and these estimates reflect the most current science on these constituents. Other sources cited by Region 4 are well-established and widely accepted in ecological risk assessment, so are appropriate values for the planned study. EPA Region 2 does not provide ecological screening values and Region 3 screening values were not selected because the values were compiled in 2006 and many have since been replaced by more recent values included in the 2018 Region 4 document. When multiple sources provided screening values, the lowest screening value among all sources was chosen as the PSL, an approach consistent with the conservative nature of a screening level evaluation.

Soil – Human Health

- USEPA RSLs for Resident Soil (USEPA; 2021a)

Soil – Ecological – benchmarks were identified according to the following hierarchy of sources:

- USEPA Interim Ecological Soil Screening Level (SSL) documents (USEPA, 2003 through 2008).
- USEPA Region 4 Ecological Risk Assessment Supplemental Guidance Soil Screening Values for Hazardous Waste Sites (March 2018, USEPA, 2018)
- Los Alamos National Laboratory ECORISK Database Ecological Screening Levels (LANL, 2020).

Sediment – Human Health

- USEPA RSLs for Resident Soil (USEPA; 2021a)

Sediment – Ecological- benchmarks were identified according to the following hierarchy of sources:

• USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018). • USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
Surface Water – Human Health • USEPA RSLs for Resident Tapwater (USEPA, 2021a). Surface Water – Ecological • USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020b). • USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
Groundwater – Human Health • USEPA RSLs for Resident Tapwater (USEPA, 2021a). Groundwater – Ecological • Not applicable - There are no groundwater specific ecological PSLs because there is not a complete groundwater exposure route for ecological receptors at this time. If groundwater discharges to surface water, it is screened as surface water.
Soil Gas – Human Health • USEPA Vapor Intrusion Screening Level Calculator – Target Sub-Slab and Near-source Soil Gas Concentration (TCR=1E-06 or THQ=0.1, Residential) Csg,Target (µg/m3) (USEPA, 2021) • United States Code of Federal Regulations (CFR) 40 § 258.23 (a) (2) "Concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary." (Methane LEL is 5%)

In the instances when the method for a specific matrix and analyte as shown in WS#15 is not sensitive enough to meet one or more of the associated PSLs, each analyte will be evaluated. When reasonable, the DQOs will be achieved by adjusting the exceeded PSL to be the limit of quantitation. This will be noted and discussed in the uncertainty analysis of the risk assessment. For significant analytes, additional evaluation or further investigation of specific analytes as a data gap may be proposed during the supplemental phase of RI sampling to meet the DQOs.

Target Action Levels

The risk target action levels for the project that would prompt the evaluation of remedial alternatives are $1x10^{-4}$ excess lifetime cancer risk for human receptors and a Hazard Index [HI] of 1 or greater for human and ecological receptors. The cancer risk target action level corresponds with the upper range of USEPA's generally acceptable risk range of 10^{-6} to 10^{-4} as discussed in the National Contingency Plan (NCP), 40 CFR 300.430., and the non-cancer HI target action level is the value that under which site action is generally not warranted (USEPA, 2020a).

Step 7: Develop the Detailed Plan for Obtaining Data

The purpose of this final step is to define the sampling and analysis program for data collection based on the knowledge gained in the previous six project quality objective steps. The initial design of the RI includes a phased sampling approach as outlined below:

- Preliminary RI Sampling - focus on characterizing the nature and spatial extent of contamination (not extent of risk) within the AOCs by collecting random and biased samples, and include sampling at a reference area for soil, and upgradient and downgradient locations for groundwater, surface water, and sediment to allow for an assessment of potential background/anthropogenic sources and impacts from historical DoD operations. Data collected during the preliminary phase of RI sampling will be evaluated to identify data gaps that exist that do not allow adequate characterization of the nature and extent of contamination and/or completion of the HHRA and SLERA.
- Supplemental RI Sampling - if data gaps exist following the preliminary phase of RI sampling, additional data will be collected during a supplemental phase of sampling from areas and matrices that it is determined to be necessary to adequately characterize the nature and extent of contamination, and complete the HHRA and SLERA.

A summary of the judgmental sampling design to obtaining data is contained in Worksheets #17 and #18. Worksheets #19 through #22 provide additional field activity specifications. Worksheets #23 through #28 detail specific laboratory analytical method requirements.

RI activities to obtain data will include a site reconnaissance, wetlands delineation survey, geophysical survey, well gauging and groundwater sampling, surface water and sediment sampling, surface soil sampling, subsurface soil sampling through advancement of soil borings, and soil gas sampling.

FUDSChem

Prior to field sampling, an electronic representation of this UFP-QAPP (eQAPP) will be created within the Formerly Used Defense Sites Chemical (FUDSChem) database. The eQAPP will be fully compliant with the project UFP-QAPP, incorporating methods, sample types, and quality specifications (limit of quantitation [LOQ], holding time, QC Sample acceptance limits, etc.). The pre-population of sampling event information (location information, sample type, matrix,

methods, etc.) will also be performed to ensure accurate database field matching and status tracking within FUDSChem.

The analytical laboratory will generate Level 4 portable document format (PDF) reports to be uploaded to the FUDSChem library and will upload the Staged Electronic Data Deliverable (SEDD) Stage 2a into FUDSChem for review against the approved eQAPP. Analytical data will be validated using the Automated Data Review (ADR) functions within FUDSChem. Following the ADR run, the data validator will review the FUDSChem ADR output and first reviewer's checklist against the laboratory report and supplement the FUDSChem ADR with a manual review, as necessary. A second data validation reviewer will perform the second review of the files to verify the project data quality requirements defined by the eQAPP and this UFP-QAPP have been satisfied. A data review report summarizing the findings from the data validation will be generated and uploaded it to the FUDSChem library.

Analytical data will be managed in FUDSChem per the requirements specified in the New England District Data Management Plan, to ensure data deliverables follow Performance Work Statement data requirements. Other types of data, which may be uploaded to FUDSChem include: spatial information pertaining to sample locations (northing, easting, and elevation), hydrogeological information and physical parameters (pH, temperature, conductivity, and turbidity for groundwater samples), and monitoring well information (such as screen intervals, depth to water, and well construction data).

QAPP WORKSHEET #12 TABLE INDEX

QAPP Worksheet #12-1 – Measurement Performance Criteria Table for Water

- Volatile Organic Compounds – Groundwater and Surface Water (USEPA Method 8260C; 8260C SIM)
- Semi-Volatile Organic Compounds – Groundwater and Surface Water (USEPA Method 8270D; 8270D SIM)
- Organochlorine Pesticides – Groundwater and Surface Water (USEPA Method 8081B)
- Polychlorinated Biphenyls – Groundwater and Surface Water (USEPA Method 8082A)
- Metals (Total & Dissolved) – Groundwater and Surface Water (USEPA Method 6020B)
- Mercury (Total & Dissolved) – Groundwater and Surface Water (USEPA Method 7470A)
- Explosive Compounds – Groundwater and Surface Water (USEPA Method 8330B)
- Hardness – Groundwater (Calculation using SM 2340B)
- Alkalinity – Groundwater and Surface Water (SM 2320B)
- Sulfide – Groundwater and Surface Water (Sulfide (SM 4500 S2D)
- Anions (Chloride/Sulfate) – Groundwater and Surface Water (USEPA Method 9056A)
- Dissolved Organic Carbon – Surface Water (SM 5310C)
- PFAS – Groundwater IDW (USEPA LC/MS/MS in accordance with QSM, Table B-15)

QAPP Worksheet #12-2 – Measurement Performance Criteria Table for Soil/Sediment

- Volatile Organic Compounds – Soil and Sediment (USEPA Method 8260C)
- Semi-Volatile Organic Compounds – Soil and Sediment (USEPA Method 8270D; 8270D SIM)
- Organochlorine Pesticides – Soil and Sediment (USEPA Method 8081B)
- Polychlorinated Biphenyls – Soil and Sediment (USEPA Method 8082A)
- Metals – Soil and Sediment (USEPA Method 6020B)
- Mercury – Soil and Sediment (USEPA Method 7471B)
- Explosive Compounds – Soil and Sediment (USEPA Method 8330B)
- Dioxins – Soil (USEPA Method 8290A)

- Grain Size Distribution – Soil and Sediment (ASTM D422)
- Total Organic Carbon – Soil and Sediment (USEPA Method 9060A)
- Cation Exchange Capacity – Soil and Sediment (USEPA Method 9081)
- Oxidation-Reduction Potential – Soil and Sediment (ASTM D1498)
- pH – Soil and Sediment (USEPA Method 9045D)
- Moisture Content – Soil and Sediment (SM 2540G)
- PFAS – Soil IDW (USEPA LC/MS/MS in accordance with QSM, Table B-15)

QAPP Worksheet #12-3 – Measurement Performance Criteria Table for Soil Gas

- Volatile Organic Compounds – Soil Gas (USEPA Method TO-15)
- Methane and Helium – Soil Gas (ASTM D1946)

Appendix M provides a detailed listing of all analytical project limits and measurement performance criteria for analyses that are to be performed on samples collected during the preliminary phase of sampling for the RI.

QAPP Worksheet #12: Measurement Performance Criteria

(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

QAPP Worksheet #12-1: Measurement Performance Criteria Table – Water

12-1.1 VOCs

Matrix	Groundwater and Surface Water
Analytical Group	VOCs (8260C/8260D SIM)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy / Bias / Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy / Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy / Field Contamination	Field (Equipment) Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Accuracy / Transport Contamination	Trip Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection “Completeness”
Bias / Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
MDL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
VOC = Volatile Organic Compound

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.2 SVOCs

Matrix	Groundwater and Surface Water
Analytical Group	SVOCs (8270D/8270D SIM)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Field Contamination	Field (Equipment) Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SIM = Selective Ion Monitoring
SVOC = Semi-Volatile Organic Compound

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.3 Organochloride Pesticides

Matrix	Groundwater and Surface Water
Analytical Group	Organochloride Pesticides (8081B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3.
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Field Contamination	Field (Equipment) Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.4 PCBs

Matrix	Groundwater and Surface Water
Analytical Group	PCBs (8082A)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3.
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Field Contamination	Field (Equipment) Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
PCB = Polychlorinated Biphenyl
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.5 TAL Metals

Matrix	Groundwater and Surface Water
Analytical Group	TAL Metals (Excluding Mercury) (6020B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Lab Duplicate	RPD ≤20%
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Field Contamination	Field (Equipment) Blank	No analytes detected ≥ 1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RL = Reporting Limit
RPD = Relative Percent Difference
TAL = Target Analyte List

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.6 Mercury

Matrix	Groundwater and Surface Water
Analytical Group	Mercury (7470A)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥ 1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Lab Duplicate	RPD ≤20%
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Field Contamination	Field (Equipment) Blank	No analytes detected ≥ 1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RL = Reporting Limit
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.7 Explosive Compounds

Matrix	Groundwater and Surface Water
Analytical Group	Explosive Compounds (8330B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥ 1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Field Contamination	Field (Equipment) Blank	No analytes detected ≥ 1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Accuracy/Transport Contamination	Trip Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.8 Hardness

Matrix	Groundwater
Analytical Group	Hardness (SM 2340B)
Concentration Level	Not Applicable

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Hardness by SM 2340B is determined by calculation using Ca and Mg data by ICP/MS from Method 6020B. Therefore, MPC criteria for Method 6020B listed in Worksheet #12-1.5 will be applied prior to the calculations of hardness.		

Legend:
QC = Quality Control

12-1.9 Alkalinity

Matrix	Groundwater and Surface Water
Analytical Group	Alkalinity (SM 2320B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias	Laboratory Control Spike/Matrix Spike	Laboratory statistical limits (see Appendix M).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥LOQ or ≥1/10 the amount measured in any sample
Precision	Lab Duplicate	RPD ≤ 10%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
RPD = Relative Percent Difference
SM = Standard Method

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.10 Sulfide

Matrix	Groundwater and Surface Water
Analytical Group	Sulfide (SM 4500 S2D)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Laboratory statistical limits (see Appendix M).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample
Precision	Lab Duplicate	RPD ≤ 29%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
RPD = Relative Percent Difference
SM = Standard Method

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.11 Anions

Matrix	Groundwater and Surface Water
Analytical Group	Anions (Chloride, Sulfate; 9056A)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias	Laboratory Control Spike/Matrix Spike	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blanks	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample
Precision	Lab Duplicate	RPD ≤ 4.0% for chloride and RPD ≤ 4.1% for sulfate
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheets #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.12 Dissolved Organic Carbon

Matrix	Surface Water
Analytical Group	Dissolved Organic Carbon (SM 5310C)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias	Laboratory Control Spike/Matrix Spike	Laboratory statistical limits (see Appendix M)
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥MDL or ≥1/10 the amount measured in any sample
Precision	Lab Duplicate	RPD ≤ 10%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheets #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
RPD = Relative Percent Difference
SM = Standard Method

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-1.13 PFAS

Matrix	Groundwater IDW
Analytical Group	PFAS (LC/MS/MS in accordance with QSM, Table B-15)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Isotope Extracted Labeled Standards	Recovery limits per QSM 5.4. Laboratory statistical limits for compounds not in the QSM 5.4 (see Appendix M for laboratory statistical limits).
Accuracy / Bias / Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.4. Laboratory statistical limits for compounds not in the QSM 5.4 (see Appendix M for laboratory statistical limits).
Accuracy / Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias / Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
MDL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
PFAS = Per- and Polyfluoroalkyl Substances
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

QAPP Worksheet #12-2: Measurement Performance Criteria Table – Soil/Sediment

12-2.1 VOCs

Matrix	Soil and Sediment
Analytical Group	VOCs (8260C)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy / Field Contamination	Field (Equipment) Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Accuracy/Transport Contamination	Trip Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Completeness	Reported Sample Data	See Worksheet #37, Subsection “Completeness”
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.2 SVOCs

Matrix	Soil and Sediment
Analytical Group	SVOCs (8270D / 8270D SIM)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SIM = Selective Ion Monitoring
SVOC = Semi-Volatile Organic Compound

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.3 Organochloride Pesticides

Matrix: Soil and Sediment
Analytical Group: Organochloride Pesticides (8081B)
Concentration Level: Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3.
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.4 PCBs

Matrix	Soil and Sediment
Analytical Group	PCBs (8082A)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3.
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
PCB = Polychlorinated Biphenyl
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.5 TAL Metals

Matrix	Soil and Sediment
Analytical Group	TAL Metals (Excluding Mercury) (6020B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Lab Duplicate	RPD ≤20%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
TAL = Target Analyte List

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.6 Mercury

Matrix	Soil and Sediment
Analytical Group	Mercury (7471B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Lab Duplicate	RPD ≤20%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.7 Explosive Compounds

Matrix	Soil and Sediment
Analytical Group	Explosive Compounds (8330B)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Surrogate Spike	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.3.
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.8 Dioxins

Matrix Soil
Analytical Group Dioxins (8290A)
Concentration Level Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Labeled compounds	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	On-going Precision Recovery (OPR) Sample	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Bias/Precision	Matrix Spike/Matrix Spike Duplicate, if required by project	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.9 Grain Size Distribution

Matrix	Soil and Sediment
Analytical Group	Grain Size Distribution (ASTM D422)
Concentration Level	Not Applicable

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Precision	Lab Duplicate	Laboratory statistical limits (see Appendix M).
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"

Legend:
ASTM = American Society for Testing and Materials
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.10 Total Organic Carbon

Matrix	Soil and Sediment
Analytical Group	Total Organic Carbon (9060A)
Concentration Level	Not Applicable

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias	Laboratory Control Spike/Matrix Spike	Laboratory statistical limits (see Appendix M).
Accuracy/Laboratory Contamination	Method Blank	No analytes detected ≥LOQ or ≥1/10 the amount measured in any sample, whichever is greater
Precision	Lab Duplicate	RPD ≤ 20%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	DLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.11 Cation Exchange Capacity

Matrix	Soil and Sediment
Analytical Group	Cation Exchange Capacity (9081)
Concentration Level	Not Applicable

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Precision	Field Duplicate	RPD ≤ 30%[1]
Accuracy/Laboratory Contamination	Method Blank	<LOQ
Accuracy/Bias/Precision	LCS / LCSD	80-120% Recovery. 20% RPD
Accuracy/Bias/Precision	MS / MSD	75-125% Recovery. 20% RPD
Sensitivity	DLs, LODs, and LOQs	See Worksheet #15

Legend:
DL = Detection Limit
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Level of Quantification
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.12 Oxidation-Reduction Potential

Matrix	Soil and Sediment
Analytical Group	Oxidation-Reduction Potential (ASTM D1498)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias	Laboratory Control Spike/Laboratory Control Spike Duplicate	98-102% Recovery. 20% RPD
Precision	Lab Duplicate	5% RPD
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"

Legend:
ASTM = American Society for Testing and Materials
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.13 pH

Matrix	Soil and Sediment
Analytical Group	pH (9045D)
Concentration Level	Not Applicable

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Precision	Laboratory Duplicates	4% RPD
Precision	Field Duplicate	±0.5 pH units
Accuracy/Bias	LCS	95-105%
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Completeness	Reported Sample Data	See Worksheet #37, Subsection “Completeness”

Legend:
QC = Quality Control
LCS = Laboratory Control Sample
RPD = Relative Percent Difference

12-2.14 Moisture Content

Matrix	Soil and Sediment
Analytical Group	Moisture Content (SM2540/G-1997)
Concentration Level	Not Applicable

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias	LCS	Laboratory statistical limits (see Appendix M).
Precision	Lab Duplicate	RPD ≤ 5%
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19

Legend:
DL = Detection Limit
LCS = Laboratory Control Sample
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-2.15 PFAS

Matrix	Soil IDW
Analytical Group	PFAS (LC/MS/MS in accordance with QSM, Table B-15)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy	Isotope Extracted Labeled Standards	Recovery limits per QSM 5.4. Laboratory statistical limits for compounds not in the QSM 5.4 (see Appendix M for laboratory statistical limits).
Accuracy / Bias / Precision	Laboratory Control Spike/Matrix Spike and their Duplicates	Recovery limits per QSM 5.4. Laboratory statistical limits for compounds not in the QSM 5.4 (see Appendix M for laboratory statistical limits).
Accuracy / Laboratory Contamination	Method Blank	No analytes detected ≥ 1/2 LOQ or ≥1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias / Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	MDLs, LODs, and LOQs	See Worksheet #15

Legend:
MDL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
PFAS = Per- and Polyfluoroalkyl Substances
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

QAPP Worksheet #12-3: Measurement Performance Criteria Table – Soil Gas

12-3.1 VOCs

Matrix	Soil Gas
Analytical Group	VOCs (TO-15)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike/Laboratory Control Spike Duplicates	Recovery limits and RPDs per QSM 5.3 published limits Table C-43; RPD <30%
Accuracy/Laboratory Contamination	Method Blank	No analytes detected >1/2 laboratory LOQ; Common lab contaminants must not be detected > LOQ.
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias/Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	DLs, LODs, and LOQs	See Worksheets #15

Legend:
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
VOC = Volatile Organic Compound

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

12-3.2 Methane and Helium

Matrix	Soil Gas
Analytical Group	Fixed Gases – Methane and Helium (ASTM D1946)
Concentration Level	Low

Data Quality Indicator	QC Sample and / or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias/Precision	Laboratory Control Spike and Duplicates	85-115% Recovery, RPD <30%, Initial and Closing CCV - see Worksheet #24
Accuracy/Laboratory Contamination	Method Blank	No targets >1/2 laboratory LOQ except for common lab contaminants which are <LOQ.
Precision	Field Duplicate	RPD ≤ 30%[1]
Completeness	Reported Sample Data	See Worksheet #37, Subsection "Completeness"
Bias / Holding Time	Reported Sample Data	See Worksheet #19
Sensitivity	DLs, LODs, and LOQs	See Worksheets #15

Legend:
ASTM = American Society for Testing and Materials
CCV = Continuing Calibration Verification
DL = Detection Limit
LOD = Limit of Detection
LOQ = Level of Quantification
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference

1. The RPD will be used to evaluate field duplicate precision if one or both results is above the LOQ. If one or both results are less than the LOQ, then precision will be evaluated by the difference in concentrations being less than 2 times the LOQ.

QAPP Worksheet #13: Secondary Data Criteria and Limitations

(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

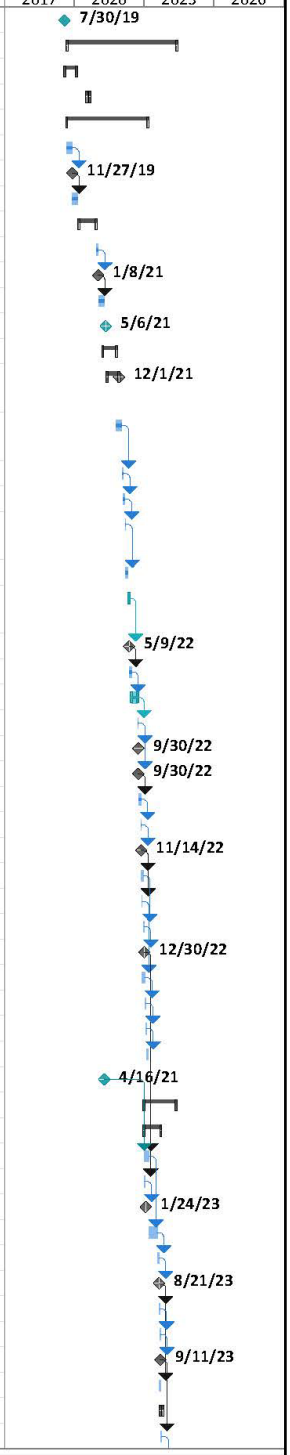
Secondary Data	Source	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Historical sampling data from past environmental investigations (see Worksheet #10)	Numerous Reports as listed in Worksheet #1, Point 4.	Historical subsurface soil, groundwater, surface water, sediment, and soil gas analytical data will be used to guide selection of RI sampling locations.	Data is in hard copy format. Data is outdated.
Historical boring logs and well completion diagrams from past environmental investigations (see Worksheet #10)	Numerous Reports as listed in Worksheet #1, Point 4.	Historical boring logs and well completion diagrams will aid in understanding site geology and knowing the depth at which to set the pump for groundwater sampling at existing wells.	Data is in hard copy format. Data has been collected by multiple contractors and geologists over time, increasing the potential for variability in how various types of geology are characterized and represented in historical documents.
Topography	USGS 2014, LIDAR 3-County data set.	Delineate drainage areas	No known limitations
Historical Aerial Photographs	United States Army Geospatial Center, 2019. Historical Environmental Photographic Analysis, FUDS DERP C02NY070401, Stewart AFB, NY, Final Draft Report, September.	Historical aerial photographs of Site inform CSM development and RI sampling location selection as well as provide background information.	Age of photos results in grainy imagery. The photos represent only a snapshot in time and do not capture all past site activity.

QAPP Worksheet #14/16: Project Tasks and Schedule

(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

Contract No. W912WJ-19-D-0006, Delivery Order No. W912WJ-19-F-0135
Former Stewart Air Force Base, Newburgh and New Windsor, New York

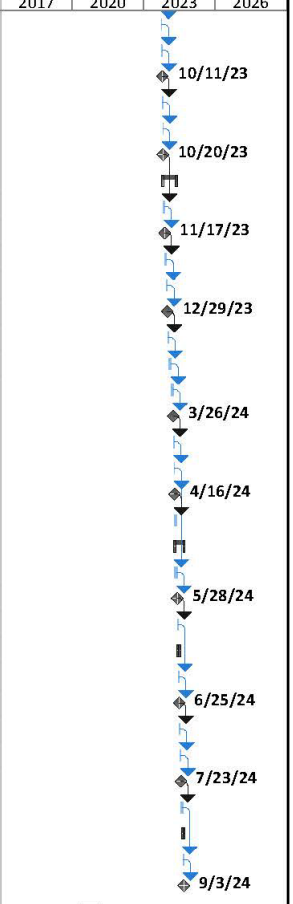
ID	Task Name	Duration	Start	Finish
1	Award Date / Notice to Proceed	0 days	Tue 7/30/19	Tue 7/30/19
2	**Project and Financial Management**	**1233 days**	**Tue 9/10/19**	**Fri 5/31/24**
126	**Data Review, Data Gap Evaluation, and Coordination Meet**	**134 days**	**Tue 7/30/19**	**Fri 1/31/20**
149	**Modification 01**	**30 days**	**Fri 7/17/20**	**Thu 8/27/20**
154	**RI Work Plan (including UFP-QAPP and APP)**	**912 days**	**Mon 9/2/19**	**Tue 2/28/23**
155	Prepare Client Draft RI Work Plan	63 days	Mon 9/2/19	Wed 11/27/19
156	Submit Client Draft RI Work Plan	0 days	Wed 11/27/19	Wed 11/27/19
157	USACE Review of Client Draft RI Work Plan	57 days	Thu 11/28/19	Fri 2/14/20
158	**Revised Approach Following Site Visit**	**196 days**	**Tue 3/10/20**	**Tue 12/8/20**
192	Prepare PDT Draft RI Work Plan	23 days	Wed 12/9/20	Fri 1/8/21
193	Submit PDT Draft RI Work Plan	0 days	Fri 1/8/21	Fri 1/8/21
194	PDT Review of Draft RI Work Plan	68 days	Mon 1/11/21	Wed 4/14/21
195	Meeting with PDT to Discuss Comments on RI Work Plan	0 days	Thu 5/6/21	Thu 5/6/21
196	**Conduct Pre-Investigation Field Work**	**153 days**	**Wed 3/24/21**	**Fri 10/22/21**
207	**Modification 04 to Revise RI Work Plan to Include Former Incinerator**	**134 days**	**Thu 5/27/21**	**Wed 12/1/21**
212	Prepare Responses to PDT Comments and Revised Draft RI Work Plan	70 days	Mon 10/11/21	Fri 1/14/22
213	PDT Review of RTCs and Revised RI Workplan	16 days	Mon 1/17/22	Mon 2/7/22
214	Prepare Responses to PDT Backcheck Comments	19 days	Tue 2/8/22	Fri 3/4/22
215	PDT Review and Concurrence of Responses to Backcheck Comments	7 days	Mon 3/7/22	Tue 3/15/22
216	Prepare CX Draft RI Work Plan and RTCs	20 days	Wed 3/16/22	Tue 4/12/22
217	Additional PDT Backcheck Comment Resolution and Prepare CX Draft RI Work Plan	4 days	Wed 5/4/22	Mon 5/9/22
218	Submit CX Draft RI Work Plan	0 days	Mon 5/9/22	Mon 5/9/22
219	CX Review of ITR Draft RI Work Plan	25 days	Tue 5/10/22	Mon 6/13/22
220	Resolution of CX Comments	69 days	Tue 6/14/22	Fri 9/16/22
221	Prepare Draft RI Work Plan and RTCs	10 days	Mon 9/19/22	Fri 9/30/22
222	Submit Draft RI Work Plan	0 days	Fri 9/30/22	Fri 9/30/22
223	Submit Annual Revision/Update to APP/SSHP	0 days	Fri 9/30/22	Fri 9/30/22
224	PDT and CX Backcheck and Approval	28 days	Mon 10/3/22	Wed 11/9/22
225	Prepare Regulatory Draft RI Work Plan	3 days	Thu 11/10/22	Mon 11/14/22
226	Submit Regulatory Draft RI Work Plan	0 days	Mon 11/14/22	Mon 11/14/22
227	Regulatory Review of RI Work Plan	24 days	Tue 11/15/22	Fri 12/16/22
228	Meet with NYSDEC to Present RI Work Plan	1 day	Tue 11/29/22	Tue 11/29/22
229	Prepare Final RI Work Plan and RTCs	10 days	Mon 12/19/22	Fri 12/30/22
230	Submit Final RI Work Plan	0 days	Fri 12/30/22	Fri 12/30/22
231	Prepare eQAPP	35 days	Wed 11/30/22	Tue 1/17/23
232	eQAPP Approvals and Laboratory Acknowledgement	10 days	Wed 1/18/23	Tue 1/31/23
233	PDT Review and Approval of eQAPP	5 days	Wed 2/1/23	Tue 2/7/23
234	Complete FUDSChem Event Planning	15 days	Wed 2/8/23	Tue 2/28/23
235	Finalize Right of Entry (ROE)	0 days	Fri 4/16/21	Fri 4/16/21
236	**Execute RI Work Plan**	**357 days**	**Mon 1/2/23**	**Tue 5/14/24**
237	**RI Field Work - Preliminary Phase**	**186 days**	**Mon 1/2/23**	**Mon 9/18/23**
238	Prepare for RI Field Work	56 days	Mon 1/2/23	Mon 3/20/23
239	Prepare RI Public Notice	10 days	Mon 1/2/23	Fri 1/13/23
240	Publish RI Public Notice	0 days	Tue 1/24/23	Tue 1/24/23
241	Conduct RI Field Work	90 days	Tue 3/21/23	Mon 7/24/23
242	Prepare Field Report	20 days	Tue 7/25/23	Mon 8/21/23
243	Submit Draft Field Report	0 days	Mon 8/21/23	Mon 8/21/23
244	USACE Review	10 days	Tue 8/22/23	Mon 9/4/23
245	Prepare Final Field Report and RTCs	5 days	Tue 9/5/23	Mon 9/11/23
246	Submit Final Field Report	0 days	Mon 9/11/23	Mon 9/11/23
247	FUDSChem Uploads/Deliverables	20 days	Tue 8/22/23	Mon 9/18/23
248	**RI Project Team Meeting**	**29 days**	**Tue 9/12/23**	**Fri 10/20/23**
249	Prepare Agenda	15 days	Tue 9/12/23	Mon 10/2/23



Page 1

Contract No. W912WJ-19-D-0006, Delivery Order No. W912WJ-19-F-0135
Former Stewart Air Force Base, Newburgh and New Windsor, New York

ID	Task Name	Duration	Start	Finish
250	Attend Meeting	2 days	Tue 10/3/23	Wed 10/4/23
251	Prepare Meeting Summary	5 days	Thu 10/5/23	Wed 10/11/23
252	Submit Meeting Summary	0 days	Wed 10/11/23	Wed 10/11/23
253	USACE Review	5 days	Thu 10/12/23	Wed 10/18/23
254	Prepare Final Meeting Summary and RTCs	2 days	Thu 10/19/23	Fri 10/20/23
255	Submit Final Meeting Summary	0 days	Fri 10/20/23	Fri 10/20/23
256	**RI Field Work - Supplemental Phase to Fill Data Gaps**	**147 days**	**Mon 10/23/23**	**Tue 5/14/24**
257	Prepare QAPP Addendum	20 days	Mon 10/23/23	Fri 11/17/23
258	Submit Draft QAPP Addendum	0 days	Fri 11/17/23	Fri 11/17/23
259	PDT Review of QAPP Addendum	20 days	Mon 11/20/23	Fri 12/15/23
260	Prepare Final QAPP Addendum	10 days	Mon 12/18/23	Fri 12/29/23
261	Submit Final QAPP Addendum	0 days	Fri 12/29/23	Fri 12/29/23
262	Prepare for RI Field Work	10 days	Mon 1/1/24	Fri 1/12/24
263	Conduct RI Field Work	32 days	Mon 1/15/24	Tue 2/27/24
264	Prepare Field Report	20 days	Wed 2/28/24	Tue 3/26/24
265	Submit Draft Field Report	0 days	Tue 3/26/24	Tue 3/26/24
266	USACE Review	10 days	Wed 3/27/24	Tue 4/9/24
267	Prepare Final Field Report and RTCs	5 days	Wed 4/10/24	Tue 4/16/24
268	Submit Final Field Report	0 days	Tue 4/16/24	Tue 4/16/24
269	FUDSChem Uploads/Deliverables	20 days	Wed 4/17/24	Tue 5/14/24
270	**Remedial Investigation Report**	**105 days**	**Wed 4/17/24**	**Tue 9/10/24**
271	Prepare PDT Draft RI Report	30 days	Wed 4/17/24	Tue 5/28/24
272	Submit PDT Draft RI Report	0 days	Tue 5/28/24	Tue 5/28/24
273	USACE Review of PDT Draft RI Report	10 days	Wed 5/29/24	Tue 6/11/24
274	**Meeting No. 1**	**15 days**	**Wed 6/12/24**	**Tue 7/2/24**
282	Prepare CX Draft RI Report and RTCs	10 days	Wed 6/12/24	Tue 6/25/24
283	Submit CX Draft RI Report	0 days	Tue 6/25/24	Tue 6/25/24
284	CX Review of ITR Draft RI Report	10 days	Wed 6/26/24	Tue 7/9/24
285	Prepare Draft RI Report and RTCs	10 days	Wed 7/10/24	Tue 7/23/24
286	Submit Draft RI Report	0 days	Tue 7/23/24	Tue 7/23/24
287	Regulatory Review of RI Report	20 days	Wed 7/24/24	Tue 8/20/24
288	**Meeting No. 2**	**15 days**	**Wed 8/21/24**	**Tue 9/10/24**
296	Prepare Final RI Report and RTCs	10 days	Wed 8/21/24	Tue 9/3/24
297	Submit Final RI Report	0 days	Tue 9/3/24	Tue 9/3/24
298	**Public Involvement Plan (PIP)**	**230 days**	**Mon 4/6/20**	**Fri 2/19/21**
307	**Feasibility Study (FS) Report**	**110 days**	**Wed 9/4/24**	**Tue 2/4/25**
319	**Proposed Plan**	**122 days**	**Wed 2/5/25**	**Thu 7/24/25**
333	**Decision Document (DD)**	**110 days**	**Fri 7/11/25**	**Thu 12/11/25**
345	**Post-Contract Site Walk / Project Transition Meeting**	**29 days**	**Fri 12/12/25**	**Wed 1/21/26**



Page 2

QAPP Worksheet #15: Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

(UFP-QAPP Manual Section 2.8.1)
(EPA 2106-G-05 Section 2.2.6)

PSLs have been selected that are consistent with applicable regulatory guidance, and that can be achieved by the analytical methods (i.e., the level of quantitation [LOQ] and limit of detection [LOD] is lower than the selected PSL) to the maximum extent possible. Various regulatory guidance documents were used to derive human health and ecological PSLs for each type of media as described in detail in Worksheet #11. The selected PSLs in Worksheet #15 were based on the lowest values between human health and ecological benchmarks. The PSLs identified for each chemical class and media type are provided in Worksheets #15-1 through #15-23 as outlined in the index below.

Rows that are shaded in Worksheets #15-1 through #15-23 represent analytes where the human health or ecological benchmarks are less than the LOQ. LOQ exceedances of PSLs exist in the water, soil, sediment, and soil gas matrices to differing degrees across multiple chemical classes including VOCs, SVOCs, OCPs, PCBs, metals, explosives compounds, and dioxins. The largest number and greatest frequency of LOQ exceedances is in the water matrix in comparison to human health PSLs, with exceedances of individual analytes on the standard list of compounds of VOCs, SVOCs, OCPs, PCBs, metals, and explosives compounds ranging from a minimum of 33% to a maximum of 78%. For comparison, LOQ exceedances of ecological benchmarks in water in the same chemical classes ranged from a minimum of 2% to a maximum of 30%. Furthermore, LOQ exceedances of human health and ecological benchmarks in soil in the same chemical classes plus dioxins ranged from 0% to 17% and 6% and 33%, respectively. The primary driver for analyte LOQs in water exceeding applicable human health PSLs is that the PSLs are extremely low and based on the lower of the cancer and non-cancer RSL to the RSLs are calculated purely on risk without consideration of theoretical ceiling limits or detection limits. For example, in the case of PCBs where all of the individual Aroclors included on the standard list for USEPA Method 8082 exceed the applicable human health PSL, the LOQ for all Aroclors is 0.25 micrograms per liter (µg/L) whereas the human health PSLs range from 0.0047 to 0.14 µg/L with all but one PSL being at or below 0.044 µg/L. With PSLs that are so low, there is a higher likelihood that laboratory analytical methods will not be sensitive enough to achieve them in every instance.

The project team has taken steps to reduce LODs and LOQs to be below PSLs to the extent possible by selecting more sensitive analytical methods. For example, PAHs and 1,4-dioxane will be analyzed using selective ion monitoring (SIM) in addition to the standard USEPA Method 8270 for groundwater, surface water and sediment, and metals will be analyzed using the more sensitive USEPA Method 6020 as opposed to USEPA Method 6010. In addition, the project team evaluated historical detections and prioritized methods for lower detection

limits when the analyte was detected in the past and methods with lower detection limits were technically feasible. For example, due to past detections of 1,2-dichloroethane, trichloroethene and vinyl chloride in aqueous samples, groundwater/surface water samples will be analyzed using SIM for those three compounds to reduce the achievable LODs and LOQs as close as possible or below the PSLs. Appendix L presents a summary of the evaluation of historical detections for analytes that have LOQs greater than PSLs including tables that indicate the corresponding risk levels associated with the LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors). Even with more sensitive analytical methods being used there will be instances when PSLs are lower than the LOD and LOQ, which is common during comprehensive environmental investigations and results in a scenario that it cannot be determined with certainty if the chemical is present in the sample above or below the PSL. For example, dieldrin and 4,4-DDT were both detected numerous times in the past, however, there are no methods that allow for LODs and LOQs below the PSLs for those two analytes. In these instances when the method for a specific matrix and analyte as shown in Worksheet #15 is not sensitive enough to meet one or more of the associated PSLs, each analyte will be evaluated. When reasonable, the DQOs will be achieved by adjusting the exceeded PSL to be the LOQ. This will be noted and discussed in the uncertainty analysis of the risk assessments contained in the RI report. For significant analytes, additional evaluation or further investigation of specific analytes as a data gap may be proposed during the supplemental phase of RI sampling to meet the DQOs.

QAPP WORKSHEET #15 TABLE INDEX

QAPP Worksheet #15-1: Volatile Organic Compounds – Groundwater and Surface Water (USEPA Method 8260C; 8260C SIM)
QAPP Worksheet #15-2: Semi-Volatile Organic Compounds – Groundwater and Surface Water (USEPA Method 8270D; 8270D SIM)
QAPP Worksheet #15-3: Organochlorine Pesticides – Groundwater and Surface Water (USEPA Method 8081B)
QAPP Worksheet #15-4: Polychlorinated Biphenyls – Groundwater and Surface Water (USEPA Method 8082A)
QAPP Worksheet #15-5: Metals – Groundwater and Surface Water (USEPA Method 6020B; 7470A)
QAPP Worksheet #15-6: Explosive Compounds – Groundwater and Surface Water (USEPA Method 8330B)
QAPP Worksheet #15-7: Hardness – Groundwater (Calculation using SM 2340B)
QAPP Worksheet #15-8: Select Geochemistry Analytes – Surface Water (Various Methods)
QAPP Worksheet #15-9: Volatile Organic Compounds – Soil and Sediment (USEPA Method 8260C)
QAPP Worksheet #15-10A: Semi-Volatile Organic Compounds – Soil (USEPA Method 8270D)
QAPP Worksheet #15-10B: Semi-Volatile Organic Compounds – Sediment (USEPA Method 8270D; 8270D SIM)
QAPP Worksheet #15-11: Organochlorine Pesticides – Soil and Sediment (USEPA Method 8081B)
QAPP Worksheet #15-12: Polychlorinated Biphenyls – Soil and Sediment (USEPA Method 8082A)
QAPP Worksheet #15-13: Metals – Soil and Sediment (USEPA Method 6020B; 7471B)
QAPP Worksheet #15-14: Explosive Compounds – Soil and Sediment (USEPA Method 8330B)

QAPP Worksheet #15-15: Dioxins – Soil (USEPA Method 8290A)
QAPP Worksheet #15-16: Grain Size Distribution – Soil and Sediment (ASTM D422)
QAPP Worksheet #15-17: Total Organic Carbon – Soil and Sediment (USEPA Method 9060A)
QAPP Worksheet #15-18: Cation Exchange Capacity – Soil and Sediment (USEPA Method 9081)
QAPP Worksheet #15-19: Oxidation-Reduction Potential – Soil and Sediment (ASTM D1498)
QAPP Worksheet #15-20: pH – Soil and Sediment (USEPA Method 9045D)
QAPP Worksheet #15-21: Moisture Content – Soil and Sediment (SM 2540G)
QAPP Worksheet #15-22: Volatile Organic Compounds – Soil Gas (TO-15)
QAPP Worksheet #15-23: Methane and Helium – Soil Gas (ASTM D1946)
QAPP Worksheet #15-24: PFAS – Groundwater IDW (USEPA LC/MS/MS in accordance with QSM, Table B-15)
QAPP Worksheet #15-25: PFAS – Soil IDW (USEPA LC/MS/MS in accordance with QSM, Table B-15)

QAPP Worksheet #15-1 - VOCs (Water)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater; Surface Water
Analytical Group: VOCs (USEPA Method 8260C/8260D SIM)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[3] (µg/L)	PQL Goal Ecological[3] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
1,1,1-Trichloroethane	71-55-6	800	USEPA RSL[1,4,5]	76	USEPA ERASG[2]	267	25	1.0	0.6	0.3
1,1,2,2-Tetrachloroethane	79-34-5	0.076	USEPA RSL[1,4,5]	200	USEPA ERASG[2]	1.0	67	1.0	0.6	0.3
1,1,2-Trichloroethane	79-00-5	0.041	USEPA RSL[1,4,5]	730	USEPA ERASG[2]	1.0	243	1.0	0.6	0.3
1,1-Dichloroethane	75-34-3	2.8	USEPA RSL[1,4,5]	410	USEPA ERASG[2]	1.0	137	1.0	0.6	0.3
1,1-Dichloroethene	75-35-4	28	USEPA RSL[1,4,5]	130	USEPA ERASG[2]	9	43	1.0	0.6	0.3
1,2,4-Trichlorobenzene	120-82-1	0.4	USEPA RSL[1,4,5]	130	USEPA ERASG[2]	5	43	5.0	1.0	0.3
1,2-Dibromo-3-chloropropane	96-12-8	0.00033	USEPA RSL[1,4,5]	NE	-	5	25	5.0	1.0	0.3
1,2-Dibromoethane	106-93-4	0.0075	USEPA RSL[1,4,5]	NE	-	1.0	5	1.0	0.5	0.2
1,2-Dichlorobenzene	95-50-1	30	USEPA RSL[1,4,5]	23	USEPA ERASG[2]	10	8	5.0	0.5	0.2
1,2-Dichloroethane[6]	107-06-2	0.17	USEPA RSL[1,4,5]	2,000	USEPA ERASG[2]	0.2	667	0.2	0.05	0.016
1,2-Dichloropropane	78-87-5	0.82	USEPA RSL[1,4,5]	520	USEPA ERASG[2]	1.0	173	1.0	0.6	0.3
1,3-Dichlorobenzene	541-73-1	NE	-	22	USEPA ERASG[2]	25	7	5.0	1.4	0.68
1,4-Dichlorobenzene	106-46-7	0.48	USEPA RSL[1,4,5]	9.4	USEPA ERASG[2]	5	5	5.0	0.6	0.3
2-Butanone	78-93-3	560	USEPA RSL[1,4,5]	22,000	USEPA ERASG[2]	187	7,333	10.0	1.0	0.5
2-Hexanone	591-78-6	3.8	USEPA RSL[1,4,5]	99	USEPA ERASG[2]	10	33	10.0	1.7	0.85
4-Methyl-2-pentanone	108-10-1	630	USEPA RSL[1,4,5]	170	USEPA ERASG[2]	210	57	10.0	1.0	0.5
Acetone	67-64-1	1,400	USEPA RSL[1,4,5]	1,700	USEPA ERASG[2]	467	567	20.0	2.0	0.7
Benzene	71-43-2	0.46	USEPA RSL[1,4,5]	160	USEPA ERASG[2]	1.0	53	1.0	0.6	0.3
Bromodichloromethane	75-27-4	0.13	USEPA RSL[1,4,5]	340	USEPA ERASG[2]	1.0	113	1.0	0.5	0.2
Bromoform	75-25-2	3.3	USEPA RSL[1,4,5]	230	USEPA ERASG[2]	4	77	4.0	2.0	1.0
Bromomethane	74-83-9	0.75	USEPA RSL[1,4,5]	16	USEPA ERASG[2]	1.0	5	1.0	0.6	0.3
Carbon Disulfide	75-15-0	81	USEPA RSL[1,4,5]	15	USEPA ERASG[2]	27	5	5.0	0.6	0.3
Carbon Tetrachloride	56-23-5	0.46	USEPA RSL[1,4,5]	77	USEPA ERASG[2]	1.0	26	1.0	0.6	0.3
Chlorobenzene	108-90-7	7.8	USEPA RSL[1,4,5]	25	USEPA ERASG[2]	2.6	8	1.0	0.6	0.3
Chloroethane	75-00-3	2,100	USEPA RSL[1,4,5]	NE	-	700	5	1.0	0.5	0.2
Chloroform	67-66-3	0.22	USEPA RSL[1,4,5]	140	USEPA ERASG[2]	1.0	47	1.0	0.6	0.3
Chloromethane	74-87-3	19	USEPA RSL[1,4,5]	NE	-	6	10	2.0	1.1	0.55
cis-1,2-Dichloroethene	156-59-2	3.6	USEPA RSL[1,4,5]	620	USEPA ERASG[2]	1.0	306	1.0	0.6	0.3
cis-1,3-Dichloropropene	10061-01-5	NE	-	1.7	USEPA ERASG[2]	5	1.0	1.0	0.5	0.2
Cyclohexane	110-82-7	1,300	USEPA RSL[1,4,5]	158	USEPA ERASG[2]	433	53	5.0	2.0	1.0
Dibromochloromethane	124-48-1	0.87	USEPA RSL[1,4,5]	320	USEPA ERASG[2]	1.0	107	1.0	0.5	0.2
Dichlorodifluoromethane	75-71-8	20	USEPA RSL[1,4,5]	NE	-	7	5	1.0	0.5	0.2
Ethylbenzene	100-41-4	1.5	USEPA RSL[1,4,5]	61	USEPA ERASG[2]	1.0	20	1.0	0.8	0.4

QAPP Worksheet #15-1 - VOCs (Water)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[4] (µg/L)	PQL Goal Ecological[4] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Freon 113	76-13-1	1,000	USEPA RSL[1,4,5]	NE	-	333	50	10.0	0.6	0.3
Isopropylbenzene	98-82-8	45	USEPA RSL[1,4,5]	4.8	USEPA ERASG[2]	15	5.0	5.0	0.5	0.2
Methyl Acetate	79-20-9	2,000	USEPA RSL[1,4,5]	NE	-	667	25	5.0	0.6	0.3
Methyl Tertiary Butyl Ether	1634-04-4	14	USEPA RSL[1,4,5]	730	USEPA ERASG[2]	5	243	1.0	0.5	0.2
Methylcyclohexane	108-87-2	NE	-	52	USEPA ERASG[2]	25	17	5.0	1.0	0.5
Methylene Chloride	75-09-2	11	USEPA RSL[1,4,5]	1,500	USEPA ERASG[2]	4	500	1.0	0.6	0.3
Styrene	100-42-5	120	USEPA RSL[1,4,5]	32	USEPA ERASG[2]	40	11	5.0	0.6	0.3
Tetrachloroethene	127-18-4	4.1	USEPA RSL[1,4,5]	53	USEPA ERASG[2]	1.7	18	1.0	0.6	0.3
Toluene	108-88-3	110	USEPA RSL[1,4,5]	62	USEPA ERASG[2]	37	21	1.0	0.5	0.2
trans-1,2-Dichloroethene	156-60-5	6.8	USEPA RSL[1,4,5]	558	USEPA ERASG[2]	2.3	186	2.0	1.4	0.7
trans-1,3-Dichloropropene	10061-02-6	NE	-	NE	-	5	5	1.0	0.5	0.2
Trichloroethene[6]	79-01-6	0.28	USEPA RSL[1,4,5]	220	USEPA ERASG[2]	0.2	73	0.2	0.1	0.047
Trichlorofluoromethane	75-69-4	520	USEPA RSL[1,4,5]	NE	-	173	5	1.0	0.5	0.2
Vinyl Chloride[6]	75-01-4	0.019	USEPA RSL[1,4,5]	930	USEPA ERASG[2]	0.02	310	0.02	0.016	0.008
Xylenes (Total)	1330-20-7	19	USEPA RSL[1,4,5]	27	USEPA ERASG[2]	6	9	1.0	0.8	0.4

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
3. The PQLs listed are based on 1/3 of the screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
4. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
5. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.
6. Compound will be analyzed using USEPA Method 8260C SIM. All other compounds will be analyzed using USEPA Method 8260C.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
NRWQC = National Recommended Water Quality Criteria
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
µg/L = Micrograms per Liter
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency
NE = Not Established

QAPP Worksheet #15-2 - SVOCs (Water) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater; Surface Water
Analytical Group: SVOCs (USEPA Method 8270D/8270D SIM)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[5] (µg/L)	PQL Goal Ecological[5] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
1,1'-Biphenyl	92-52-4	0.083	USEPA RSL[1,6,7]	6.5	USEPA ERASG[2]	2.0	2.0	2.0	1.0	0.5
1,4-Dioxane[4]	123-91-1	0.46	USEPA RSL1,6,7	22,000	USEPA ERASG2	0.3	7,333	0.3	0.2	0.1
1-Methylnaphthalene[4]	90-12-0	1.1	USEPA RSL[1,6,7]	6.1	USEPA ERASG[2]	0.4	2.0	0.05	0.04	0.02
2,2'-oxybis(1-Chloropropane)	108-60-1	71	USEPA RSL[1,6,7]	NE	-	24	10	2.0	1.0	0.5
2,4,5-Trichlorophenol	95-95-4	120	USEPA RSL[1,6,7]	1.9	USEPA ERASG[2]	40	2.0	2.0	1.4	0.7
2,4,6-Trichlorophenol	88-06-2	1.2	USEPA RSL[1,6,7]	4.9	USEPA ERASG[2]	2.0	2.0	2.0	1.2	0.6
2,4-Dichlorophenol	120-83-2	4.6	USEPA RSL[1,6,7]	11	USEPA ERASG[2]	2.0	4	2.0	1.0	0.5
2,4-Dimethylphenol	105-67-9	36	USEPA RSL[1,6,7]	15	USEPA ERASG[2]	12	5	2.0	1.0	0.5
2,4-Dinitrophenol	51-28-5	3.9	USEPA RSL[1,6,7]	71	USEPA ERASG[2]	30.0	30.0	30.0	20.0	10.0
2,4-Dinitrotoluene	121-14-2	0.24	USEPA RSL[1,6,7]	44	USEPA ERASG[2]	5.0	15	5.0	2.0	1.0
2,6-Dinitrotoluene	606-20-2	0.049	USEPA RSL[1,6,7]	81	USEPA ERASG[2]	2.0	27	2.0	1.4	0.7
2-Chloronaphthalene	91-58-7	75	USEPA RSL[1,6,7]	NE	-	25	5	1.0	0.8	0.4
2-Chlorophenol	95-57-8	9.1	USEPA RSL[1,6,7]	18	USEPA ERASG[2]	3.0	6	2.0	1.0	0.5
2-Methylnaphthalene[4]	91-57-6	3.6	USEPA RSL[1,6,7]	4.7	USEPA ERASG[2]	1.2	1.6	0.5	0.2	0.1
2-Methylphenol	95-48-7	93	USEPA RSL[1,6,7]	67	USEPA ERASG[2]	31	22	2.0	1.4	0.7
2-Nitroaniline	88-74-4	19	USEPA RSL[1,6,7]	17	USEPA ERASG[2]	6	6	2.0	1.4	0.7
2-Nitrophenol	88-75-5	NE	-	73	USEPA ERASG[2]	10	24	2.0	1.4	0.7
3,3'-Dichlorobenzidine	91-94-1	0.13	USEPA RSL[1,6,7]	4.5	USEPA ERASG[2]	5.0	5.0	5.0	4.0	2.0
3-Nitroaniline	99-09-2	NE	-	NE	-	10	10	2.0	1.0	0.5
4,6-Dinitro-2-methylphenol	534-52-1	0.15	USEPA RSL[1,6,7]	NE	-	15.0	75	15.0	10.0	5.0
4-Bromophenyl-phenylether	101-55-3	NE	-	1.5	USEPA ERASG[2]	10	2.0	2.0	1.0	0.5
4-Chloro-3-methylphenol	59-50-7	140	USEPA RSL[1,6,7]	1	USEPA ERASG[2]	47	2.0	2.0	1.0	0.5
4-Chloroaniline	106-47-8	0.37	USEPA RSL[1,6,7]	0.8	USEPA ERASG[2]	5.0	5.0	5.0	4.0	2.0
4-Chlorophenyl-phenyl ether	7005-72-3	NE	-	NE	-	10	10	2.0	1.0	0.5
4-Methylphenol	106-44-5	NE	-	NE	-	10	10	2.0	1.0	0.5
4-Nitroaniline	100-01-6	3.8	USEPA RSL[1,6,7]	NE	-	2.0	10	2.0	1.2	0.6
4-Nitrophenol	100-02-7	NE	-	58	USEPA ERASG[2]	150	30.0	30.0	20.0	10.0
Acenaphthene[4]	83-32-9	53	USEPA RSL[1,6,7]	15	USEPA ERASG[2]	18	5	0.05	0.03	0.01
Acenaphthylene[4]	208-96-8	NE	-	13	USEPA ERASG[2]	0.25	4.	0.05	0.03	0.01
Acetophenone	98-86-2	190	USEPA RSL[1,6,7]	NE	-	63	10	2.0	1.0	0.5
Anthracene[4]	120-12-7	180	USEPA RSL[1,6,7]	0.02	USEPA ERASG[2]	60	0.05	0.05	0.03	0.01
Atrazine	1912-24-9	0.3	USEPA RSL[1,6,7]	0.03	USEPA ERASG[2]	5.0	5.0	5.0	4.0	2.0
Benzaldehyde	100-52-7	19	USEPA RSL[1,6,7]	143	USEPA ERASG[2]	6	48	5.0	2.0	1.0
Benzo(a)anthracene[4]	56-55-3	0.03	USEPA RSL[1,6,7]	4.7	USEPA ERASG[2]	0.05	1.6	0.05	0.03	0.01

QAPP Worksheet #15-2 – SVOCs (Water) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[5] (µg/L)	PQL Goal Ecological[5] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Benzo(a)pyrene[4]	50-32-8	0.025	USEPA RSL[1,6,7]	0.06	USEPA ERASG[2]	0.05	0.05	0.05	0.03	0.01
Benzo(b)fluoranthene[4]	205-99-2	0.25	USEPA RSL[1,6,7]	2.6	USEPA ERASG[2]	0.08	0.9	0.05	0.03	0.01
Benzo(g,h,i)perylene[4]	191-24-2	NE	-	0.012	USEPA ERASG[2]	0.25	0.05	0.05	0.03	0.01
Benzo(k)fluoranthene[4]	207-08-9	2.5	USEPA RSL[1,6,7]	0.06	USEPA ERASG[2]	0.8	0.05	0.05	0.03	0.01
bis(2-Chloroethoxy)methane	111-91-1	5.9	USEPA RSL[1,6,7]	NE	-	2.0	10	2.0	1.0	0.5
bis(2-Chloroethyl)ether	111-44-4	0.014	USEPA RSL[1,6,7]	NE	-	2.0	10	2.0	1.0	0.5
bis(2-Ethylhexyl)phthalate	117-81-7	5.6	USEPA RSL[1,6,7]	8	USEPA ERASG[2]	5.0	5.0	5.0	4.0	2.0
Butylbenzylphthalate	85-68-7	16	USEPA RSL[1,6,7]	23	USEPA ERASG[2]	5	8	5.0	4.0	2.0
Caprolactam	105-60-2	990	USEPA RSL[1,6,7]	NE	-	330	75	15.0	10.0	5.0
Carbazole	86-74-8	NE	-	4.0	USEPA ERASG[2]	10	2.0	2.0	1.0	0.5
Chrysene[4]	218-01-9	25	USEPA RSL[1,6,7]	4.7	USEPA ERASG[2]	8	2	0.05	0.03	0.01
Di-n-butylphthalate	84-74-2	90	USEPA RSL[1,6,7]	19	USEPA ERASG[2]	30	6	5.0	4.0	2.0
Di-n-octylphthalate	117-84-0	20	USEPA RSL[1,6,7]	215	USEPA ERASG[2]	7	72	5.0	4.0	2.0
Dibenz(a,h)anthracene[4]	53-70-3	0.025	USEPA RSL[1,6,7]	0.012	USEPA ERASG[2]	0.05	0.05	0.05	0.04	0.02
Dibenzofuran	132-64-9	0.79	USEPA RSL[1,6,7]	4.0	USEPA ERASG[2]	2.0	2.0	2.0	1.0	0.5
Diethylphthalate	84-66-2	1,500	USEPA RSL[1,6,7]	220	USEPA ERASG[2]	500	73	5.0	4.0	2.0
Dimethylphthalate	131-11-3	NE	-	1,100	USEPA ERASG[2]	25	367	5.0	4.0	2.0
Fluoranthene[4]	206-44-0	80	USEPA RSL[1,6,7]	0.8	USEPA ERASG[2]	27	0.3	0.05	0.03	0.01
Fluorene[4]	86-73-7	29	USEPA RSL[1,6,7]	19	USEPA ERASG[2]	10	6	0.05	0.03	0.01
Hexachlorobenzene	118-74-1	0.0098	USEPA RSL[1,6,7]	0.15	USEPA ERASG[2]	0.5	0.5	0.5	0.2	0.1
Hexachlorobutadiene	87-68-3	0.14	USEPA RSL[1,6,7]	1	USEPA ERASG[2]	2.0	2.0	2.0	1.2	0.6
Hexachlorocyclopentadiene	77-47-4	0.041	USEPA RSL[1,6,7]	0.45	USEPA ERASG[2]	15.0	15.0	15.0	10.0	5.0
Hexachloroethane	67-72-1	0.33	USEPA RSL[1,6,7]	12	USEPA ERASG[2]	5.0	4	5.0	2.0	1.0
Indeno(1,2,3-cd)pyrene[4]	193-39-5	0.25	USEPA RSL[1,6,7]	0.012	USEPA ERASG[2]	0.08	0.05	0.05	0.04	0.02
Isophorone	78-59-1	78	USEPA RSL[1,6,7]	920	USEPA ERASG[2]	26	307	2.0	1.0	0.5
N-Nitroso-di-n-propylamine	621-64-7	0.011	USEPA RSL[1,6,7]	NE	-	2.0	10	2.0	1.0	0.5
N-Nitrosodiphenylamine	86-30-6	12	USEPA RSL[1,6,7]	25	USEPA ERASG[2]	4	8	2.0	1.0	0.5
Naphthalene[4]	91-20-3	0.12	USEPA RSL[1,6,7]	21	USEPA ERASG[2]	0.07	7	0.07	0.06	0.03
Nitrobenzene	98-95-3	0.14	USEPA RSL[1,6,7]	230	USEPA ERASG[2]	2.0	77	2.0	1.6	0.5
Pentachlorophenol	87-86-5	0.041	USEPA RSL[1,6,7]	15	USEPA NRWQC[3]	5.0	5	5.0	2.0	1.0
Phenanthrene[4]	85-01-8	NE	-	2.3	USEPA ERASG[2]	0.35	0.8	0.07	0.06	0.03
Phenol	108-95-2	580	USEPA RSL[1,6,7]	160	USEPA ERASG[2]	193	53	2.0	1.0	0.5
Pyrene[4]	129-00-0	12	USEPA RSL[1,6,7]	4.6	USEPA ERASG[2]	4	1.5	0.05	0.03	0.01

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2021, USEPA, 2021a)
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
3. PSL based on the USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020b).
4 Compound will be analyzed using USEPA Method 8270D SIM. All other compounds will be analyzed using USEPA Method 8270D.

QAPP Worksheet #15-2 - SVOCs (Water) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[5] (µg/L)	PQL Goal Ecological[5] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)

5. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
6. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
7. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MCL=Maximum Contaminant Level
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established
NRWQC = National Recommended Water Quality Criteria
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level.
SIM = Selective Ion Monitoring
TBD = To be determined
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-3 - Organochloride Pesticides (Water)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater, Surface Water
Analytical Group: Organochlorine Pesticides (USEPA Method 8081B)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[4] (µg/L)	PQL Goal Ecological[4] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Aldrin	309-00-2	0.00092	USEPA RSL[1,5,6]	0.04	USEPA ERASG[2]	0.02	0.02	0.02	0.01	0.002
Alpha BHC	319-84-6	0.0072	USEPA RSL[1,5,6]	0.01	USEPA ERASG[2]	0.02	0.02	0.02	0.01	0.003
Alpha Chlordane	5103-71-9	0.36	USEPA RSL[1,5,6,7]	NE	-	0.12	0.10	0.02	0.01	0.003
Beta BHC	319-85-7	0.025	USEPA RSL[1,5,6]	NE	-	0.03	0.15	0.03	0.022	0.011
Delta BHC	319-86-8	NE	-	NE	-	0.10	0.10	0.02	0.01	0.003
Dieldrin	60-57-1	0.0018	USEPA RSL[1,5,6]	0.056	USEPA NRWQC[3]	0.03	0.03	0.03	0.02	0.005
Endosulfan I	959-98-8	NE	-	NE	-	0.10	0.10	0.02	0.01	0.004
Endosulfan II	33213-65-9	NE	-	NE	-	0.20	0.20	0.04	0.02	0.015
Endosulfan Sulfate	1031-07-8	11	USEPA RSL[1,5,6]	0.06	USEPA ERASG[2]	4	0.03	0.03	0.02	0.006
Endrin	72-20-8	0.23	USEPA RSL[1,5,6]	0.036	USEPA NRWQC[3]	0.08	0.03	0.03	0.02	0.008
Endrin Aldehyde	7421-93-4	NE	-	NE	-	0.5	0.5	0.1	0.06	0.02
Endrin Ketone	53494-70-5	NE	-	NE	-	0.15	0.15	0.03	0.02	0.005
Gamma BHC - Lindane	58-89-9	0.042	USEPA RSL[1,5,6]	0.11	USEPA ERASG[2]	0.02	0.04	0.02	0.01	0.002
Gamma Chlordane	5103-74-2	1.0	USEPA RSL[1,5,6,7]	NE	-	0.3	0.2	0.04	0.03	0.007
Heptachlor	76-44-8	0.0014	USEPA RSL[1,5,6]	0.0038	USEPA NRWQC[3]	0.02	0.02	0.02	0.01	0.002
Heptachlor Epoxide	1024-57-3	0.0014	USEPA RSL[1,5,6]	0.0038	USEPA NRWQC[3]	0.02	0.02	0.02	0.01	0.002
Methoxychlor	72-43-5	3.7	USEPA RSL[1,5,6]	0.03	USEPA NRWQC[3]	1.2	0.11	0.11	0.10	0.03
p,p'-DDD	72-54-8	0.0063	USEPA RSL[1,5,6]	0.01	USEPA ERASG[2]	0.03	0.03	0.03	0.02	0.005
p,p'-DDE	72-55-9	0.046	USEPA RSL[1,5,6]	0.3	USEPA ERASG[2]	0.03	0.1	0.03	0.02	0.005
p,p'-DDT	50-29-3	0.23	USEPA RSL[1,5,6]	0.001	USEPA NRWQC[3]	0.08	0.03	0.03	0.02	0.005
Toxaphene	8001-35-2	0.071	USEPA RSL[1,5,6]	0.0002	USEPA NRWQC[3]	1.0	1.0	1.0	0.6	0.3

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
3. PSL based on the USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020b).
4. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
5. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
6. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.
7. Exact compound not available; surrogates used. Chlordane used for Alpha Chlordane and Gamma Chlordane. Endosulfan used for Endosulfan I and Endosulfan II, Endrin used for Endrin Aldehyde and Endrin Ketone.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established
NRWQC = National Recommended Water Quality Criteria
PSL = Project Screening Limit

QAPP Worksheet #15-3 - Organochloride Pesticides (Water)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[4] (µg/L)	PQL Goal Ecological[4] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)

PQL = Project Quantitation Limit
RSL = Regional Screening Level.
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-4 - PCBs (Water) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater; Surface Water
Analytical Group: PCBs (USEPA Method 8082A)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[4] (µg/L)	PQL Goal Ecological[4] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
PCB-1016	12674-11-2	0.14	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.1
PCB-1221	11104-28-2	0.0047	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.1
PCB-1232	11141-16-5	0.0047	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.1
PCB-1242	53469-21-9	0.0078	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.1
PCB-1248	12672-29-6	0.0078	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.1
PCB-1254	11097-69-1	0.0078	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.078
PCB-1260	11096-82-5	0.0078	USEPA RSL[1,5,6]	NE	-	0.25	1.25	0.25	0.2	0.078
Total PCBs	1336-36-3	0.044	USEPA RSL[1,5,6]	0.014	USEPA ERASG[2] / USEPA NRWQC[3]	0.25	1.25	0.25	0.2	0.1

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2021, USEPA, 2021a)
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
3. PSL based on the USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020b).
4. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania, with the exception of Cation Exchange Capacity, which will be analyzed by Eurofins Calscience in Garden Grove, California.
5. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
6. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
LOD = Limit of Detection
LOQ = Level of Quantitation
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established
NRWQC = National Recommended Water Quality Criteria
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-5 - TAL Metals (Water) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater; Surface Water
Analytical Group: Metals (USEPA Methods 6020B/7470A)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[4] (µg/L)	PQL Goal Ecological[4] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Aluminum	7429-90-5	2,000	USEPA RSL[1,5,6]	87	USEPA ERASG[2]	667	30.0	30.0	24.0	12.0
Antimony	7440-36-0	0.78	USEPA RSL[1,5,6]	190	USEPA ERASG[2]	1.0	63	1.0	0.5	0.20
Arsenic	7440-38-2	0.052	USEPA RSL[1,5,6]	150	USEPA NRWQC[3]	2.0	50	2.0	1.7	0.68
Barium	7440-39-3	380	USEPA RSL[1,5,6]	220	USEPA ERASG[2]	127	73	2.0	1.6	0.74
Beryllium	7440-41-7	2.5	USEPA RSL[1,5,6]	11	USEPA ERASG[2]	0.8	4	0.5	0.30	0.11
Cadmium	7440-43-9	0.92	USEPA RSL[1,5,6]	0.72	USEPA NRWQC[3]	0.5	0.5	0.5	0.4	0.15
Calcium	7440-70-2	NE	-	116,000	USEPA ERASG[2]	600	38,667	120	100	50.0
Chromium	7440-47-3	NE	-	74	USEPA NRWQC[3]	10	25	2.0	0.8	0.33
Cobalt	7440-48-4	0.6	USEPA RSL[1,5,6]	19	USEPA ERASG[2]	0.5	6	0.5	0.4	0.15
Copper	7440-50-8	80	USEPA RSL[1,5,6]	4.95	USEPA ERASG[2]	27	1.65	1.0	0.9	0.36
Iron	7439-89-6	1,400	USEPA RSL[1,5,6]	1,000	USEPA NRWQC[3]	467	333	50.0	40.0	20.0
Lead	7439-92-1	15	USEPA RSL[1,5,6]	3.2	USEPA NRWQC[3]	5	1.1	0.5	0.20	0.071
Magnesium	7439-95-4	NE	-	82,000	USEPA ERASG[2]	250	27,333	50.0	32.0	16.0
Manganese	7439-96-5	43	USEPA RSL[1,5,6]	93	USEPA ERASG[2]	14	31	2.0	1.9	0.95
Mercury	7439-97-6	0.063	USEPA RSL[1,5,6]	0.77	USEPA NRWQC[3]	0.2	0.26	0.2	0.16	0.079
Nickel	7440-02-0	39	USEPA RSL[1,5,6]	52	USEPA NRWQC[3]	13	17	1.5	0.8	0.4
Potassium	7440-09-7	NE	-	53,000	USEPA ERASG[2]	1,000	17,667	200	180	65.0
Selenium	7782-49-2	10	USEPA RSL[1,5,6]	5	USEPA ERASG[2]	3	2	1.0	0.6	0.27
Silver	7440-22-4	9.4	USEPA RSL[1,5,6]	0.06	USEPA ERASG[2]	3.1	0.5	0.5	0.3	0.1
Sodium	7440-23-5	NE	-	680,000	USEPA ERASG[2]	1,000	226,667	200	180	90.0
Thallium	7440-28-0	0.02	USEPA RSL[1,5,6]	6	USEPA ERASG[2]	0.5	2	0.5	0.3	0.13
Vanadium	7440-62-2	8.6	USEPA RSL[1,5,6]	27	USEPA ERASG[2]	4.0	9	4.0	2.0	0.79
Zinc	7440-66-6	600	USEPA RSL[1,5,6]	120	USEPA NRWQC[3]	200	40	15.0	8.0	4.0

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
3. PSL based on the USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020b).
4. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
5. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
6. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established

QAPP Worksheet #15-5 - TAL Metals (Water) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[4] (µg/L)	PQL Goal Ecological[4] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)

NRWQC = National Recommended Water Quality Criteria
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-6 – Explosive compounds (Water) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater, Surface Water
Analytical Group: Explosive Compounds (USEPA Method 8330B)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[3] (µg/L)	PQL Goal Ecological[3] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
1,3,5-Trinitrobenzene	99-35-4	59	USEPA RSL[1,4, 5]	11	USEPA ERASG[2]	20	4	1.0	0.92	0.46
1,3-Dinitrobenzene	99-65-0	0.2	USEPA RSL[1,4, 5]	22	USEPA ERASG[2]	1.0	7	1.0	3.6	0.4
2,4,6-Trinitrotoluene	118-96-7	0.98	USEPA RSL[1,4, 5]	13	USEPA ERASG[2]	3.7	3.7	3.7	3.6	1.8
2,4-Dinitrotoluene[1]	121-14-2	0.24	USEPA RSL[1,4, 5]	44	USEPA ERASG[2]	0.6	15	0.6	0.5	0.2
2,6-Dinitrotoluene[2]	606-20-2	0.049	USEPA RSL[1,4, 5]	81	USEPA ERASG[2]	0.8	27	0.8	0.7	0.4
2-Amino-4,6-Dinitrotoluene	35572-78-2	NE	-	18	USEPA ERASG[2]	4	6	0.8	0.8	0.4
2-Nitrotoluene[1]	88-72-2	0.31	USEPA RSL[1,4, 5]	71	USEPA ERASG[2]	0.9	24	0.9	0.8	0.3
3-Nitrotoluene	99-08-1	0.17	USEPA RSL[1,4, 5]	42	USEPA ERASG[2]	0.8	14	0.8	0.7	0.3
4-Amino-2,6-Dinitrotoluene	19406-51-0	0.19	USEPA RSL[1,4, 5]	11	USEPA ERASG[2]	2.0	4	2.0	1.8	0.9
4-Nitrotoluene	99-99-0	4.3	USEPA RSL[1,4, 5]	46	USEPA ERASG[2]	1.4	15	0.8	0.7	0.3
HMX	2691-41-0	100	USEPA RSL[1,4, 5]	220	USEPA ERASG[2]	33	73	1.6	1.4	0.7
Nitrobenzene[2]	98-95-3	0.14	USEPA RSL[1,4, 5]	230	USEPA ERASG[2]	0.9	77	0.9	0.5	0.2
Nitroglycerin[2]	55-63-0	0.2	USEPA RSL[1,4, 5]	18	USEPA ERASG[2]	20.0	20.0	20.0	19.0	8.5
PETN[1]	78-11-5	3.9	USEPA RSL[1,4, 5]	NE	-	23.0	115	23.0	22.0	10.8
RDX	121-82-4	0.97	USEPA RSL[1,4, 5]	79	USEPA ERASG[2]	0.8	26	0.8	0.7	0.4
Tetryl	479-45-8	3.9	USEPA RSL[1,4, 5]	NE	-	2.0	10	2.0	1.9	0.9

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
3. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
4. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
5. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level.
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-7 – Hardness (Water) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater
Analytical Group: Hardness (SM 2340B)
Concentration Level: Not Applicable

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	Ecological PSL for Surface Water (µg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[1] (µg/L)	PQL Goal Ecological[1] (µg/L)	Achievable Laboratory Limits		
								LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Total Hardness as $CaCO_3$	NE	NE	-	NE	-	4,555	4,555	911	800	405

Notes:
1. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-8 – Select Geochemistry Analytes (Water) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater and Surface Water
Analytical Group: Select Geochemistry Analytes (Various Methods)
Concentration Level: Low

Analyte	CAS	Human PSL (mg/L)	Human PSL Reference	Ecological PSL for Surface Water (mg/L)	Ecological PSL for Surface Water Reference	PQL Goal Human[3] (mg/L)	PQL Goal Ecological[3] (mg/L)	Achievable Laboratory Limits		
								LOQ (mg/L)	LOD (mg/L)	MDL (mg/L)
Total Alkalinity (as $CaCO_3$; SM 2320B)	NE	NE	-	230,000	USEPA NRWQC[2]	40	76,667	8	6	2.6
Sulfide (SM 4500 S2 D)	18496-25-8	NE	-	2.0	USEPA NRWQC[2]	1.5	0.7	0.3	0.25	0.1
Sulfate (USEPA Method 9056A)	14996-02-2	NE	-	NE	-	5.25	5.25	1.5	1.0	0.5
Chloride (USEPA Method 9056A)	16887-00-6	NE	-	230,000	USEPA ERASG[1]	5.25	76,667	1.5	1.2	0.6
Dissolved Organic Carbon (SM 5310C)	7440-44-0	NE	-	NE	-	5	5	1	0.9	0.5

Notes:
1. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018; USEPA, 2018).
2. PSL based on the USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020b).
3. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
mg/L = Milligrams per Liter
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-9 - VOCs (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil; Sediment
Analytical Group: VOCs (USEPA Method 8260C)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[8] (µg/kg)	PQL Goal Ecological[8] Soil (µg/kg)	PQL Goal Ecological[8] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
1,1,1-Trichloroethane	71-55-6	810,000	USEPA RSL[1,9,10]	40	USEPA ERASG[2]	70	USEPA ERASG[3]	270,000	13	23	5.0	2.0	0.6
1,1,2,2-Tetrachloroethane	79-34-5	600	USEPA RSL[1,9,10]	127	USEPA ERASG[2]	250	USEPA ERASG[3]	200	42	83	5.0	1.0	0.4
1,1,2-Trichloroethane	79-00-5	150	USEPA RSL[1,9,10]	320	USEPA ERASG[2]	538	USEPA ERASG[3]	50	106	179	5.0	2.0	0.5
1,1-Dichloroethane	75-34-3	3,600	USEPA RSL[1,9,10]	140	USEPA ERASG[2]	20	USEPA ERASG[3]	1,200	46	6	5.0	2.0	0.5
1,1-Dichloroethene	75-35-4	23,000	USEPA RSL[1,9,10]	40	USEPA ERASG[2]	100	USEPA ERASG[3]	7,666.7	13	33	5.0	2.0	0.5
1,2,4-Trichlorobenzene	120-82-1	5,800	USEPA RSL[1,9,10]	270	USEPA ERASG[2]	11	USEPA ERASG[3]	1,933.3	90	10	10.0	8.0	5.0
1,2-Dibromo-3-chloropropane	96-12-8	5.3	USEPA RSL[1,9,10]	NE	-	NE	-	5	25	25	5.0	1.0	0.5
1,2-Dibromoethane	106-93-4	36	USEPA RSL[1,9,10]	NE	-	NE	-	12	25	25	5.0	1.0	0.4
1,2-Dichlorobenzene	95-50-1	180,000	USEPA RSL[1,9,10]	90	USEPA ERASG[2]	95	USEPA ERASG[3]	60,000	30	32	5.0	2.0	0.5
1,2-Dichloroethane	107-06-2	460	USEPA RSL[1,9,10]	400	USEPA ERASG[2]	986	USEPA ERASG[3]	153	133	329	5.0	2.0	0.6
1,2-Dichloropropane	78-87-5	1,600	USEPA RSL[1,9,10]	280	USEPA ERASG[2]	428	USEPA ERASG[3]	533	93	143	5.0	2.0	0.5
1,3-Dichlorobenzene	541-73-1	NE	-	80	USEPA ERASG[2]	89	USEPA ERASG[3]	25	27	30	5.0	2.0	0.5
1,4-Dichlorobenzene	106-46-7	2,600	USEPA RSL[1,9,10]	880	USEPA ERASG[2]	30	USEPA ERASG[3]	867	293	10	5.0	1.0	0.4
2-Butanone	78-93-3	2,700,000	USEPA RSL[1,9,10]	1,000	USEPA ERASG[2]	7,604	USEPA ERASG[3]	900,000	333	2,535	10.0	4.0	2.0
2-Hexanone	591-78-6	20,000	USEPA RSL[1,9,10]	360	USEPA ERASG[2]	45	USEPA ERASG[3]	6,667	120	15	10.0	4.0	1.0
4-Methyl-2-pentanone	108-10-1	3,300,000	USEPA RSL[1,9,10]	NE	-	73	USEPA ERASG[3]	1,100,000	50	24	10.0	4.0	1.0
Acetone	67-64-1	6,100,000	USEPA RSL[1,9,10]	1,200	USEPA ERASG[2]	65	USEPA ERASG[3]	2,033,333	400	22	20.0	16.0	6.0
Benzene	71-43-2	1,200	USEPA RSL[1,9,10]	120	USEPA ERASG[2]	10	USEPA ERASG[3]	400	40	5	5.0	2.0	0.5

QAPP Worksheet #15-9 - VOCs (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[8] (µg/kg)	PQL Goal Ecological[8] Soil (µg/kg)	PQL Goal Ecological[8] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Bromodichloromethane	75-27-4	290	USEPA RSL[1,9,10]	NE	-	210	USEPA ERASG[4]	97	25	70	5.0	1.0	0.4
Bromoform	75-25-2	19,000	USEPA RSL[1,9,10]	70	USEPA ERASG[2]	142	USEPA ERASG[4]	6,333	23	47	10.0	8.0	5.0
Bromomethane	74-83-9	680	USEPA RSL[1,9,10]	2	USEPA ERASG[2]	6.5	USEPA ERASG[4]	227	5	5	5.0	2.0	0.7
Carbon Disulfide	75-15-0	77,000	USEPA RSL[1,9,10]	5	USEPA ERASG[2]	7.8	USEPA ERASG[3]	25,667	5	5	5.0	2.0	0.6
Carbon Tetrachloride	56-23-5	650	USEPA RSL[1,9,10]	50	USEPA ERASG[2]	57	USEPA ERASG[3]	217	17	19	5.0	2.0	0.5
Chlorobenzene	108-90-7	28,000	USEPA RSL[1,9,10]	2,400	USEPA ERASG[2]	30	USEPA ERASG[3]	9,333	800	10	5.0	2.0	0.5
Chloroethane	75-00-3	1,400,000	USEPA RSL[1,9,10]	NE	-	NE	-	466,667	25	25	5.0	4.0	1.0
Chloroform	67-66-3	320	USEPA RSL[1,9,10]	50	USEPA ERASG[2]	87	USEPA ERASG[3,4,5]	107	17	29	5.0	2.0	0.6
Chloromethane	74-87-3	11,000	USEPA RSL[1,9,10]	NE	-	NE	-	3,667	25	25	5.0	2.0	0.6
cis-1,2-Dichloroethene	156-59-2	16,000	USEPA RSL[1,9,10]	40	USEPA ERASG[2]	432	USEPA ERASG[3]	5,333	13	144	5.0	2.0	0.5
cis-1,3-Dichloropropene	10061-01-5	NE	-	NE	-	NE	-	25	25	25	5.0	1.0	0.4
Cyclohexane	110-82-7	650,000	USEPA RSL[1,9,10]	NE	-	278	USEPA ERASG[5]	216,667	25	93	5.0	2.0	0.5
Dibromochloromethane	124-48-1	8,300	USEPA RSL[1,9,10]	NE	-	198	USEPA ERASG[3]	2,767	25	66	5.0	1.0	0.5
Dichlorodifluoromethane	75-71-8	8,700	USEPA RSL[1,9,10]	NE	-	NE	-	2,900	25	25	5.0	2.0	0.6
Ethylbenzene	100-41-4	5,800	USEPA RSL[1,9,10]	270	USEPA ERASG[2]	290	USEPA ERASG[3]	1,933	90	97	5.0	1.0	0.4
Freon 113	76-13-1	670,000	USEPA RSL[1,9,10]	NE	USEPA ERASG[2]/USEPA EcoSSL[6]/LANL ESL[7]	NE	-	223,333	50	50	10.0	2.0	0.6
Isopropylbenzene	98-82-8	190,000	USEPA RSL[1,9,10]	40	USEPA ERASG[2]	35	USEPA ERASG[3]	63,333	13	12	5.0	1.0	0.4
Methyl Acetate	79-20-9	7,800,000	USEPA RSL[1,9,10]	NE	-	NE	-	2,600,000	25	25	5.0	4.0	1.0
Methyl Tertiary Butyl Ether	1634-04-4	47,000	USEPA RSL[1,9,10]	NE	-	304	USEPA ERASG[3]	15,667	25	101	5.0	2.0	0.5

QAPP Worksheet #15-9 - VOCs (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[8] (µg/kg)	PQL Goal Ecological[8] Soil (µg/kg)	PQL Goal Ecological[8] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Methylcyclohexane	108-87-2	NE	-	NE	-	NE	-	25	25	25	5.0	2.0	0.6
Methylene Chloride	75-09-2	35,000	USEPA RSL[1,9,10]	210	USEPA ERASG[2]	18	USEPA ERASG[3]	11,667	6	6	5.0	4.0	2.0
Styrene	100-42-5	600,000	USEPA RSL[1,9,10]	1,200	USEPA ERASG[2]	126	USEPA ERASG[3]	200,000	400	42	5.0	1.0	0.4
Tetrachloroethene	127-18-4	8,100	USEPA RSL[1,9,10]	60	USEPA ERASG[2]	2	USEPA ERASG[3]	2,700	20	5	5.0	2.0	0.5
Toluene	108-88-3	490,000	USEPA RSL[1,9,10]	150	USEPA ERASG[2]	10	USEPA ERASG[3]	163,333	50	5	5.0	2.0	0.6
trans-1,2-Dichloroethene	156-60-5	7,000	USEPA RSL[1,9,10]	40	USEPA ERASG[2]	389	USEPA ERASG[3]	2,333	13	130	5.0	2.0	0.5
trans-1,3-Dichloropropene	10061-02-6	NE	-	NE	-	NE	-	25	25	25	5.0	1.0	0.5
Trichloroethene	79-01-6	410	USEPA RSL[1,9,10]	60	USEPA ERASG[2]	78	USEPA ERASG[3]	137	20	26	5.0	2.0	0.5
Trichlorofluoromethane	75-69-4	2,300,000	USEPA RSL[1,9,10]	16,400	USEPA ERASG[2]	NE	-	766,667	5,467	25	5.0	2.0	0.7
Vinyl Chloride	75-01-4	59	USEPA RSL[1,9,10]	30	USEPA ERASG[2]	482	USEPA ERASG[3]	20	10	161	5.0	2.0	0.6
Xylenes (Total)	1330-20-7	58,000	USEPA RSL[1,9,10]	100	USEPA ERASG[2]	130	USEPA ERASG[3]	19,333	33	43	10.0	2.0	1.4

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
4. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
5. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Refinement Screening Value for Step 3a (March 2018; USEPA, 2018).
6. PSL based on the USEPA Interim Ecological Soil Screening Level documents (USEPA, 2003 through 2008).
7. PSL based on Los Alamos National Laboratory ECORISK Database Ecological Screening Levels (LANL, 2020).
8. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
9. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
10. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
EcoSSL = Ecological Soil Screening Level
ERASG = Ecological Risk Assessment Supplemental Guidance
LANL = Los Alamos National Laboratory
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit

QAPP Worksheet #15-9 - VOCs (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[8] (µg/kg)	PQL Goal Ecological[8] Soil (µg/kg)	PQL Goal Ecological[8] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)

PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-10A - SVOCs (Soil) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: SVOCs (USEPA Method 8270D)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	PQL Goal Human[4] (µg/kg)	PQL Goal Ecological[4] Soil (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
1,1'-Biphenyl	92-52-4	4,700	USEPA RSL[1,5,6]	200	USEPA ERASG[2]	1,567	67	36.7	33.3	16.7
1,4-Dioxane	123-91-1	5,300	USEPA RSL[1,5,6]	2,050	USEPA EcoSSL[7]	1,767	683	333.3	200.0	100.0
1-Methylnaphthalene	90-12-0	18,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	6,000	9,667	33.3	20	10.0
2,2'-oxybis(1-Chloropropane)	108-60-1	310,000	USEPA RSL[1,5,6]	NE	-	1,033,333	216.5	43.3	40.0	20.0
2,4,5-Trichlorophenol	95-95-4	630,000	USEPA RSL[1,5,6]	4,000	USEPA ERASG[2]	210,000	1,333	36.7	33.3	16.7
2,4,6-Trichlorophenol	88-06-2	6,300	USEPA RSL[1,5,6]	9,940	USEPA ERASG[2]	2,100	3,313	36.7	33.3	16.7
2,4-Dichlorophenol	120-83-2	190,000	USEPA RSL[1,5,6]	50	USEPA ERASG[2]	63,333	43.3	43.3	40.0	20.0
2,4-Dimethylphenol	105-67-9	1,300,000	USEPA RSL[1,5,6]	40	USEPA ERASG[2]	433,333	36.7	36.7	33.3	16.7
2,4-Dinitrophenol	51-28-5	130,000	USEPA RSL[1,5,6]	61	USEPA ERASG[2]	43,333	1,000	1,000	333	167
2,4-Dinitrotoluene	121-14-2	19,000	USEPA RSL[1,5,6]	6,000	USEPA ERASG[2]	6,333	2,000	167	66.7	33.3
2,6-Dinitrotoluene	606-20-2	360	USEPA RSL[1,5,6]	4,000	USEPA ERASG[2]	120	1,333	36.7	33.3	16.7
2-Chloronaphthalene	91-58-7	480,000	USEPA RSL[1,5,6]	NE	-	160,000	166.5	33.3	26.7	13.3
2-Chlorophenol	95-57-8	39,000	USEPA RSL[1,5,6]	60	USEPA ERASG[2]	13,000	36.7	36.7	33.3	16.7
2-Methylnaphthalene	91-57-6	24,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	8,000	9,667	16.7	10.0	5.0
2-Methylphenol	95-48-7	320,000	USEPA RSL[1,5,6]	100	USEPA ERASG[2]	106,667	50.0	50.0	40.0	20.0
2-Nitroaniline	88-74-4	63,000	USEPA RSL[1,5,6]	20	USEPA ERASG[2]	21,000	50.0	50.0	33.3	16.7
2-Nitrophenol	88-75-5	NE	-	NE	-	250	250	50.0	40.0	20.0
3,3'-Dichlorobenzidine	91-94-1	1,200	USEPA RSL[1,5,6]	30	USEPA ERASG[2]	400	167	167	66.7	33.3
3-Nitroaniline	99-09-2	NE	-	NE	-	835	835	167	66.7	33.3
4,6-Dinitro-2-methylphenol	534-52-1	510	USEPA RSL[1,5,6]	NE	-	500	2,500	500	333	167
4-Bromophenyl-phenylether	101-55-3	NE	-	NE	-	183.5	183.5	36.7	33.3	16.7
4-Chloro-3-methylphenol	59-50-7	630,000	USEPA RSL[1,5,6]	NE	-	210,000	250	50.0	40.0	20.0
4-Chloroaniline	106-47-8	2,700	USEPA RSL[1,5,6]	1,000	USEPA ERASG[2]	900	333	167	66.7	33.3
4-Chlorophenyl-phenylether	7005-72-3	NE	-	NE	-	183.5	183.5	36.7	33.3	16.7
4-Methylphenol	65794-96-9	NE	-	NE	-	250	250	50.0	33.3	16.7
4-Nitroaniline	100-01-6	25,000	USEPA RSL[1,5,6]	NE	-	8,333	835	167	66.7	33.3
4-Nitrophenol	100-02-7	NE	-	5,120	USEPA ERASG[2]	2,500	1,707	500	333	167
Acenaphthene	83-32-9	360,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	120,000	9,667	16.7	6.66	3.33
Acenaphthylene	208-96-8	NE	-	29,000	USEPA EcoSSL[3]	83.5	9,667	16.7	8.0	4.0
Acetophenone	98-86-2	780,000	USEPA RSL[1,5,6]	NE	-	260,000	250	50.0	33.3	16.7

QAPP Worksheet #15-10A - SVOCs (Soil) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	PQL Goal Human[4] (µg/kg)	PQL Goal Ecological[4] Soil (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Anthracene	120-12-7	1,800,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	600,000	9,667	16.7	6.7	3.3
Atrazine	1912-24-9	2,400	USEPA RSL[1,5,6]	0.05	USEPA ERASG[2]	800	167	167	133	66.7
Benzaldehyde	100-52-7	170,000	USEPA RSL[1,5,6]	NE	-	56,667	835	167	66.7	33.3
Benzo(a)anthracene	56-55-3	1,100	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	367	367	16.7	13.3	3.3
Benzo(a)pyrene	50-32-8	110	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	37	367	16.7	6.7	3.3
Benzo(b)fluoranthene	205-99-2	1,100	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	367	367	16.7	6.7	3.3
Benzo(g,h,i)perylene	191-24-2	NE	-	1,100	USEPA EcoSSL[3]	8.5	367	16.7	6.7	3.3
Benzo(k)fluoranthene	207-08-9	11,000	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	3,667	367	16.7	6.7	3.3
bis(2-Chloroethoxy)methane	111-91-1	19,000	USEPA RSL[1,5,6]	NE	-	6,333	183.5	36.7	33.3	16.7
bis(2-Chloroethyl)ether	111-44-4	230	USEPA RSL[1,5,6]	NE	-	77	183.5	36.7	33.3	16.7
bis(2-Ethylhexyl)phthalate	117-81-7	39,000	USEPA RSL[1,5,6]	20	USEPA ERASG[2]	13,000	167	167	133	66.7
Butylbenzylphthalate	85-68-7	290,000	USEPA RSL[1,5,6]	590	USEPA ERASG[2]	96,667	197	167	133	66.7
Caprolactam	105-60-2	3,100,000	USEPA RSL[1,5,6]	NE	-	1,033,333	835	167	66.7	33.3
Carbazole	86-74-8	NE	-	70	USEPA ERASG[2]	183.5	37	36.7	33.3	16.7
Chrysene	218-01-9	110,000	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	36,667	367	16.7	6.7	3.3
Di-n-butyl phthalate	84-74-2	630,000	USEPA RSL[1,5,6]	11	USEPA ERASG[2]	210,000	167	167	133	66.7
Di-n-octylphthalate	117-84-0	63,000	USEPA RSL[1,5,6]	910	USEPA ERASG[2]	21,000	303	167	133	66.7
Dibenz(a,h)anthracene	53-70-3	110	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	37	367	16.7	13.3	6.7
Dibenzofuran	132-64-9	7,800	USEPA RSL[1,5,6]	150	USEPA ERASG[2]	2,600	50	36.7	33.3	16.7
Diethylphthalate	84-66-2	5,100,000	USEPA RSL[1,5,6]	250	USEPA ERASG[2]	1,700,000	167	167	133	66.7
Dimethylphthalate	131-11-3	NE	-	350	USEPA ERASG[2]	835	167	167	133	66.7
Fluoranthene	206-44-0	240,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	80,000	9,667	16.7	6.7	3.3
Fluorene	86-73-7	240,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	80,000	9,667	16.7	6.7	3.3
Hexachlorobenzene	118-74-1	210	USEPA RSL[1,5,6]	79	USEPA ERASG[2]	70	26	16.7	13.3	6.7
Hexachlorobutadiene	87-68-3	1,200	USEPA RSL[1,5,6]	9	USEPA ERASG[2]	400	50.0	50.0	40.0	20.0
Hexachlorocyclopentadiene	77-47-4	180	USEPA RSL[1,5,6]	1	USEPA ERASG[2]	500	500	500	333	167
Hexachloroethane	67-72-1	1,800	USEPA RSL[1,5,6]	24	USEPA ERASG[2]	600	167	167	66.7	33.3
Indeno(1,2,3-cd)pyrene	193-39-5	1,100	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	367	367	16.7	8.0	4.0
Isophorone	78-59-1	570,000	USEPA RSL[1,5,6]	NE	-	190,000	334	66.7	33.3	16.7
N-Nitroso-di-n-propylamine	621-64-7	78	USEPA RSL[1,5,6]	NE	-	67	333.5	66.7	50.0	33.3
N-Nitrosodiphenylamine	86-30-6	110,000	USEPA RSL[1,5,6]	545	USEPA ERASG[2]	36,667	182	36.7	33.3	16.7
Naphthalene	91-20-3	2,000	USEPA RSL[1,5,6]	29,000	USEPA EcoSSL[3]	667	9,667	16.7	13.3	6.7
Nitrobenzene	98-95-3	5,100	USEPA RSL[1,5,6]	2,200	USEPA ERASG[2]	1,700	733	36.7	33.3	16.7
Pentachlorophenol	87-86-5	1,000	USEPA RSL[1,5,6]	2,100	USEPA EcoSSL[3]	333	700	167	133	66.7
Phenanthrene	85-01-8	NE	-	29,000	USEPA EcoSSL[3]	50.1	9,667	16.7	8.0	4.0
Phenol	108-95-2	1,900,000	USEPA RSL[1,5,6]	790	USEPA ERASG[2]	633,333	263	36.7	33.3	16.7

QAPP Worksheet #15-10A - SVOCs (Soil) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	PQL Goal Human[4] (µg/kg)	PQL Goal Ecological[4] Soil (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Pyrene	129-00-0	180,000	USEPA RSL[1,5,6]	1,100	USEPA EcoSSL[3]	60,000	367	16.7	6.7	3.3

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. PSL based on the USEPA Interim Ecological Soil Screening Level documents (USEPA, 2003 through 2008).
4. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
5. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
6. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.
7. PSL based on the USEPA Region 5 RCRA Ecological Screening Levels. (USEPA, 2003)

Legend:
CAS = Chemical Abstract Service
EcoSSL = Ecological Soil Screening Level
ERASG = Ecological Risk Assessment Supplemental Guidance
LOD = Limit of Detection
LOQ = Level of Quantitation
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
SIM = Selective Ion Monitoring
TBD = To be determined
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-10B - SVOCs (Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Sediment
Analytical Group: SVOCs (USEPA Method 8270D / 8270D SIM)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
1,1'-Biphenyl	92-52-4	4,700	USEPA RSL[1,6,7]	198	USEPA ERASG[2]	1,567	66	36.7	33.3	16.7
1,4-Dioxane[8]	123-91-1	5,300	USEPA RSL[1,6,7]	119	USEPA EcoSSL[9]	1,767	39.7	3.3	2.7	1.3
1-Methylnaphthalene[8]	90-12-0	18,000	USEPA RSL[1,6,7]	141	USEPA ERASG[2]	6,000	47	1.67	1.3	0.67
2,2'-oxybis(1-Chloropropane)	108-60-1	310,000	USEPA RSL[1,6,7]	NE	-	1,033,333	216.5	43.3	40.0	20.0
2,4,5-Trichlorophenol	95-95-4	630,000	USEPA RSL[1,6,7]	34	USEPA ERASG[3]	210,000	36.7	36.7	33.3	16.7
2,4,6-Trichlorophenol	88-06-2	6,300	USEPA RSL[1,6,7]	89	USEPA ERASG[3]	2,100	36.7	36.7	33.3	16.7
2,4-Dichlorophenol	120-83-2	190,000	USEPA RSL[1,6,7]	57	USEPA ERASG[2]	63,333	43.3	43.3	40.0	20.0
2,4-Dimethylphenol	105-67-9	1,300,000	USEPA RSL[1,6,7]	39	USEPA ERASG[3]	433,333	36.7	36.7	33.3	16.7
2,4-Dinitrophenol	51-28-5	130,000	USEPA RSL[1,6,7]	223	USEPA ERASG[3]	43,333	1,000	1,000	333	167
2,4-Dinitrotoluene	121-14-2	19,000	USEPA RSL[1,6,7]	290	USEPA ERASG[3]	6,333	167	167	66.7	33.3
2,6-Dinitrotoluene	606-20-2	360	USEPA RSL[1,6,7]	296	USEPA ERASG[3]	120	99	36.7	33.3	16.7
2-Chloronaphthalene	91-58-7	480,000	USEPA RSL[1,6,7]	NE	-	160,000	166.5	33.3	26.7	13.3
2-Chlorophenol	95-57-8	39,000	USEPA RSL[1,6,7]	55	USEPA ERASG[3]	13,000	36.7	36.7	33.3	16.7
2-Methylnaphthalene[8]	91-57-6	24,000	USEPA RSL[1,6,7]	20.2	USEPA ERASG[2]	8,000	6.7	3.3	2.67	1.3
2-Methylphenol	95-48-7	320,000	USEPA RSL[1,6,7]	119	USEPA ERASG[3]	106,667	50.0	50.0	40.0	20.0
2-Nitroaniline	88-74-4	63,000	USEPA RSL[1,6,7]	NE	-	21,000	250	50.0	33.3	16.7
2-Nitrophenol	88-75-5	NE	-	168	USEPA ERASG[3]	250	56	50.0	40.0	20.0
3,3'-Dichlorobenzidine	91-94-1	1,200	USEPA RSL[1,6,7]	31	USEPA ERASG[3]	400	167	167	66.7	33.3
3-Nitroaniline	99-09-2	NE	-	NE	-	835	835	167	66.7	33.3
4,6-Dinitro-2-methylphenol	534-52-1	510	USEPA RSL[1,6,7]	1,477	USEPA ERASG[3]	500	500	500	333	167
4-Bromophenyl-phenylether	101-55-3	NE	-	47	USEPA ERASG[2]	183.5	36.7	36.7	33.3	16.7
4-Chloro-3-methylphenol	59-50-7	630,000	USEPA RSL[1,6,7]	5	USEPA ERASG[3]	210,000	50.0	50.0	40.0	20.0
4-Chloroaniline	106-47-8	2,700	USEPA RSL[1,6,7]	0.9	USEPA ERASG[3]	900	167	167	66.7	33.3
4-Chlorophenyl-phenylether	7005-72-3	NE	-	NE	-	183.5	183.5	36.7	33.3	16.7
4-Methylphenol	65794-96-9	NE	-	NE	-	250	250	50.0	33.3	16.7
4-Nitroaniline	100-01-6	25,000	USEPA RSL[1,6,7]	NE	-	8,333	835	167	66.7	33.3
4-Nitrophenol	100-02-7	NE	-	153	USEPA ERASG[3]	2,500	500	500	333	167
Acenaphthene[8]	83-32-9	360,000	USEPA RSL[1,6,7]	6.7	USEPA ERASG[2]	120,000	4.67	4.67	1.3	0.67
Acenaphthylene[8]	208-96-8	NE	-	5.9	USEPA ERASG[2]	8.4	2.0	1.67	1.3	0.3
Acetophenone	98-86-2	780,000	USEPA RSL[1,6,7]	NE	-	260,000	250	50.0	33.3	16.7
Anthracene[8]	120-12-7	1,800,000	USEPA RSL[1,6,7]	57	USEPA ERASG[2]	600,000	19	1.67	1.3	0.67

QAPP Worksheet #15-10B – SVOCs (Sediment) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Atrazine	1912-24-9	2,400	USEPA RSL[1,6,7]	0.3	USEPA ERASG[3]	800	167	167	133	66.7
Benzaldehyde	100-52-7	170,000	USEPA RSL[1,6,7]	59	USEPA ERASG[3]	56,667	167	167	66.7	33.3
Benzo(a)anthracene[8]	56-55-3	1,100	USEPA RSL[1,6,7]	108	USEPA ERASG[2]	367	36	1.67	1.3	0.67
Benzo(a)pyrene[8]	50-32-8	110	USEPA RSL[1,6,7]	150	USEPA ERASG[2]	37	50	1.67	1.3	0.67
Benzo(b)fluoranthene[8]	205-99-2	1,100	USEPA RSL[1,6,7]	190	USEPA ERASG[2]	367	63	1.67	1.3	0.67
Benzo(g,h,i)perylene[8]	191-24-2	NE	-	170	USEPA ERASG[2]	8.4	57	1.67	1.3	0.67
Benzo(k)fluoranthene[8]	207-08-9	11,000	USEPA RSL[1,6,7]	240	USEPA ERASG[2]	3,667	80	1.67	1.3	0.67
bis(2-Chloroethoxy)methane	111-91-1	19,000	USEPA RSL[1,6,7]	NE	-	6,333	183.5	36.7	33.3	16.7
bis(2-Chloroethyl)ether	111-44-4	230	USEPA RSL[1,6,7]	8,163	USEPA ERASG[4]	77	2,721	36.7	33.3	16.7
bis(2-Ethylhexyl)phthalate	117-81-7	39,000	USEPA RSL[1,6,7]	180	USEPA ERASG[2]	13,000	167	167	133	66.7
Butylbenzylphthalate	85-68-7	290,000	USEPA RSL[1,6,7]	100	USEPA ERASG[2]	96,667	167	167	133	66.7
Caprolactam	105-60-2	3,100,000	USEPA RSL[1,6,7]	NE	-	1,033,333	835	167	66.7	33.3
Carbazole	86-74-8	NE	-	69	USEPA ERASG[2]	183.5	37	36.7	33.3	16.7
Chrysene[8]	218-01-9	110,000	USEPA RSL[1,6,7]	166	USEPA ERASG[2]	36,667	55	1.67	1.3	0.3
Di-n-butylphthalate	84-74-2	630,000	USEPA RSL[1,6,7]	11	USEPA ERASG[2]	210,000	167	167	133	66.7
Di-n-octylphthalate	117-84-0	63,000	USEPA RSL[1,6,7]	39	USEPA ERASG[2]	21,000	170	167	133	66.7
Dibenz(a,h)anthracene[8]	53-70-3	110	USEPA RSL[1,6,7]	33	USEPA ERASG[2]	37	11	1.67	1.3	0.67
Dibenzofuran	132-64-9	7,800	USEPA RSL[1,6,7]	510	USEPA ERASG[2]	2,600	170	36.7	33.3	16.7
Diethylphthalate	84-66-2	5,100,000	USEPA RSL[1,6,7]	630	USEPA ERASG[2]	1,700,000	210	167	133	66.7
Dimethylphthalate	131-11-3	NE	-	678	USEPA ERASG[2]	835	226	167	133	66.7
Fluoranthene[8]	206-44-0	240,000	USEPA RSL[1,6,7]	423	USEPA ERASG[2]	80,000	141	1.67	1.3	0.67
Fluorene[8]	86-73-7	240,000	USEPA RSL[1,6,7]	77	USEPA ERASG[2]	80,000	26	1.67	1.3	0.67
Hexachlorobenzene	118-74-1	210	USEPA RSL[1,6,7]	20	USEPA ERASG[3]	70	17	16.7	13.3	6.7
Hexachlorobutadiene	87-68-3	1,200	USEPA RSL[1,6,7]	NE	-	400	250	50.0	40.0	20.0
Hexachlorocyclopentadiene	77-47-4	180	USEPA RSL[1,6,7]	6.5	USEPA ERASG[3]	500	500	500	333	167
Hexachloroethane	67-72-1	1,800	USEPA RSL[1,6,7]	27	USEPA ERASG[2]	600	167	167	66.7	33.3
Indeno(1,2,3-cd)pyrene[8]	193-39-5	1,100	USEPA RSL[1,6,7]	200	USEPA ERASG[2]	367	67	1.67	1.3	0.67
Isophorone	78-59-1	570,000	USEPA RSL[1,6,7]	876	USEPA ERASG[2]	190,000	292	66.7	33.3	16.7
N-Nitroso-di-n-propylamine	621-64-7	78	USEPA RSL[1,6,7]	NE	-	67	333.5	66.7	50.0	33.3
N-Nitrosodiphenylamine	86-30-6	110,000	USEPA RSL[1,6,7]	110	USEPA ERASG[2]	36,667	36.7	36.7	33.3	16.7
Naphthalene[8]	91-20-3	2,000	USEPA RSL[1,6,7]	176	USEPA ERASG[2]	667	59	3.3	2.67	1.3
Nitrobenzene	98-95-3	5,100	USEPA RSL[1,6,7]	407	USEPA ERASG[2]	1,700	136	36.7	33.3	16.7
Pentachlorophenol	87-86-5	1,000	USEPA RSL[1,6,7]	10	USEPA ERASG[3]	333	167	167	133	66.7
Phenanthrene[8]	85-01-8	NE	-	204	USEPA ERASG[2]	11.5	68	2.3	2.0	1.0
Phenol	108-95-2	1,900,000	USEPA RSL[1,6,7]	175	USEPA ERASG[3]	633,333	58	36.7	33.3	16.7
Pyrene[8]	129-00-0	180,000	USEPA RSL[1,6,7]	195	USEPA ERASG[2]	60,000	65	1.67	1.3	0.67

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

QAPP Worksheet #15-10B - SVOCs (Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
3. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
4. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Refinement Screening Value for Step 3a (March 2018; USEPA, 2018).
5. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
6. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
7. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.
8. Compound will be analyzed using USEPA Method 8270D SIM. All other compounds will be analyzed using USEPA Method 8270D.
9. PSL based on the USEPA Region 5 RCRA Ecological Screening Levels. (USEPA, 2003)

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOD = Limit of Detection
LOQ = Level of Quantitation
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
SIM = Selective Ion Monitoring
TBD = To be determined
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-11 – Organochloride Pesticides (Soil and Sediment) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil, Sediment
Analytical Group: Organochloride Pesticides (USEPA Method 8081B)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[6] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Aldrin	309-00-2	39	USEPA RSL[1,6,7]	30	USEPA ERASG[2]	42	USEPA ERASG[3]	13	10	14	0.83	0.60	0.17
Alpha BHC	319-84-6	86	USEPA RSL[1,6,7]	0.3	USEPA ERASG[2]	0.3	USEPA ERASG[3]	29	0.83	0.83	0.83	0.60	0.17
Alpha Chlordane	5103-71-9	3,600	USEPA RSL[1,6,7,8]	2.9	USEPA ERASG[2]	3.2	USEPA ERASG[3,8]	1,200	1.0	1.1	0.83	0.60	0.17
Beta BHC	319-85-7	300	USEPA RSL[1,6,7]	0.3	USEPA ERASG[2]	300	USEPA ERASG[3]	100	1.0	100	1.0	0.90	0.44
Delta BHC	319-86-8	NE	-	NE	-	NE	-	5.0	5.0	5.0	1.0	0.90	0.45
Dieldrin	60-57-1	34	USEPA RSL[1,6,7]	4.9	USEPA EcoSSL[4]	1.9	USEPA ERASG[3]	11	1.6	1.7	1.7	1.2	0.33
Endosulfan I	959-98-8	NE	-	0.9	USEPA ERASG[2]	0.9	USEPA ERASG[3]	4.15	0.83	0.83	0.83	0.60	0.22
Endosulfan II	33213-65-9	NE	-	0.9	USEPA ERASG[2]	0.9	USEPA ERASG[3]	11.5	2.3	2.3	2.3	2.2	1.1
Endosulfan Sulfate	1031-07-8	38,000	USEPA RSL[1,6,7]	6.5	USEPA ERASG[2]	0.7	USEPA ERASG[3]	12,667	2.2	1.7	1.7	1.2	0.33
Endrin	72-20-8	1,900	USEPA RSL[1,6,7]	1.9	USEPA ERASG[2]	2.2	USEPA ERASG[3]	633	1.7	1.7	1.7	1.2	0.68
Endrin Aldehyde	7421-93-4	NE	-	1.9	USEPA ERASG[2,8]	2.2	USEPA ERASG[3,8]	8.5	1.7	1.7	1.7	1.2	0.33
Endrin Ketone[8]	53494-70-5	NE	-	1.9	USEPA ERASG[2,8]	2.2	USEPA ERASG[3,8]	10	2.0	2.0	2.0	1.8	0.60
Gamma BHC – Lindane	58-89-9	570	USEPA RSL[1,6,7]	3.1	USEPA ERASG[2]	2.4	USEPA ERASG[3]	190	1.0	0.83	0.83	0.60	0.21
Gamma Chlordane	5103-74-2	3,600	USEPA RSL[1,6,7,8]	20	USEPA ERASG[2]	3.2	USEPA ERASG[3,8]	1,200	7	1.1	0.83	0.60	0.25
Heptachlor	76-44-8	130	USEPA RSL[1,6,7]	1.6	USEPA ERASG[2]	0.6	USEPA ERASG[3]	43	0.83	0.83	0.83	0.62	0.31
Heptachlor Epoxide	1024-57-3	70	USEPA RSL[1,6,7]	0.15	USEPA ERASG[2]	2.5	USEPA ERASG[3]	23	0.83	0.83	0.83	0.60	0.17
Methoxychlor	72-43-5	32,000	USEPA RSL[1,6,7]	2.1	USEPA ERASG[2]	30	USEPA ERASG[3]	10,667	6.7	10	6.7	5.9	1.8
p,p'-DDD	72-54-8	190	USEPA RSL[1,6,7]	21	USEPA ERASG[2]	3.5	USEPA ERASG[3]	63	7	1.2	1.7	1.6	0.33
p,p'-DDE	72-55-9	2,000	USEPA RSL[1,6,7]	21	USEPA ERASG[2]	1.4	USEPA ERASG[3]	667	7	1.7	1.7	1.2	0.33

QAPP Worksheet #15-11 - Organochloride Pesticides (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[6] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
p,p'-DDT	50-29-3	1,900	USEPA RSL[1,6,7]	21	USEPA EcoSSL[4]	1.0	USEPA ERASG[3]	633	7	1.7	1.7	1.2	0.79
Toxaphene	8001-35-2	490	USEPA RSL[1,6,7]	0.15	USEPA ERASG[2]	0.1	USEPA ERASG[3]	163	33	33	33	28	14

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
4. PSL based on the USEPA Interim Ecological Soil Screening Level documents (USEPA, 2003 through 2008).
5. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
6. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
7. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.
8. Exact compound not available; surrogates used. Chlordane used for Alpha Chlordane and Gamma Chlordane. Endosulfan used for Endosulfan I and Endosulfan II, Endrin used for Endrin Aldehyde and Endrin Ketone.

Legend:
CAS = Chemical Abstract Service
EcoSSL = Ecological Soil Screening Level
ERASG = Ecological Risk Assessment Supplemental Guidance
LANL = Los Alamos National Laboratory
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level.
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-12 - PCBs (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil, Sediment
Analytical Group: PBCs (USEPA 8082B)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
PCB-1016	12674-11-2	410	USEPA RSL[1,6,7]	1,100	LANL ESL[4]	NE	-	137	367	85	17.0	10.0	5.3
PCB-1221	11104-28-2	200	USEPA RSL[1,6,7]	NE	-	NE	-	67	85	85	17.0	10.0	5.3
PCB-1232	11141-16-5	170	USEPA RSL[1,6,7]	NE	-	NE	-	57	85	85	17.0	10.0	5.3
PCB-1242	53469-21-9	230	USEPA RSL[1,6,7]	41	LANL ESL[4]	NE	-	77	17.0	85	17.0	10.0	5.3
PCB-1248	12672-29-6	230	USEPA RSL[1,6,7]	7.3	LANL ESL[4]	NE	-	77	17.0	85	17.0	10.0	5.3
PCB-1254	11097-69-1	120	USEPA RSL[1,6,7]	41	LANL ESL[4]	NE	-	40	17.0	85	17.0	10.0	6.4
PCB-1260	11096-82-5	240	USEPA RSL[1,6,7]	880	LANL ESL[4]	NE	-	80	293	85	17.0	10.0	6.4
Total PCBs	1336-36-3	230	USEPA RSL[1,6,7]	41	USEPA ERASG[2]	59.8	USEPA ERASG[3]	77	17.0	19.9	17.0	10.0	6.4

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
4. PSL based on Los Alamos National Laboratory ECORISK Database Ecological Screening Levels (LANL, 2020).
5. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
6. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
7. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
EcoSSL = Ecological Soil Screening Level
ERASG = Ecological Risk Assessment Supplemental Guidance
LANL = Los Alamos National Laboratory
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
NE = Not Established
µg/kg = Micrograms per Kilogram
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-13 - TAL Metals (Soil and Sediment)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil, Sediment
Analytical Group: Metals (USEPA Method 6020B/7471B)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Aluminum	7429-90-5	7,700,000	USEPA RSL[1,6,7]	NE	-	25,000,000	USEPA ERASG[3]	2,566,667	150,000	8,333,333	10,000	9,000	4,370
Antimony	7440-36-0	3,100	USEPA RSL[1,6,7]	270	USEPA EcoSSL[4]	2,000	USEPA ERASG[3]	1,033	100	667	100	80	40
Arsenic	7440-38-2	680	USEPA RSL[1,6,7]	18,000	USEPA EcoSSL[4]	9,800	USEPA ERASG[3]	227	6,000	3,267	200	160	67
Barium	7440-39-3	1,500,000	USEPA RSL[1,6,7]	330,000	USEPA EcoSSL[4]	20,000	USEPA ERASG[3]	5,000	110,000	6,667	200	180	92
Beryllium	7440-41-7	16,000	USEPA RSL[1,6,7]	21,000	USEPA EcoSSL[4]	NE	-	5,333	7,000	2,500	500	25	12
Cadmium	7440-43-9	7,100	USEPA RSL[1,6,7]	360	USEPA EcoSSL[4]	1,000	USEPA ERASG[3]	2,367	120	333	50	40	20
Calcium	7440-70-2	NE	-	NE	-	NE	-	100,000	100,000	100,000	20,000	19,600	9,800
Chromium	7440-47-3	NE	-	26,000	USEPA EcoSSL[4]	43,400	USEPA ERASG[3]	1,000	8,667	14,467	200	150	44
Cobalt	7440-48-4	2,300	USEPA RSL[1,6,7]	13,000	USEPA EcoSSL[4]	50,000	USEPA ERASG[3]	767	4,333	16,667	100	50	20
Copper	7440-50-8	310,000	USEPA RSL[1,6,7]	28,000	USEPA EcoSSL[4]	31,600	USEPA ERASG[3]	103,333	9,333	10,533	200	150	44
Iron	7439-89-6	5,500,000	USEPA RSL[1,6,7]	NE	-	20,000,000	USEPA ERASG[3]	1,833,333	50,000	6,666,667	10,000	9,000	4,610
Lead	7439-92-1	400,000	USEPA RSL[1,6,7]	11,000	USEPA EcoSSL[4]	35,800	USEPA ERASG[3]	133,333	3,667	11,933	100	80	38
Magnesium	7439-95-4	NE	-	NE	-	NE	-	25,000	25,000	25,000	5,000	4,000	1,570
Manganese	7439-96-5	180,000	USEPA RSL[1,6,7]	220,000	USEPA EcoSSL[4]	460,000	USEPA ERASG[3]	60,000	73,333	153,333	250	200	106
Mercury	7439-97-6	1,100	USEPA RSL[1,6,7]	13	USEPA ERASG[2]	180	USEPA ERASG[3]	367	60	60	60	40	20
Nickel	7440-02-0	150,000	USEPA RSL[1,6,7]	38,000	USEPA EcoSSL[4]	22,700	USEPA ERASG[3]	50,000	12,667	7,567	200	160	81
Potassium	7440-09-7	NE	-	NE	-	NE	-	100,000	100,000	100,000	20,000	16,000	9,520
Selenium	7782-49-2	39,000	USEPA RSL[1,6,7]	520	USEPA EcoSSL[4]	720	USEPA ERASG[3]	13,000	200	240	200	100	50
Silver	7440-22-4	39,000	USEPA RSL[1,6,7]	4,200	USEPA EcoSSL[4]	1,000	USEPA ERASG[3]	13,000	1,400	333	50	40	20
Sodium	7440-23-5	NE	-	NE	-	NE	-	125,000	125,000	125,000	25,000	20,000	10,000

QAPP Worksheet #15-13 - TAL Metals (Soil and Sediment)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Thallium	7440-28-0	78	USEPA RSL[1,6,7]	50	USEPA ERASG[2]	NE	-	50	50	250	50	40	20
Vanadium	7440-62-2	39,000	USEPA RSL[1,6,7]	7,800	USEPA EcoSSL[4]	NE	-	13,000	2,600	2,000	400	200	100
Zinc	7440-66-6	2,300,000	USEPA RSL[1,6,7]	46,000	USEPA EcoSSL[4]	121,000	USEPA ERASG[3]	766,667	15,333.	70,000	15,000	4,000	2,000

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
4. PSL based on the USEPA Interim Ecological Soil Screening Level documents (USEPA, 2003 through 2008).
5. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
6. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
7. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
EcoSSL = Ecological Soil Screening Level
ERASG = Ecological Risk Assessment Supplemental Guidance
LANL = Los Alamos National Laboratory
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-14 - Explosive Compounds (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil, Sediment
Analytical Group: Explosive Compounds (USEPA Method 8330B)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
1,3,5-Trinitrobenzene	99-35-4	220,000	USEPA RSL[1,6,7]	300	USEPA ERASG[2]	15	USEPA ERASG[4]	73,333	120	120	120	80	32
1,3-Dinitrobenzene	99-65-0	630	USEPA RSL[1,6,7]	34	USEPA ERASG[2]	40	USEPA ERASG[4]	210	120	120	120	80	20
2,4,6-Trinitrotoluene	118-96-7	3,600	USEPA RSL[1,6,7]	7,500	USEPA ERASG[2]	27	USEPA ERASG[4]	1,200	2,500	200	200	196	83
2,4-Dinitrotoluene	121-14-2	1,700	USEPA RSL[1,6,7]	6,000	USEPA ERASG[2]	290	USEPA ERASG[4]	567	2,000	120	120	80	36
2,6-Dinitrotoluene	606-20-2	360	USEPA RSL[1,6,7]	4,000	USEPA ERASG[2]	296	USEPA ERASG[4]	150	1,333	150	150	148	47
2-Amino-4,6-Dinitrotoluene	35572-78-2	770	USEPA RSL[1,6,7]	14,000	USEPA ERASG[2]	47	USEPA ERASG[4]	257	4,667	200	200	196	98
2-Nitrotoluene	88-72-2	3,200	USEPA RSL[1,6,7]	190	USEPA ERASG[2]	207	USEPA ERASG[3]	1,067	150	150	150	148	74
3-Nitrotoluene	99-08-1	630	USEPA RSL[1,6,7]	130	USEPA ERASG[2]	145	USEPA ERASG[3]	210	150	150	150	148	48
4-Amino-2,6-Dinitrotoluene	19406-51-0	770	USEPA RSL[1,6,7]	12,000	USEPA ERASG[2]	28	USEPA ERASG[4]	257	4,000	120	120	80	30
4-Nitrotoluene	99-99-0	25,000	USEPA RSL[1,6,7]	140	USEPA ERASG[2]	145	USEPA ERASG[3]	8,333	150	150	150	148	54
HMX	2691-41-0	390,000	USEPA RSL[1,6,7]	16,000	USEPA ERASG[2]	108	USEPA ERASG[4]	130,000	5,333	200	200	150	71
Nitrobenzene	98-95-3	5,100	USEPA RSL[1,6,7]	2,200	USEPA ERASG[2]	407	USEPA ERASG[3]	1,700	733	136	120	80	22
Nitroglycerin	55-63-0	630	USEPA RSL[1,6,7]	13,000	USEPA ERASG[2]	10	USEPA ERASG[4]	2,400	4,333	2,400	2,400	2,000	760
PETN	78-11-5	13,000	USEPA RSL[1,6,7]	2,200	USEPA ERASG[2]	NE	-	4,333	2,400	12,000	2,400	2,000	1,000
RDX	121-82-4	8,300	USEPA RSL[1,6,7]	2,300	USEPA ERASG[2]	65	USEPA ERASG[4]	2,767	767	120	120	100	45
Tetryl	479-45-8	16,000	USEPA RSL[1,6,7]	18	USEPA ERASG[2]	NE	-	5,333	150	750	150	148	68

QAPP Worksheet #15-14 – Explosive Compounds (Soil and Sediment) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[5] (µg/kg)	PQL Goal Ecological[5] Soil (µg/kg)	PQL Goal Ecological[5] Sediment (µg/kg)	Achievable Laboratory Limits		
											LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
4. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018; USEPA, 2018).
5. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
6. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
7. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
EcoSSL = Ecological Soil Screening Level
ERASG = Ecological Risk Assessment Supplemental Guidance
LANL = Los Alamos National Laboratory
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-15 - Dioxins (Soil) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: Dioxins (USEPA Method 8290A)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	PQL Goal Human[3] (µg/kg)	PQL Goal Ecological[3] Soil (µg/kg)	Achievable Laboratory Limits		
								LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
1234678-HpCDD	35822-46-9	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
1234678-HpCDF	67562-39-4	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
123478-HxCDD	39227-28-6	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
123478-HxCDF	70648-26-9	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
1234789-HpCDF	55673-89-7	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
123678-HxCDD	57653-85-7	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
123678-HxCDF	57117-44-9	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
12378-PeCDD	40321-76-4	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
12378-PeCDF	57117-41-6	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
123789-HxCDD	19408-74-3	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
123789-HxCDF	72918-21-9	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
234678-HxCDF	60851-34-5	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
23478-PeCDF	57117-31-4	NE	-	NE	-	0.025	0.025	0.005	0.004	0.002
2378-TCDD	1746-01-6	0.0048	USEPA RSL[1,4,5]	0.00315	USEPA ERASG[2]	0.002	0.001	0.001	0.0008	0.0002
2378-TCDF	51207-31-9	NE	-	NE	-	0.005	0.005	0.001	0.0008	0.0002
OCDD	3268-87-9	NE	-	NE	-	0.05	0.05	0.01	0.008	0.002
OCDF	39001-02-0	NE	-	NE	-	0.05	0.05	0.01	0.008	0.002

Notes:
1. PSL based on the USEPA Regional Screening Levels for Resident Soil (May 2021, USEPA, 2021a).
2. PSL based on the USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018; USEPA, 2018).
3. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
4. The lower of the non-carcinogenic or carcinogenic RSL is reported in the table.
5. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
ERASG = Ecological Risk Assessment Supplemental Guidance
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-16 – Grain Size Distribution (Soil and Sediment) – Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Analytical Group: Grain Size Distribution (ASTM D422)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/kg)	Human PSL Reference	Ecological PSL for Soil (µg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (µg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human (µg /kg)	PQL Goal Ecological Soil (µg/kg)	Achievable Laboratory Limits		
										LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)
Not Applicable												

Legend:
ASTM = American Society for Testing and Materials
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/kg = Micrograms per Kilogram
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-17 - Total Organic Carbon (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil; Sediment
Analytical Group: Total Organic Carbon (USEPA Method 9060A)
Concentration Level: Low

Analyte	CAS	Human PSL (mg/kg)	Human PSL Reference	Ecological PSL for Soil (mg/kg)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (mg/kg)	Ecological PSL for Sediment Reference	PQL Goal Human[1] (mg /kg)	PQL Goal Ecological[1] Soil (mg /kg)	PQL Goal Ecological[1] Sediment (mg /kg)	Achievable Laboratory Limits		
											LOQ (mg/kg)	LOD (mg/kg)	MDL (mg/kg)
Total Organic Carbon	--	NE	-	NE	-	NE	-	1,500	1,500	1,500	300	200	100

Notes:
1. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
mg/kg = Milligrams per Kilogram
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-18 - Cation Exchange Capacity (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil; Sediment
Analytical Group: Cation Exchange Capacity (USEPA Method 9081)
Concentration Level: Low

Analyte	CAS	Human PSL (meq/100gm)	Human PSL Reference	Ecological PSL for Soil (meq/100gm)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (meq/100gm)	Ecological PSL for Sediment Reference	PQL Goal Human[1] (meq/100gm)	PQL Goal Ecological[1] Soil (meq/100gm)	PQL Goal Ecological[1] Sediment (meq/100gm)	Achievable Laboratory Limits		
											LOQ (meq/100gm)	LOD (meq/100gm)	MDL (meq/100gm)
Cation Exchange Capacity (Sodium)	7740-23-5	NE	-	NE	-	NE	-	0.25	0.25	0.25	0.05	--	---

Notes:
1. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
meq/100gm = milliequivalents per 100 grams of soil/sediment
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-19 - Oxidation-Reduction Potential (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil; Sediment
Analytical Group: Oxidation-Reduction Potential (ASTM D1498)
Concentration Level: Low

Analyte	CAS	Human PSL (mV)	Human PSL Reference	Ecological PSL for Soil (mV)	Ecological PSL for Soil Reference	Ecological PSL for Sediment (mV)	Ecological PSL for Sediment Reference	PQL Goal Human (mV)	PQL Goal Ecological Soil (mV)	PQL Goal Ecological Sediment (mV)	Achievable Laboratory Limits		
											LOQ (mV)	LOD (mV)	MDL (mV)
Not Applicable													

Legend:
ASTM = American Society for Testing and Materials
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
mV = Millivolts
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-20 - pH (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil and Sediment
Analytical Group: pH (USEPA Method 9045D)
Concentration Level: Low

Analyte	CAS	Human PSL	Human PSL Reference	Ecological PSL for Soil	Ecological PSL for Soil Reference	Ecological PSL for Sediment	Ecological PSL for Sediment Reference	PQL Goal Human	PQL Goal Ecological Soil	PQL Goal Ecological Sediment	Achievable Laboratory Limits		
											LOQ	LOD	MDL
Not Applicable													

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-21 - Moisture Content (Soil and Sediment) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil; Sediment
Analytical Group: Moisture Content (SM 2540G)
Concentration Level: Low

Analyte	CAS	Human PSL	Human PSL Reference	Ecological PSL for Soil	Ecological PSL for Soil Reference	Ecological PSL for Sediment	Ecological PSL for Sediment Reference	PQL Goal Human	PQL Goal Ecological Soil	PQL Goal Ecological Sediment	Achievable Laboratory Limits		
											LOQ	LOD	MDL
Not Applicable													

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-22 – VOCs (Soil Gas)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil Gas
Analytical Group: VOCs (TO-15)
Concentration Level: Low

Analyte	CAS Number	PSL (µg/m³)	PSL Reference	PQL Goal[2] (µg/m³)	Achievable Laboratory Limits[3]		
					LOQ (µg/m³)	LOD (µg/m³)	MDL (µg/m³)
1,1,1-Trichloroethane	71-55-6	17,400	USEPA VISL[1]	5,800	2.7	1.6	0.33
1,1,2,2-Tetrachloroethane	79-34-5	1.61	USEPA VISL[1]	3.4	3.4	2.1	0.48
1,1,2-Trichloroethane	79-00-5	0.695	USEPA VISL[1]	2.7	2.7	1.6	0.66
1,1-Dichloroethane	75-34-3	58.5	USEPA VISL[1]	19.5	2.0	1.2	0.32
1,1-Dichloroethene	75-35-4	695	USEPA VISL[1]	232	2.0	1.2	0.52
1,2,4-Trichlorobenzene	120-82-1	6.95	USEPA VISL[1]	15	15	7.4	1.9
1,2,4-Trimethylbenzene	95-63-6	209	USEPA VISL[1]	70	2.4	1.5	0.44
1,2-Dibromoethane (EDB)	106-93-4	0.156	USEPA VISL[1]	3.8	3.8	2.3	0.69
1,2-Dichlorobenzene	95-50-1	695	USEPA VISL[1]	232	3.0	1.8	0.42
1,2-Dichloroethane	107-06-2	3.6	USEPA VISL[1]	2	2.0	1.2	0.32
1,2-Dichloropropane	78-87-5	13.9	USEPA VISL[1]	4.6	2.3	1.4	0.79
1,3,5-Trimethylbenzene	108-67-8	209	USEPA VISL[1]	70	2.4	1.5	0.25
1,3-Butadiene	106-99-0	3.12	USEPA VISL[1]	1.1	1.1	0.66	0.24
1,3-Dichlorobenzene	541-73-1	NE	-	15	3.0	1.8	0.60
1,4-Dichlorobenzene	106-46-7	8.51	USEPA VISL[1]	3	3.0	1.8	0.42
1,4-Dioxane	123-91-1	18.7	USEPA VISL[1]	7.2	7.2	3.6	1.2
2,2,4-Trimethylpentane	540-84-1	NE	-	11.5	2.3	1.4	0.60
2-Butanone (Methyl Ethyl Ketone)	78-93-3	17,400	USEPA VISL[1]	5,800	5.9	2.9	1.12
2-Hexanone	591-78-6	104	USEPA VISL[1]	35	8.2	4.1	1.52
2-Propanol	67-63-0	695	USEPA VISL[1]	232	4.9	2.5	0.81
3-Chloropropene	107-05-1	3.48	USEPA VISL[1]	6.3	6.3	3.1	1.5
4-Ethyltoluene	622-96-8	NE	-	12	2.4	1.5	0.44
4-Methyl-2-pentanone	108-10-1	10,400	USEPA VISL[1]	3,467	2.0	1.2	0.70
Acetone	67-64-1	107,000	USEPA VISL[1]	35,667	12	2.4	1.0
alpha-Chlorotoluene	100-44-7	1.91	USEPA VISL[1]	2.6	2.6	1.6	0.16
Benzene	71-43-2	12	USEPA VISL[1]	4	1.6	0.96	0.064
Bromodichloromethane	75-27-4	2.53	USEPA VISL[1]	3.4	3.4	2.0	0.47
Bromoform	75-25-2	85.1	USEPA VISL[1]	28	5.2	3.1	0.62
Bromomethane	74-83-9	17.4	USEPA VISL[1]	19	19	3.9	1.7
Carbon Disulfide	75-15-0	2430	USEPA VISL[1]	810	6.2	3.1	0.70
Carbon Tetrachloride	56-23-5	15.6	USEPA VISL[1]	5.2	3.1	1.9	0.38
Chlorobenzene	108-90-7	174	USEPA VISL[1]	58	2.3	1.4	0.32
Chloroethane	75-00-3	34,800	USEPA VISL[1]	11,600	5.3	2.6	0.87
Chloroform	67-66-3	4.07	USEPA VISL[1]	2.4	2.4	1.5	0.39

QAPP Worksheet #15-22 – VOCs (Soil Gas)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits (continued)

Analyte	CAS Number	PSL (µg/m³)	PSL Reference	PQL Goal[2] (µg/m³)	Achievable Laboratory Limits[3]		
					LOQs (µg/m³)	LODs (µg/m³)	MDLs (µg/m³)
Chloromethane	74-87-3	313	USEPA VISL[1]	104	10	2.1	0.93
cis-1,2-Dichloroethene	156-59-2	NE	-	10	2.0	1.2	0.63
cis-1,3-Dichloropropene	10061-01-5	NE	-	11.5	2.3	1.4	0.36
Cumene	98-82-8	1,390	USEPA VISL[1]	463	2.4	1.5	0.30
Cyclohexane	110-82-7	20,900	USEPA VISL[1]	6,967	1.7	1.0	0.52
Dibromochloromethane	124-48-1	NE	-	21	4.2	2.6	0.68
Ethanol	64-17-5	NE	-	19	3.8	1.9	1.9
Ethyl Benzene	100-41-4	37.4	USEPA VISL[1]	12.5	2.2	1.3	0.13
Freon 11	75-69-4	NE	-	14	2.8	1.7	0.67
Freon 113	76-13-1	17,400	USEPA VISL[1]	5,800	3.8	2.3	0.61
Freon 114	76-14-2	NE	-	17.5	3.5	2.1	0.42
Freon 12	75-71-8	348	USEPA VISL[1]	116	2.5	1.5	0.40
Heptane	142-82-5	1,390	USEPA VISL[1]	463	2.0	1.2	0.53
Hexachlorobutadiene	87-68-3	4.25	USEPA VISL[1]	21	21	11	2.5
Hexane	110-54-3	2,430	USEPA VISL[1]	810	1.8	1.1	0.25
m,p-Xylene	108-38-3	348	USEPA VISL[1]	116	2.2	1.3	0.17
Methyl tert-butyl ether	1634-04-4	360	USEPA VISL[1]	120	7.2	3.6	0.69
Methylene Chloride	75-09-2	2,090	USEPA VISL[1]	697	17	3.5	0.66
o-Xylene	95-47-6	348	USEPA VISL[1]	116	2.2	1.3	0.22
Propylbenzene	103-65-1	3,480	USEPA VISL[1]	1,160	2.4	1.5	0.55
Styrene	100-42-5	3,480	USEPA VISL[1]	1,160	2.1	1.3	0.09
Tetrachloroethene	127-18-4	139	USEPA VISL[1]	46	3.4	2.0	0.75
Tetrahydrofuran	109-99-9	6,950	USEPA VISL[1]	2,317	1.5	0.88	0.32
Toluene	108-88-3	17,400	USEPA VISL[1]	5,800	1.9	1.1	0.08
trans-1,2-Dichloroethene	156-60-5	139	USEPA VISL[1]	46	2.0	1.2	0.71
trans-1,3-Dichloropropene	10061-02-6	NE	-	11.5	2.3	1.4	0.36
Trichloroethene	79-01-6	6.95	USEPA VISL[1]	2.7	2.7	1.6	0.70
Vinyl Chloride	75-01-4	5.59	USEPA VISL[1]	1.86	1.3	0.77	0.33

Notes:
Shaded rows indicate analytes with a LOQ that exceed one or more PSLs. Appendix L contains tables that indicate the corresponding risk levels associated with LOQs (noncancer hazard quotient and cancer risk for human health, and hazard quotient for ecological receptors).

1. USEPA Vapor Intrusion Screening Level Calculator – Target Sub-Slab and Near-source Soil Gas Concentration (TCR=1E-06 or THQ=0.1, Residential) Csg,Target (µg/m3) (USEPA, 2021b)
2. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
3. Achievable laboratory limits are for a 1 L sampling canister and are subject to change depending on the canister dilution factor. LODs and MDLs are instrument specific; LOD values are updated every quarter and MDLs are updated annually. Actual sample LOQs, LODs and MDLs will be elevated due to canister pressurization prior to sample analysis. In general, the dilution factor from pressurization will raise limits approximately 2.64 times for 1L canisters.

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
NE=Not Exist
PSL = Project Screening Limit
PQL = Project Quantitation Limit
TCR= Target Cancer Risk
THQ= Target Hazard Quotient
VISL=Vapor intrusion screening level

QAPP Worksheet #15-23 – Methane and Helium (Soil Gas)- Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil Gas
Analytical Group: Fixed Gases – Methane and Helium (ASTM D1946)
Concentration Level: Low

Analyte	CAS	PSL[1] (%)	PSL Reference	PQL Goal[2] (%)	Achievable Laboratory Limits[3]		
					LOQ (%)	LOD (%)	MDL (%)
Methane	74-82-8	5	US CFR[1]	1.6	.0001	0.00005	0.000028
Helium	7440-59-7	Not Applicable	-	0.25	0.05	0.0039	0.0012

Notes:
1. United States Code of Federal Regulations (CFR) 40 § 258.23 (a) (2) "Concentration of methane gas does not exceed the lower explosive limit for methane at the facility property boundary." Methane LEL is 5%. If exceedances of the methane LEL are measured during the RI sampling activities, the SSHO will notify the TI-SDC Safety and Health Manager and evaluate whether there are any field personnel health and safety concerns requiring adjustments to work procedures.
2. The PQLs listed are based on 1/3 of the lowest screening level except where that value is less than the LOQ. In circumstances when 1/3 of the lowest screening level is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
3. Achievable laboratory limits are for a 1 L sampling canister and are subject to change depending on the canister dilution factor. LODs and MDLs are instrument specific; LOD values are updated every quarter and MDLs are updated annually. Actual sample LOQs, LODs and MDLs will be elevated due to canister pressurization prior to sample analysis. In general, the dilution factor from pressurization will raise limits approximately 2.64 times for 1L canisters.

Legend:
ASTM = American Society for Testing and Materials
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
PSL = Project Screening Limit
PQL = Project Quantitation Limit

QAPP Worksheet #15-24 - PFAS (Groundwater IDW) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Groundwater IDW
Analytical Group: PFAS (USEPA LC/MS/MS in accordance with QSM, Table B-15)
Concentration Level: Low

Analyte	CAS	Human PSL (µg/L)	Human PSL Reference	PQL Goal Human[2] (µg/L)	Achievable Laboratory Limits		
					LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Perfluorohexanoic acid	307-24-4	NE	-	0.01	0.002	0.001	0.0005
Perfluoroheptanoic acid	375-85-9	NE	-	0.01	0.002	0.001	0.0005
Perfluorooctanoic acid	335-67-1	0.006	USEPA RSL[1,3]	0.002	0.002	0.001	0.0005
Perfluorononanoic acid	375-95-1	0.0059	USEPA RSL[1,3]	0.002	0.002	0.001	0.0005
Perfluorodecanoic acid	335-76-2	NE	-	0.01	0.002	0.001	0.0005
Perfluorotridecanoic acid	72629-94-8	NE	-	0.01	0.002	0.001	0.0005
Perfluorotetradecanoic acid	376-06-7	NE	-	0.01	0.002	0.001	0.0005
Perfluorobutanesulfonic acid	375-73-5	0.6	USEPA RSL[1,3]	0.2	0.002	0.001	0.0005
Perfluorohexanesulfonic acid	355-46-4	0.039	USEPA RSL[1,3]	0.013	0.002	0.001	0.0005
Perfluorooctanesulfonic acid	1763-23-1	0.004	USEPA RSL[1,3]	0.0021	0.0021	0.002	0.001
NEtFOSAA	2991-50-6	NE	-	0.015	0.003	0.001	0.0005
NMeFOSAA	2355-31-9	NE	-	0.01	0.002	0.0012	0.0006
Perfluoropentanesulfonic acid	2706-91-4	NE	-	0.01	0.002	0.001	0.0005
Perfluoroheptanesulfonic acid	375-92-8	NE	-	0.01	0.002	0.001	0.0005
Perfluorononanesulfonic acid	68259-12-1	NE	-	0.01	0.002	0.001	0.0005
Perfluorodecanesulfonic acid	335-77-3	NE	-	0.01	0.002	0.001	0.0005
Perfluorooctanesulfonamide	754-91-6	NE	-	0.01	0.002	0.0014	0.0007
Perfluorobutanoic acid	375-22-4	NE	-	0.025	0.005	0.004	0.002
Perfluoropentanoic acid	2706-90-3	NE	-	0.01	0.002	0.001	0.0005
Perfluoroundecanoic acid	2058-94-8	NE	-	0.01	0.002	0.001	0.0005
Perfluorododecanoic acid	307-55-1	NE	-	0.01	0.002	0.001	0.0005
6:2 Fluorotelomer sulfonic acid	27619-97-2	NE	-	0.040	0.0081	0.008	0.004
8:2 Fluorotelomer sulfonic acid	39108-34-4	NE	-	0.015	0.003	0.002	0.001
4:2 Fluorotelomer sulfonic acid	757124-72-4	NE	-	0.01	0.002	0.001	0.0005

Notes:
1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2022, USEPA, 2022).
2. The PQLs listed are based on 1/3 of the PSL except where that value is less than the LOQ. In circumstances when 1/3 of the PSL is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
3. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
LOQ = Level of Quantitation
LOD = Limit of Detection
MDL = Method Detection Limit
µg/L = Micrograms per Liter
NE = Not Established
PSL = Project Screening Limit
PQL = Project Quantitation Limit
RSL = Regional Screening Level.
USACE = United States Army Corps of Engineers
USEPA = United States Environmental Protection Agency

QAPP Worksheet #15-25 - PFAS (Soil IDW) - Project Screening Levels and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil IDW
Analytical Group: PFAS (USEPA LC/MS/MS in accordance with QSM, Table B-15)
Concentration Level: Low

Analyte	CAS	Human PSL (mg/kg)	Human PSL Reference	PQL Goal Human[2] (mg/kg)	Achievable Laboratory Limits		
					LOQ (mg/kg)	LOD (mg/kg)	MDL (mg/kg)
Perfluorohexanoic acid	307-24-4	NE	-	0.003	0.0006	0.0004	0.0002
Perfluoroheptanoic acid	375-85-9	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorooctanoic acid	335-67-1	0.019	USEPA RSL1,3	0.006	0.0006	0.0004	0.0002
Perfluorononanoic acid	375-95-1	0.019	USEPA RSL1,3	0.006	0.0006	0.0004	0.0002
Perfluorodecanoic acid	335-76-2	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorotridecanoic acid	72629-94-8	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorotetradecanoic acid	376-06-7	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorobutanesulfonic acid	375-73-5	1.9	USEPA RSL1,3	0.63	0.002	0.0016	0.0004
Perfluorohexanesulfonic acid	355-46-4	0.13	USEPA RSL1,3	0.04	0.0006	0.0004	0.0002
Perfluorooctanesulfonic acid	1763-23-1	0.013	USEPA RSL1,3	0.004	0.0006	0.0004	0.0002
NEtFOSAA	2991-50-6	NE	-	0.01	0.002	0.0004	0.0002
NMeFOSAA	2355-31-9	NE	-	0.01	0.002	0.0004	0.0002
Perfluoropentanesulfonic acid	2706-91-4	NE	-	0.015	0.003	0.0004	0.0002
Perfluoroheptanesulfonic acid	375-92-8	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorononanesulfonic acid	68259-12-1	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorodecanesulfonic acid	335-77-3	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorooctanesulfonamide	754-91-6	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorobutanoic acid	375-22-4	NE	-	0.01	0.002	0.0016	0.0006
Perfluoropentanoic acid	2706-90-3	NE	-	0.003	0.0006	0.0004	0.0002
Perfluoroundecanoic acid	2058-94-8	NE	-	0.003	0.0006	0.0004	0.0002
Perfluorododecanoic acid	307-55-1	NE	-	0.003	0.0006	0.0004	0.0002
6:2 Fluorotelomer sulfonic acid	27619-97-2	NE	-	0.01	0.002	0.0016	0.0006
8:2 Fluorotelomer sulfonic acid	39108-34-4	NE	-	0.015	0.003	0.0016	0.0006
4:2 Fluorotelomer sulfonic acid	757124-72-4	NE	-	0.01	0.002	0.0016	0.0006

Notes:
1. PSL based on the USEPA Regional Screening Levels for Tapwater (May 2022, USEPA, 2022).
2. The PQLs listed are based on 1/3 of the PSL except where that value is less than the LOQ. In circumstances when 1/3 of the PSL is less than the LOQ, the PQL is set at the lab's LOQ due to limitations in the analytical method. When no screening level is listed, the PQL is set at 5-times the LOQ. The laboratory achievable detection limits are based on those provided for Eurofins Lancaster Laboratories Environmental in Lancaster, Pennsylvania.
3. The regulatory agencies often revise the USEPA RSLs. USACE will screen future analytical data to the current USEPA RSLs when reporting the data.

Legend:
CAS = Chemical Abstract Service
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PQL = Project Quantitation Limit
RSL = Regional Screening Level.
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QAPP Worksheet #17: Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

Worksheet #17 (Sampling Design and Rationale) describes the judgmental sampling design and associated rationale to meet the objectives of the RI and includes discussion of non-sampling related investigations (e.g., wetlands delineation and geophysical surveying). Details describing the RI field activities and specific tasks are included in Worksheet #18.

A phased sampling approach has been planned to complete the RI. The preliminary phase of RI sampling will focus on characterizing the nature and spatial extent of contamination (not extent of risk) within the AOCs by collecting random and biased samples in each, and include sampling at a reference area for soil, and upgradient and downgradient locations for groundwater, surface water, and sediment to allow for an assessment of potential background/anthropogenic sources and impacts from historical DoD operations. Data collected during the preliminary phase of RI sampling will be evaluated to identify data gaps that exist, which will subsequently be filled by conducting a supplemental phase of RI sampling to adequately characterization of the nature and extent of contamination and/or complete the HHRA and SLERA. The activities and sampling described in this QAPP comprise the preliminary phase of RI sampling. An addendum to this QAPP will be prepared identifying the data gaps and associated sampling that will be performed to fill them during the supplemental phase of RI sampling.

Sampling Design and Rationale:

Preliminary RI sampling activities include surface and subsurface soil sampling, groundwater sampling, surface water sampling, sediment sampling, and soil gas sampling within the Site boundaries as well as reference/upgradient locations where applicable. Sampling conducted within the Site boundaries during the preliminary and supplemental phases of work is designed to adequately characterize the nature and spatial extent of contamination and assess whether any releases from DoD activities poses a threat to human health, safety, or the environment. Reference area soil samples will be collected to characterize naturally occurring and anthropogenic conditions in an area with similar historical use near the Site. In addition, groundwater, surface water, and sediment samples will be collected upgradient of the Site to characterize conditions of these matrices before they enter the Site. The reference soil and upgradient groundwater, surface water, and sediment data will be compared to Site data to determine the nature and spatial extent of contamination and incremental risk to human health and the environment associated with historical operations at the Site.

Background soil gas sampling is not being done because the preliminary phase of sampling is being conducted to evaluate the presence and levels of contamination in the AOCs and determine if additional investigation of soil gas needs to be done. If so, it would be included in the supplemental phase of RI sampling, and background soil gas sampling would be conducted at that

time. It is noted that when there are no on-site buildings, if unacceptable risk associated with soil gas is demonstrated, DoD is required only to notify the landowners of the potential risk.

Physical boundaries for the area under the study

The physical boundaries of the study area include the areas within the AOC 2, AOC 3, and AOC FI boundaries as well as the surrounding upgradient and downgradient areas which encompass nearby surface water features of interest and a designated reference area within the Site boundary. The proposed reference area was chosen based on its close proximity to the Site, which in turn increases the likelihood that it will have similar physical, chemical, geological, and biological characteristics as the Site. The proposed reference area is believed to not have been affected by past activities associated with the Site since it is situated on the other side of an elevated area to the east of AOC 2 and a review of historical imagery does not indicate any significant ground disturbance. The physical boundaries for the area under study are shown in Figure 19 through Figure 21.

Time period represented

The time period represented is the present.

Basis for sampling areas

Sampling areas are defined by the unique AOC as well as physical relationship to each AOC and the proposed reference and upgradient areas. Preliminary exposure points indicate risk will most likely be evaluated for each AOC separately, therefore each AOC is sampled as a unique area. Sampling areas are summarized in Table 10 and shown in Figure 19, Figure 20, and Figure 21 for surface/subsurface soil, groundwater, and surface water/sediment, respectively.

Basis for the number and placement of samples

The initial basis for the number of surface and subsurface soil, groundwater, surface water and sediment samples was determined by recommendations from the Bluestone 2019 ETM, which developed sampling recommendations to address identified data gaps. As documented in Worksheet #10, additional reports documenting past investigations at the Site were made available after the Bluestone 2019 ETM was issued and the CSM was updated to include two additional areas (AOC 3N and AOC FI). Sample numbers and locations were adjusted based on the updates to the CSM. The approximate locations of proposed samples for surface/subsurface soil, groundwater, and surface water/sediment are shown in Figure 19, Figure 20, and Figure 21, respectively. All samples will be discrete samples.

Table 10. Sampling Areas and Rationale by Media

Media	Sampling Area	Rationale
Surface and Subsurface Soil	AOC 2	Encompass the extent of DoD-related activities
	AOC 3S	Encompass the extent of DoD-related activities
	AOC 3N	Encompass the extent of DoD-related activities
	AOC FI	Encompass the extent of DoD-related activities
	Reference	Assess naturally occurring and anthropogenic conditions in a reference area with similar historical use near the Site.
Groundwater	Upgradient AOC 2	Assess conditions in upgradient groundwater and contributions of off-site areas before entering AOC 2
	AOC 2	Assess potential impacts of DoD-related activities
	Downgradient AOC 2	Assess conditions in downgradient groundwater upon leaving AOC 2
	Upgradient AOC 3S	Assess conditions in upgradient groundwater and contributions of off-site areas before entering AOC 3S
	AOC 3S[1]	Assess potential impacts of DoD-related activities.
	AOC 3N[1]	Assess potential impacts of DoD-related activities
	Upgradient AOC FI	Assess conditions in upgradient groundwater and contributions of areas upgradient before entering AOC FI. (Note that downgradient groundwater sampling locations for AOC 2 represent upgradient sampling locations for AOC FI).
	AOC FI[1]	Assess potential impacts of DoD-related activities
Surface Water and Sediment	Upgradient AOC 3	Assess conditions in upgradient surface water/sediment and contributions of off-site areas before entering AOC 3.
	AOC 3	Assess potential contribution from area of DoD-related activities
	AOC 2-CS	Assess potential contribution of AOC 2 relating to the central intermittent stream
	Downgradient AOC 2-CS	Assess conditions in surface water/sediment of central intermittent stream upon leaving AOC 2
	Upgradient AOC 2-SW	Assess conditions in upgradient surface water/sediment and contributions of off-site areas before entering the southwestern portion of AOC 2
	AOC 2-SW	Assess potential contribution of AOC 2 relating to the drainage channel to the southwest
	Downgradient AOC 2-SW	Assess conditions in surface water/sediment of drainage channel in southwestern portion of AOC 2 leaving AOC 2
	AOC FI	Assess potential contribution from area of DoD-related activities
	Downgradient AOC FI	Assess conditions in surface water/sediment of drainage channel upon leaving AOC FI

Table 10. Sampling Areas and Rationale by Media (continued)

Media	Sampling Area	Rationale
Soil Gas	AOC 2	Assess potential impacts of DoD-related activities
	AOC 3	Assess potential impacts of DoD-related activities
	AOC FI	Assess potential impacts of DoD-related activities

1. Downgradient groundwater sampling from AOCs 3S, 3N, and FI are not planned during the preliminary phase of RI sampling as it will first be determined if a DoD release occurred at one or more of these AOCs, and if so, then downgradient wells would be considered during the supplemental phase of investigation.

Soil (Surface and Subsurface)

The number of planned soil samples are listed below by area:

- AOC 2: 30 surface/30 subsurface (15 borings with 2 subsurface samples per boring)
- AOC 3S: 11 surface/12 subsurface (6 borings with 2 subsurface samples per boring)
- AOC 3N: 10 surface/10 subsurface (5 borings with 2 subsurface samples per boring)
- AOC FI: 10 surface/10 subsurface (5 borings with 2 subsurface samples per boring)
- Reference Area: 20 surface/20 subsurface (10 borings with 2 subsurface samples per boring)

The approximate proposed surface and subsurface sampling locations are shown in Figure 19.

For all four AOCs, the surface soil samples are spatially distributed using an adaptive grid through the program Visual Sampling Plan 7 (VSP). For the reference area, the proposed number of sampling locations were placed within an adaptive grid covering the proposed reference area. Locations of soil borings are a subset of the surface soil locations. The boring locations were selected to be approximately every other surface soil sampling location.

Surface soil samples will be collected from 0-1 ft bgs to assess ecological and human health exposure to surface soil in risk assessments based on the human health and ecological CSMs. Surface soil samples will be collected using a hand auger or trowel.

Subsurface soil samples will be collected from 1-5 ft bgs, 5-10 ft bgs, 10-15 ft bgs, etc. within the vadose zone and to the depth that groundwater is encountered. Subsurface soil from 1-4 ft bgs will be used to assess ecological and human health exposure to subsurface soil and subsurface soil from 5-10 ft bgs will be used to assess human health exposure under certain scenarios (e.g., construction worker in excavation) to subsurface soil. Since groundwater levels at the Site are generally shallow (i.e., within twelve (12) feet of ground surface in most areas), it is anticipated that two subsurface soil samples will be collected from most borings. The exact depth that samples will be collected from each subsurface interval will be the following:

- To provide unbiased data that is representative of overall Site conditions, VOC samples within each subsurface soil sampling interval will be collected from the approximate mid-point of the interval. If during subsurface soil sampling, visible or field instrument-detected contamination is present, VOC sample(s) will also be collected from the interval that the impacts are observed/measured to assist in defining potential source areas and inform the

characterization of the nature and spatial extent of contamination. At the completion of the preliminary phase of sampling, all of the data collected during the preliminary phase will be reviewed for usability and representativeness to inform the supplemental phase of sampling. As the preliminary phase of sampling may include biased samples, these biased samples will be assumed to be unusable for demonstrating unacceptable DoD-related contamination, unless it is defensibly demonstrated that the data are usable, representative and appropriate to support the objectives of the supplemental phase of sampling.

- All other analyses will be performed on a composite sample consisting of soil across the entire 4 or 5-ft subsurface interval.

If waste material is observed in any soil borings at the depth that groundwater is encountered, the borings will be advanced into the saturated zone until the bottom of the waste material is determined. Soil borings will be advanced utilizing a DPT, hollow-stem auger, or air rotary drill rig, as required by drilling conditions. Soil collection processes may vary depending on the drilling method and are described in WS#18.

Groundwater

The number of wells planned for groundwater sampling are listed below by area:

- Upgradient AOC 2: 6 wells (All existing: SFMW-3, MEG-2, SFMW-4, SFMW-5, SLMW-01, SLMW-02)
    - There are additional upgradient wells which are not proposed for sampling. The selected wells are closest to the AOC 2 boundary and provide sufficient coverage to determine if contamination is coming onto the Site.
- AOC 2: 16 wells (All existing: GWML-02, SLMW-03 through SLMW-09, SLMW-10S, SLMW-10D, SLMW-13S, SLMW-13D, SLMW-22, SLMW-24, SLMW-25, and SLMW-26)
    - All wells with the AOC 2 boundary are to be sampled. The existing 16 wells provide good spatial coverage of AOC 2 which is needed given the heterogenous nature of the landfill material at AOC 2.
- Downgradient AOC 2: 13 wells (All existing: CW-11, SLMW-11S, SLMW-11D, SLMW-12S, SLMW-12D, SLMW-16S, SLMW-16D, SLMW-17S, SLMW-17D, SLMW-18S, SLMW-18D, SLMW-19S, SLMW-19D.)
    - There are additional downgradient wells which are not proposed for sampling. The selected wells provide sufficient downgradient coverage to detect if contamination is leaving AOC 2.
- Upgradient AOC 3S: 1 well (1 to be installed: SLMW-28)
    - No upgradient monitoring wells exist for AOC 3S. A new upgradient well is proposed to determine if contamination is coming onto the Site. The proposed well will be co-located at a subsurface soil sampling location.
- AOC 3S: 4 wells (3 existing: SLMW-20S, SLMW-20D, SLMW-21WT; 1 to be installed: SLWM-27)

    - The three existing wells in two unique locations do not provide sufficient coverage of AOC 3S given the heterogenous nature of the landfill material at AOC 3S. Therefore, an additional well is proposed in the northwest portion of AOC 3S.
- AOC 3N: 1 well (1 to be installed: SLMW-29)
    - No monitoring wells exist within AOC 3N. A new well is proposed to determine if contamination is present in groundwater at AOC 3N.
- AOC FI: 1 well (1 to be installed: SLMW-30)
    - No monitoring wells exist within AOC FI. A new well is proposed to determine if contamination is present in groundwater at AOC FI.

The proposed groundwater sampling locations are shown in Figure 20. Both overburden and bedrock wells are proposed to be sampled to evaluate the vertical distribution of chemicals in groundwater. If it is determined after an initial round of sampling that additional vertical coverage is necessary, then it will be done during the supplemental phase of RI sampling. Note that all the proposed new wells will be installed into the overburden material.

The depth of the screened interval for existing wells is provided in WS#18, Table 17. Groundwater will be sampled using low-flow groundwater purging to reduce investigation derived waste and minimize turbidity.

Surface Water and Sediment

Twenty (20) co-located surface water and sediment samples are proposed. The number of samples is based on a sufficient number of samples to capture upgradient, Site and downgradient locations along the three main drainage paths in the study area. The objective for each proposed location is provided in WS#18, Table 13 and Table 14.

The proposed location of co-located surface water and sediment samples are shown in Figure 21.

Surface water will be sampled using a peristaltic pump with dedicated tubing set 1) approximately 2 ft above the bottom of the surface water body to minimize impacts of any bottom disturbance, and 2) at least 2 ft below the surface of the water body. If the surface water body is less than 2 ft deep, the sample will be collected near the bottom with as little bottom disturbance as possible. The planned sampling depth interval is intended to represent the lower portion of the water column, avoiding suspended sediments at the sediment-water interface. The lower part of the water column is expected to reflect potential flux of chemicals from the sediment and/or upwelling groundwater and this approach is intended to provide a representative sample of the surface water body. The sampling depth at each location will be recorded on field forms.

Sediment samples will be collected using a ponar grab sampler or hand corer from 0 to 6 inches below sediment surface, which represents the interval within which the majority of aquatic life will be exposed. If the sediment is too coarse grained to employ either the grab sampler or hand corer, then a hand trowel will be used. The corer will reduce bias away from finer material which is possible when using a trowel.

Soil Gas

The number of planned soil gas samples are listed below by area:

- AOC 2: 8
- AOC 3S: 3
- AOC 3N: 3
- AOC FI: 3

Soil gas samples will be located adjacent to select soil borings. The soil gas locations will be selected based on the field subsurface soil screening results during the soil boring process described in Worksheet #18. Soil gas sampling locations and intervals will be selected to provide a representative dataset of vadose zone soil gas concentrations that exist across the AOCs present at the Site with some samples being collected from borings ranging from little to no indication of organic vapors to those with the highest indication of organic vapors.

Soil gas samples will be collected using a single Post-Run Tubing (PRT) system that allows for soil gas to be collected from the desired depth directly into the laboratory provided canisters.

ISM Sampling Considerations

The project team evaluated the potential for using ISM for soil and/or sediment sampling specifically at the AOCs to be investigated at Former Stewart AFB. The team concluded that challenges associated with there being no published ISM methods for the large list of analytes proposed for chemical testing favor a discrete sampling approach over systematically implementing ISM for the Primary RI sampling effort. In addition, based on the CSM, subsurface soil sampling is planned to understand the nature and spatial extent of contamination at the Site. Accomplishing ISM sampling for subsurface soil requires a substantial amount of drilling to collect the required sample aliquots per decision unit (DU)/SU (minimum of 30). Due to the associated logistical and financial implications, ISM sampling is considered impractical for subsurface soil sampling. ISM as a possible sampling approach will be re-evaluated in the future as appropriate based on updated understanding of the Site and data collected during the RI activities.

How sample positions will be located once in the field if specified in QAPP

Soil (Surface and Subsurface) and Soil Gas

The latitude and longitude of the locations identified on Figure 19 will be loaded into a portable global positioning application such as ArcGIS Explorer or similar. The application will allow the field team to locate the approximate latitude and longitude as shown on Figure 19. All surface soil sample locations will be marked in the field with a flag prior to sampling. The flags will help to establish locations for soil borings as well. Additionally, once soil borings are complete, the locations selected for soil gas sampling will be identified with stake markers.

Groundwater

Groundwater sample positions for existing wells will be determined by locating the wells in the field. The field team will have a physical map with the historical well locations to guide them. The field team may also use a metal detector to locate wells. Choosing the locations to install the new wells will be guided using the longitude and latitude of the proposed locations shown in Figure 20. Professional judgement will be used the select the best drilling site near the approximate location based on site conditions.

Surface Water and Sediment

The field team will use their professional judgement to determine each of the surface water and sediment sampling locations. Worksheet #18 describes the intent for each surface water and sediment sampling location. Latitude and longitudes of the approximate locations from Figure 21 will be used to guide the team to the approximate locations. Then based on observed field conditions, the team will collect the sample from a location which best meets the identified objective for the sample.

Decision process for changing sampling location if planned location is not possible

Soil (Surface and Subsurface)

The surface and subsurface soil sampling locations are laid out in adaptive grids. If a planned location for soil sampling is not possible, the field team will try to find a suitable alternative sampling location still within the grid square. If a suitable location cannot be located within the grid cell, the sample will be relocated by shifting it to the left or right edge of the AOC along the same horizontal grid level favoring the side with the largest space between the current last sample in that grid level and the edge.

Groundwater

If is not possible to sample from an existing well within the Site or downgradient, the sampling location will not be changed, and the sample will not be collected. For upgradient AOC 2 wells, there are six additional monitoring wells that are designated as backup in the event that one of the planned wells cannot be sampled. In this case, the team would sample from the closest suitable backup well.

Surface Water and Sediment

The planned surface water and sediment sampling locations are approximate. The team will use professional judgement to locate samples to best meet sample objectives specified in worksheet #18. If no sample is possible in the vicinity of the approximate location, and an alternative location can be selected to best meet the objective, then the field team will proceed with sample collection at the alternative location. If that is not possible, the sample will not be collected.

Soil Gas Sampling

The soil gas sampling locations will be adjacent to the soil borings. If an attempted soil gas location is not feasible, another location in the nearby vicinity of the identified boring will be attempted.

Decision process for locating samples in the field

All preliminary RI sampling locations have been planned in the QAPP.

Contingencies for changes in field conditions that could affect the sample design

The field team will use professional judgement to identify a strategy for completing the sampling that will allow for meeting project DQOs documented in Worksheet #11 and sample specific objectives. Field conditions that are substantially different would be reported to the TI-SDC PM who would consult the project team to determine a path forward.

RI Approach

This section identifies the investigation activities planned for the preliminary phase of the RI. Detailed descriptions of field activities and task descriptions to implement the investigation activities are provided in Worksheet #18 following the Sampling Locations and Methods section.

Preliminary RI Activities

Planned investigation activities during the preliminary phase of the RI are as follows:

- Redevelop, repair, or abandon wells as necessary.
- Conduct subsurface utility survey at AOC FI.
- Collect groundwater samples, including groundwater elevation survey.
- Complete wetland delineation field survey in and around AOC FI to identify areas that meet the definition of wetlands.
- Collect co-located surface water and sediment samples at identified locations.
- Collect surface soil samples from AOC 2, AOC 3, AOC FI, and the proposed reference area.
- Install soil borings and collect subsurface soil samples at AOC 2, AOC 3, AOC FI, and the proposed reference area.
- Collect soil gas samples from AOC 2, AOC 3, and AOC FI.
- Install, develop, gauge and sample from new monitoring wells at AOC 3S, AOC 3N, and AOC FI.
- Land survey all primary RI sampling locations.

All soil, groundwater, surface water, sediment, and soil gas samples will be analyzed by certified, fixed laboratories for the analytes specified in Worksheet #11. The order of investigation activities may vary depending on weather and field team logistics.

Supplemental RI Activities

Additional data gap sampling will be performed during a supplemental phase of work if critical data gaps remain following the preliminary phase RI sampling that would not allow for risk assessments to be completed or the nature and extent of contamination to be adequately defined. Supplemental QAPP Worksheets #11, #17, and #18 to address DQOs and sampling design for additional samples would be prepared prior to the supplemental phase of field work. Supplemental investigation activities would follow the same applicable investigation procedures executed for the preliminary RI sampling activities.

QAPP Worksheet #18: Sampling Locations and Methods

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.4 and 2.3.2)

This worksheet describes the planned RI field activities and specific tasks that would otherwise be covered in the Field Activities portion of a Work Plan.

Sampling Locations and Methodology

The following tables provide a completeness check for field personnel and auditors/assessors to ensure all planned samples are collected and properly analyzed. Worksheet #20 describes additional quality control samples including matrix spike (MS)/matrix spike duplicate (MSD), trip blanks, and equipment blanks.

Location IDs were developed in accordance with Recommended Naming Conventions for Locations and Field Samples, FUDSChem User Manual, Version 2.1 Appendix B to facilitate straightforward FUDSChem data entry.

Field Sample IDs will be generated according to the following conventions:

Surface Soil: FSA-[Location ID]-[Depth]-[Date]

Subsurface Soil: FSA-[Location ID]-[Depth]-[Date]

Groundwater: FSA-[Well ID]-[Date]

Surface Water: FSA-[Location ID]-[Date]

Sediment: FSA-[LocationID]-[Date]

Soil Gas: FSA-[LocationID]-[Date]

The depth placeholder in the Sample ID [Depth] will be replaced by two numbers representing the depth interval below ground surface (e.g., 0-1, 1-5, 5-10, etc.]) from which the sample was collected.

The date placeholder of the Sample ID suffix [Date] will be displayed as a two-digit month and two-digit year (e.g., July 2021 would be “0721”).

Duplicates will be blind duplicates, with Location IDs numbered sequentially starting one unit greater than the highest location ID for a given matrix.

Soil (Surface and Subsurface):

All surface soil samples will be collected from 0-1 ft bgs. Subsurface soil samples will be collected from 1-5 ft bgs, 5-10 ft bgs, 10-15 ft bgs, etc. at each bore hole within the vadose zone and to the depth that groundwater is encountered (see description of Subsurface Soil Sampling under RI Field Activities later in this worksheet). Based on historical water levels measured at the Site it is estimated on average that two subsurface soil samples will be collected from each boring; however, it is possible the more or less subsurface samples will end up being collected during the sampling activities based on the depth of groundwater. VOC samples within each subsurface interval will be collected from the approximate mid-point of the interval. In addition, if visible or field instrument-detected contamination is observed during subsurface soil sampling, VOC samples will be collected from the interval that the impacts are observed/measured to assist in defining potential source areas and inform the characterization of the nature and spatial extent of contamination. All other analyses will be performed on a composite sample consisting of soil across the entire 4 or 5-ft subsurface interval. Soil sampling will follow SOP No. 5 Soil Sampling (See Worksheet #21). See Worksheet #11 for the analytical methods. Table 11 lists the soil samples to be collected. Figure 19 shows the locations of the proposed soil sampling.

For TOC only a subset of all soil samples will be analyzed as outlined in Table 11 to establish an adequate distribution across the Site. Presence of ash in subsurface soil samples will be determined by visual observation in the field and will lead to dioxins analysis within the associated AOC subsurface soil samples and reference area subsurface soil samples if ash is present.

Table 11. Soil Sampling Locations

Sampling Location	Matrix	Depth (Feet)	Analytical Group[1]	Number of Samples[3]	Comments	Sampling SOP Reference
AOC 2: SS001 to SS030	Soil	0-1	SVOCs, OCPs, PCBs, metals, mercury, explosive compounds, grain size distribution, CEC, ORP, pH, moisture content, TOC (at SS002, SS004, SS012, SS021, SS025, SS030)	30	Hand auger or trowel	No. 5 Soil Sampling
AOC 3N: SS041 to SS050	Soil	0-1	SVOCs, PCBs, metals, mercury, explosive compounds, grain size distribution, CEC, ORP, pH, moisture content, TOC (at SS043, SS050, SS051, SS055, SS059)	10	Hand auger or trowel	No. 5 Soil Sampling
AOC 3S: SS051 to SS061	Soil	0-1		11	Hand auger or trowel	No. 5 Soil Sampling
AOC FI: SS031 to SS040	Soil	0-1	SVOCs, PCBs, metals, mercury, grain size distribution, CEC, ORP, pH, moisture content, TOC (at SS034 and SS040)	10	Hand auger or trowel	No. 5 Soil Sampling
Reference Area: SS062 to SS081	Soil	0-1	SVOCs, OCPs, PCBs, metals, mercury, explosives compounds, grain size distribution, CEC, ORP, pH, moisture content, TOC (at SS062, SS067, SS075, SS080)	20	Hand auger or trowel	No. 5 Soil Sampling
AOC 2: BH001, BH002, BH004, BH006, BH009, BH010, BH012, BH014, BH016, BH018, BH021, BH023, BH025, BH028, BH030	Soil	2 Intervals	VOCs, SVOCs, OCPs, PCBs, metals, mercury, explosive compounds, grain size distribution, CEC, ORP, pH[2], moisture content, dioxins (only if ash is present), TOC (at BH002, BH021, BH030)	30	Drill rig	No. 5 Soil Sampling
AOC 3N: BH041, BH043, BH046, BH048, BH050	Soil	2 Intervals	VOCs, SVOCs, PCBs, metals, mercury, explosive compounds, grain size distribution, CEC, ORP, pH[2], moisture content, dioxins (only if ash is present), TOC (at BH043, BH050, BH051, BH059)	10	Drill rig	No. 5 Soil Sampling
AOC 3S: BH051, BH053, BH055, BH057, BH059, BH061	Soil	2 Intervals		12	Drill rig	No. 5 Soil Sampling
AOC FI: BH034, BH035, BH036, BH038, BH040	Soil	2 Intervals	VOCs, SVOCs, PCBs, metals, mercury, grain size distribution, CEC, ORP, pH[2], moisture content, dioxins (only if ash is present), TOC (at BH034)	10	Drill rig	No. 5 Soil Sampling
Reference Area: BH063, BH065, BH067, BH070, BH072, BH073, BH075, BH076, BH078, BH080	Soil	2 Intervals	VOCs, SVOCs, OCPs, PCBs, metals, mercury, explosive compounds, grain size distribution, CEC, ORP, pH[2], moisture content, dioxins (only if dioxins are analyzed in any AOC), TOC (at BH065, BH073)	20	Drill rig	No. 5 Soil Sampling

1. VOC = Volatile Organic Compound, SVOC = Semi-Volatile Organic Compound, OCP = Organochlorine Pesticides, PCB = Poly Chlorinated Biphenyl, CEC = Cation Exchange Capacity, ORP = Oxidation-Reduction Potential, TOC = Total Organic Carbon.
2. Some subsurface soil samples need to be collected from 1 to 2 ft bgs because it is a potential exposure medium for deep-rooted plants and some ecological benchmarks are intended for soils within a certain pH range; therefore, it is important to understand what the pH is in shallow subsurface soil.
3. Duplicate samples will be collected for 10% of all soil samples at locations spread across the Site to evaluate field reproducibility. MS/MSD samples will also be collected for 5% of soil samples across the Site to evaluate laboratory method precision and accuracy (See Worksheet #20).

Groundwater:

Groundwater sampling will follow SOP No. 2 Groundwater Sampling (See Worksheet #21). See Worksheet #11 for the analytical methods. Table 12 lists the groundwater samples to be collected. Figure 20 shows the locations of the proposed groundwater sampling.

For alkalinity, sulfide, chloride, and sulfate analysis only a subset of all groundwater samples will be analyzed as outlined in Table 12 to establish an adequate distribution across the Site.

Table 12. Groundwater Sampling Locations

Sampling Location[1]	Matrix[2]	Sampling Interval	Analytical Group[3]	Number of Samples[4]	Comments	Sampling SOP Reference
Upgradient AOC 2: SFMW-3, MEG-2, SFMW-4, SFMW-5, SLMW-01, SLMW-02	GW	At Screened Interval (Variable)	VOCs incl. SIM, SVOCs incl. SIM, OCPs, PCBs, metals (total and dissolved), mercury (total and dissolved), explosive compounds, hardness Alkalinity, sulfide, chloride, and sulfate at SFMW-3, SFMW-5, SLMW-01, SLMW-06, SLMW-08, SLMW-10S, SLMW-10D, SLMW-13S, SLMW-22, SLMW-25, SLMW-26, CW-11, SLMW-11S, SLMW-11D, SLMW-17S, SLMW-17D, SLMW-18S, SLMW-19S	6+1 Duplicate	Pour from pump discharge line	No. 2 Groundwater Sampling
AOC 2: GWML-02, SLMW-03 through SLMW-09, SLMW-10S, SLMW-10D, SLMW-13S, SLMW-13D, SLMW-22, SLMW-24, SLMW-25, SLMW-26	GW	At Screened Interval (Variable)		16+2 Duplicates	Pour from pump discharge line	No. 2 Groundwater Sampling
Downgradient AOC 2: CW-11, SLMW-11S, SLMW-11D, SLMW-12S, SLMW-12D, SLMW-16S, SLMW-16D, SLMW-17S, SLMW-17D, SLMW-18S, SLMW-18D, SLMW-19S, SLMW-19D	GW	At Screened Interval (Variable)		13+1 Duplicate	Pour from pump discharge line	No. 2 Groundwater Sampling
Upgradient AOC 3S: SLMW-28	GW	Overburden	VOCs incl. SIM, SVOCs incl. SIM, PCBs, metals (total and dissolved), mercury (total and dissolved), explosive compounds, hardness, alkalinity, sulfide, chloride, sulfate	1	SLMW-28 to be installed; Pour from pump discharge line	No. 2 Groundwater Sampling
AOC 3S: SLMW-20S, SLMW-20D, SLMW-21WT, SLMW-27	GW	At Screened Interval (Variable)	VOCs incl. SIM, SVOCs incl. SIM, PCBs, metals (total and dissolved), mercury (total and dissolved), explosive compounds, hardness Alkalinity, sulfide, chloride, sulfate at SLMW-21WT and SLMW-27	4+1 Duplicate	SLMW-27 to be installed; Pour from pump discharge line	No. 2 Groundwater Sampling
AOC 3N: SLMW-29	GW	Overburden	VOCs incl. SIM, SVOCs incl. SIM, PCBs, metals (total and dissolved), mercury (total and dissolved), explosive compounds, hardness, alkalinity, sulfide, chloride, sulfate	1	SLMW-29 to be installed; Pour from pump discharge line	No. 2 Groundwater Sampling
AOC FI: SLMW-30	GW	Overburden	VOCs incl. SIM, SVOCs incl. SIM, PCBs, metals (total and dissolved), mercury (total and dissolved), hardness, alkalinity, sulfide, chloride, sulfate	1	SLMW-30 to be installed; Pour from pump discharge line	No. 2 Groundwater Sampling

1. The naming convention for existing monitoring wells that has been used at the Site will be used for naming newly installed wells. Note that hyphens will not be used on sample chain of custody forms (e.g., SFMW3 for SFMW-3).
2. GW = Groundwater
3. VOC = Volatile Organic Compound, SVOC = Semi-Volatile Organic Compound, SIM = Selective Ion Monitoring, OCP = Organochlorine Pesticides, PCB = Poly Chlorinated Biphenyl, CEC = Cation Exchange Capacity, ORP = Oxidation-Reduction Potential.
4. Duplicate samples will be collected for 10% of all groundwater samples at locations spread across the Site that have adequate volume to fill the required containers to evaluate field reproducibility. MS/MSD samples will also be collected for 5% of soil and groundwater samples across the Site from locations that have adequate volume to fill the required containers to evaluate laboratory method precision and accuracy (See Worksheet #20).

Surface Water and Sediment:

Surface water and sediment samples will be co-located. Surface water and sediment sampling will follow SOP No. 10 Surface Water/Sediment Sampling (See Worksheet #21). See Worksheet #11 for the analytical methods. Table 13 lists the surface water samples to be collected and Table 14 lists the sediment samples to be collected. For alkalinity, sulfide, chloride, and sulfate analysis only a subset of all surface water samples will be analyzed as outlined in Table 13 to establish an adequate distribution across the Site.

Table 13. Surface Water Sampling Locations

Sampling Location	Matrix[1]	Depth	Analytical Group[2]	Number of Samples[3]	Comments	Sampling SOP Reference
Upgradient Locations: • Outflow from Recreation Pond: SW001 • Outfall 013: SW003 • Outfall 012: SW004 • Outfall 011: SW009 • Northern drainage from MCC facility prior to joining wetland: SW010	SW	2 ft above the bottom of the surface water body. If less than 2 ft deep, near bottom with as little bottom disturbance as possible.	VOCs incl. SIM, SVOCs incl. SIM, OCPs (at sampling locations upgradient, downgradient, and within AOC 2), PCBs, metals (total and dissolved), mercury (total and dissolved), explosive compounds, DOC Alkalinity, sulfide, chloride, sulfate at SW001, SW002, SW003, SW004, SW006, SW007, SW008, SW009, SW010, SW011, SW015, SW018, SW019	20+2 duplicates	Grab collected using a peristaltic pump	No. 10 Surface Water/Sediment Sampling
Site Related Locations: • Adjacent to AOC 3N: SW002 • Along drainage from Outfall 012 and 013 just prior to joining stream from recreation pond: SW005 • Adjacent to northern portion of AOC 3S: SW006 • Adjacent to southern portion of AOC 3S: SW007 • Within wetland and within AOC 2 south of military fill boundary: SW011 • Within AOC 2 near northernmost portion of origin of central intermittent stream: SW015 • Within AOC 2 near middle portion of origin of central intermittent stream: SW016 • Within AOC 2 near southern portion of origin of central intermittent stream: SW017 • Within AOC 2 at location of historically identified seep: SW018						
Downgradient Locations: • Within wetland north of northern drainage from MCC facility joining wetland: SW012 • Within wetland near southernmost boundary and downstream drainage from MCC facility: SW013 • Along drainage from wetland prior to southern drainage from MCC facility: SW014 • Downgradient AOC FI: SW008 • Downgradient of AOC 2 along intermittent stream drainage: SW019 • Along Silver Stream downstream of AOC FI: SW020						

1. SW= Surface Water
2. VOC = Volatile Organic Compound, SVOC = Semi-Volatile Organic Compound, SIM = Selective Ion Monitoring, OCP = Organochlorine Pesticides, PCB = Poly Chlorinated Biphenyl, DOC = Dissolved Organic Carbon.
3. Duplicate samples will be collected for 10% of all surface water samples at locations spread across the Site that have adequate volume to fill the required containers to evaluate field reproducibility. MS/MSD samples will also be collected for 5% of surface water samples across the Site from locations that have adequate volume to fill the required containers to evaluate laboratory method precision and accuracy (See Worksheet #20).

Table 14. Sediment Sampling Locations

Sampling Location	Matrix[1]	Depth (inches)	Analytical Group[2]	Number of Samples[3]	Comments	Sampling SOP Reference
Upgradient Locations: • Outflow from Recreation Pond: SD001 • Outfall 013: SD003 • Outfall 012: SD004 • Outfall 011: SD009 • Northern drainage from MCC facility prior to joining wetland: SD010	SD	0-6	VOCs incl. SIM, SVOCs incl. SIM, OCPs (at sampling locations upgradient, downgradient, and within AOC 2), PCBs, metals, mercury, explosive compounds, grain size distribution, TOC, CEC, ORP, moisture content, pH	20	Ponar grab sampler or hand corer	No. 10 Surface Water/Sediment Sampling
Site Related Locations: • Adjacent to AOC 3N: SD002 • Along drainage from Outfall 012 and 013 just prior to joining stream from recreation pond: SD005 • Adjacent to northern portion of AOC 3S: SD006 • Adjacent to southern portion of AOC 3S: SD007 • Within wetland and within AOC 2 south of military fill boundary: SD011 • Within AOC 2 near northernmost portion of origin of central intermittent stream: SD015 • Within AOC 2 near middle portion of origin of central intermittent stream: SD016 • Within AOC 2 near southern portion of origin of central intermittent stream: SD017 • Within AOC 2 at location of historically identified seep: SD018						
Downgradient Locations: • Within wetland north of northern drainage from MCC facility joining wetland: SD012 • Within wetland near southernmost boundary and downstream drainage from MCC facility: SD013 • Along drainage from wetland prior to southern drainage from MCC facility: SD014 • Downgradient AOC FI: SD008 • Downgradient of AOC 2 along intermittent stream drainage: SD019 • Along Silver Stream downstream of AOC FI: SD020						

1. SD = Sediment
2. VOC = Volatile Organic Compound, SVOC = Semi-Volatile Organic Compound, SIM = Selective Ion Monitoring, OCP = Organochlorine Pesticides, PCB = Poly Chlorinated Biphenyl, CEC = Cation Exchange Capacity, ORP = Oxidation-Reduction Potential, TOC = Total Organic Carbon.
3. MS/MSD samples will be collected for 5% of sediment samples across the Site from locations that have adequate volume to fill the required containers to evaluate laboratory method precision and accuracy (See Worksheet #20)

Soil Gas:

Soil borings will be conducted prior to soil gas sampling to help inform locations and depths of the soil gas sampling locations. Soil gas samples will be collected from the same approximate depth as a VOC sample collected from the respective soil boring (i.e., the midpoint of subsurface soil sampling intervals and intervals that visible or instrument-detected contamination is present). Soil gas sampling locations will be placed 3-5 feet away from their respective soil boring to reduce the potential for any disruption of the equilibrium due to installation of soil borings. Furthermore, soil gas sampling will not occur less than 48 hours after completing work at their respective soil boring (CalEPA, 2015). Soil gas sampling will follow SOP No. 14 Soil Gas Sampling (See Worksheet #21). Table 15 lists the soil gas samples to be collected.

Table 15. Soil Gas Sampling Locations

Sampling Location	Matrix[1]	Sampling Interval	Analytical Group[2]	Number of Samples[3]	Comments	Sampling SOP Reference
AOC 2: SG001 to SG008	SG	Vadose Zone	VOCs, Methane, and Helium	8+1 duplicate	Canister	No. 14 Soil Gas Sampling
AOC 3N: SG009 to SG011	SG	Vadose Zone		3+1 duplicate	Canister	
AOC 3S: SG012 to SG014	SG	Vadose Zone		3	Canister	
AOC FI: SG015 to SG017	SG	Vadose Zone		3	Canister	

1. SG = Soil Gas
2. VOC = Volatile Organic Compound
3. Duplicate samples will be collected for 10% of all soil gas samples at locations spread across the Site to evaluate field reproducibility.

RI Field Activities

The RI will involve multiple surveys and sampling performed during the preliminary phase of the RI and, additional sampling will be performed during a supplemental phase of sampling to fill data gaps identified after the preliminary phase of sampling as outlined in Worksheet #17. Further details regarding the activities proposed during the preliminary phase of RI sampling are described below. TI-SDC field SOPs are provided in Appendix G and Field Forms are provided in Appendix H. The Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP) is provided in Appendix I and the Community Air Monitoring Plan (CAMP) is provided in Appendix J.

Preliminary RI Sampling

Mobilization

Prior to initiation of fieldwork, all field personnel will review this QAPP, including the APP and SSHP included as Appendix I as all field activities will be conducted in accordance with these approved plans. The APP and SSHP discusses the general and site-specific health hazards including COVID-19 protocols, the hazard mitigation procedures, and the emergency response procedures. Daily health and safety tailgate meetings will be conducted with all on-site personnel during each day of field activities.

Prior to mobilizing personnel and heavy equipment (e.g., drill rigs) to the Site, TI-SDC will coordinate with the USACE PM and other stakeholders (e.g., airport personnel) to obtain any required environmental permits, including a dig permit. All stakeholders will be notified of pending RI activities at least four weeks in advance of mobilization to the Site and if any work is to occur within air-side areas of the airport, coordination will occur with airport personnel regarding required escort in a company vehicle.

Based on the GAC (2001) report discussed in Worksheet #10, UXO risk appeared negligible in AOC 2 and it has been determined that the Site is not considered a Military Munitions Response Program (MMRP) site. However, a qualified UXO Technician II will be on-site during all intrusive investigations and will be responsible for leading UXO avoidance activities that are modeled after applicable procedures detailed in the USACE Explosives Safety and Health Requirements Manual (USACE, 2008) and the USACE Munitions and Explosives of Concern (MEC) Support During HTRW and Construction Activities Engineer Pamphlet (2004). TI-SDC will consult with airport personnel to determine if there are any other site-specific dig restrictions due to proximity to the airport.

Wetlands Delineation Survey

TI-SDC have teamed with Woodard and Curran to perform a wetlands delineation survey at the Site. Wetlands delineation activities include conducting desktop research, followed by field assessment and determination per USACE guidelines. The personnel performing the wetlands delineation survey will traverse the surface topography to identify various wetland areas (e.g., freshwater forested/shrub, freshwater emergent, freshwater pond, riverine, outfall and seep areas,

etc.), while considering criteria such as hydrology, hydric soils, and vegetation. The wetlands delineation will be conducted in accordance with the USACE Wetland Delineation Manual (1987) and the Regional Supplement to the USACE Wetland Delineation Manual: North Central and Northeast Region, Version 2.0 (USACE, 2012a). The wetland delineation field assessment will also identify any vernal pools. Wetlands delineation is complete for AOC 2 and AOC 3. Wetlands, streams, and vernal pools in the vicinity of AOC FI will be delineated as part of the primary RI field activities.

Protection of Unique and Special Value Resources

TI-SDC will perform research of current and historical documents, engage in discussions with on-site personnel, and perform site reconnaissance to determine if unique and special value resources are present at the Site. Unique and special value resources may include wetland areas, riparian and other vegetation habitats, nesting and other evidence of inhabitants, areas with endangered and/or protected species habitats, protected vegetation, vernal pools, items of historical value, etc. Any areas determined to contain unique and special value resources will be designated and protected using a combination of temporary fencing, snow-fencing, delineators, caution tape, cones, etc., and will be clearly marked and visible. TI-SDC personnel will communicate any identified areas with all project personnel and discuss risk mitigation activities. Additionally, TI-SDC will notify the USACE PM of any identified resources, and any other appropriate airport entities.

Vegetation Clearing and Site Preparation

TI-SDC will coordinate all required vegetation clearance with a qualified contractor, and/or other responsible entities, prior to the commencement of any intrusive activities at the Site. Any areas that are anticipated to require vegetation clearance will be cleared prior to the investigation. Appropriate erosion and sedimentation controls will be installed in order to safely access and conduct investigation activities. The locations of the surface and subsurface soil sampling locations, and new groundwater monitoring well locations will be staked prior to mobilizing equipment to the Site.

Utility Survey

Prior to intrusive activities, a survey to locate any overhead or observable features of underground utilities in the near vicinity of the soil boring and monitoring well locations will be conducted. TI-SDC will utilize an available New York call center to notify them of the field activities, and representatives from the various utility companies with potential operations in the area will verify, and mark on the surface, all identified underground utilities. Additionally, TI-SDC will coordinate with Dig Safe Systems, Incorporated (Dig Safe), or an equivalent vendor, to perform a third-party utility location survey. Dig Safe, or another entity, will mark on the surface all identified underground utilities. The results of the underground utility clearances will be used to confirm or modify the proposed intrusive sampling locations. TI-SDC will coordinate with airport officials to temporarily disconnect any utilities that are located in or near the proposed soil boring locations, if needed.

Repair of Surface Completions and Well Abandonment

If the existing groundwater monitoring wells are determined to require repair of the surface completion, TI-SDC will repair the surface completion to allow suitable wells to be gauged and sampled. If existing groundwater wells are determined to be unsuitable, TI-SDC will properly abandon the groundwater monitoring wells using a licensed, professional driller. The well abandonment activities will be conducted in accordance with NYSDEC requirements. The resulting soil borings will be backfilled with bentonite grout from the total depth to the surface, and completed with a concrete cap.

Well Gauging and Groundwater Sampling

TI-SDC will perform well redevelopment if necessary. Well redevelopment will be deemed necessary if the well has accumulated sediment as evidenced by differences in the depth to bottom of the well as measured versus the well construction diagram. Well redevelopment will also be deemed necessary and performed if during sampling water quality measurements to not stabilize to meet stabilization criteria.

TI-SDC will perform a groundwater elevation survey by gauging all suitable monitoring wells and monitoring localized groundwater flow.

TI-SDC will collect groundwater samples from existing suitable monitoring wells as specified in the Worksheet #18. Well gauging will follow procedures documented in SOP No. 1 Water Level Measurement, and groundwater sampling will follow procedures documented in SOP No. 2 Groundwater Sampling. Groundwater sampling will not be carried out when weather conditions preclude the operation of field instruments, such as heavy rains.

Groundwater samples will be collected using the low-flow groundwater purging and sampling method as outlined in SOP No. 2. Prior to collecting each sample, groundwater will be purged until water quality measurements (collected every three to five minutes) meet the stabilization criteria shown in Table 16 over three consecutive measurements, with a minimum of five measurement events. Purging rates will be approximately 150 to 200 mL/min to minimize water turbulence and possible outgassing of potential VOCs. Water quality measurements and sampling data will be recorded on the groundwater purge log provided in Appendix H – Field Forms. Groundwater samples will be collected in laboratory-provided containers, properly labeled, and placed in a cooler with ice pending shipment to the laboratory identified in Worksheet #11 to be analyzed according to the analytical approach documented in Step 5 of Worksheet #11.

Sampling equipment will be decontaminated prior to and in between samples according to the TI-SDC SOP No. 4 Sampling Equipment Decontamination (See Worksheet #21) to minimize the possibility of cross-contamination.

Table 16. Stabilization Criteria for Low-Flow Groundwater Sampling

Parameter	Criteria
Dissolved Oxygen	± 10% of reading
Oxidation-Reduction Potential	± 10 millivolts
Turbidity	≤ 10 Nephelometric Turbidity Units (or ± 10% of reading)
Specific Conductivity	± 3% of reading
Temperature	± 10% of reading
pH	± 0.1 units

Groundwater intake pumps will be placed at the approximate midpoint of the well screen. Well details including well depth and depth of screened interval are provided in Table 17.

Table 17. Well Details for Placing Intake Pump for Groundwater Sampling

Well No.	Size (in)	Well Depth (ft)	Depth of Screened Interval (ft bgs)	Top of Casing Elevation (ft amsl)	Geologic Unit/Formation Screened
GWML-02	2	24	18-23	420.12	Unknown
SLMW-01	2	25	10-25	417.72	Overburden/Till
SLMW-02	2	25	15-25	422.12	Bedrock
SLMW-03	2	17	7-17	416.65	Overburden/Till
SLMW-04	2	18	8-18	419.08	Overburden/Till
SLMW-05	2	23	8-23	419.76	Overburden/Till
SLMW-06	2	23	8-23	419.02	Overburden/Till
SLMW-07	2	16	6-16	412.59	Overburden/Till
SLMW-08	2	16	6-16	412.71	Overburden/Till
SLMW-09	2	19	4-19	409.48	Overburden/Till
SLMW-10S	2	24	11.5-21.5	411.38	Overburden/Till
SLMW-11S	2	10	5-10	387.55	Bedrock
SLMW-12S	2	10	5-10	377.28	Bedrock
SLMW-13S	2	11	5-11	383.35	Overburden/Till & Bedrock
SLMW-16S	2	14	4-14	375.83	Bedrock
SLMW-17S	2	32	12-32	399.65	Overburden/Till
SLMW-18S	2	15	5-15	381.11	Overburden/Till & Bedrock
SLMW-19S	2	26	4-26	359.14	Overburden/Till & Bedrock
SLMW-20S	2	23	5-22	NA	Overburden/Till
SLMW-21S(WT)	2	15	5-15	346.53	Overburden/Till
SLMW-22	2	20	10-20	419.02	Overburden/Till
SLMW-24	2	20	10-20	NA	Bedrock
SLMW-25	2	20	10-20	401.42	Overburden/Till
SLMW-26	2	20	5-20	405.94	Overburden/Till
MEG-2	2	15	5-15	NA	Overburden/Till & Bedrock
SFMW-3	2	24	14-24	NA	Bedrock
SFMW-4	2	20	10-20	NA	Bedrock
SFMW-5	2	18	8-18	NA	Bedrock
SLMW-10D	6	91	OB: 39-91	410.31	Bedrock
SLMW-11D	6	27.5	OB: 16.5-27.5	387.22	Bedrock
SLMW-12D	6	53	OB: 18-53	376.10	Bedrock
SLMW-13D	6	27.5	OB: 18-27.5	383.34	Bedrock

Table 17. Well Details for Placing Intake Pump for Groundwater Sampling (continued)

Well No.	Size (in)	Well Depth (ft)	Depth of Screened Interval (ft bgs)	Top of Casing Elevation (ft amsl)	Geologic Unit/Formation Screened
SLMW-16D	6	201	OB: 18-201	376.34	Bedrock
SLMW-17D	6	200	OB: 37.5-200	401.34	Bedrock
SLMW-18D	6	200	OB: 18.5-200	380.61	Bedrock
SLMW-19D	6	200	OB: 28-200	359.08	Bedrock
SLMW-20D	6	42.5	OB: 28-42.5	342.41	Bedrock
CW-11	4	10.5	4-12	396.86	Unknown
SLMW-27	TBD	TBD	TBD	TBD	Overburden/Till
SLMW-28	TBD	TBD	TBD	TBD	Overburden/Till
SLMW-29	TBD	TBD	TBD	TBD	Overburden/Till
SLMW-30	TBD	TBD	TBD	TBD	Overburden/Till

amsl – above mean sea level, bgs – below ground surface, in = inch, ft = feet, OB = open borehole, TBD – to be determined.

Surface Water and Sediment Sampling

TI-SDC will perform co-located surface water and sediment sampling at locations identified in seeps, drainage channels, streams, and wetland areas within and in the nearby vicinity of the Site. Surface water and sediment sampling will follow procedures documented in SOP No. 10 Surface Water/Sediment Sampling. Surface water and sediment sampling should take place when the preceding 72-hours have had less than 0.1 inches of precipitation such that the samples are representative of base flow versus stormwater flow conditions.

TI-SDC will collect surface water samples first from approximately two feet above the bottom of the surface water body. If the depth of the surface water body is less than two feet, then the sample will be collected with as little bottom disturbance as possible. TI-SDC will collect the surface water samples utilizing a peristaltic pump with dedicated tubing. Water quality parameters will be measured in the field prior to collecting surface water samples from each location. All samples will be containerized in laboratory-provided sample containers, properly labeled, and placed in a cooler with ice pending shipment to the laboratory identified in Worksheet #11 to be analyzed according to the analytical approach documented in Step 5 of Worksheet #11 and in Table 13.

Sediment samples will be collected from 0 to 0.5 feet bgs using a ponar grab sampler or hand corer. The ponar sampler is a self-closing clam-shell scoop that provides the collection of an intact sediment. The hand corer has a one-way valve and can be advance by hand. This corer relies on suction and may not work well if the sediment is coarse-grained. If sediment is coarse-grained a hand trowel will be used. These sediment sampling tools are most appropriate for this Site where the surface water depths are wadable. Sediment samples will be hand-packed into laboratory-provided sample containers, properly labeled, and placed in a cooler with ice pending shipment to the laboratory identified in Worksheet #11 to be analyzed according to the analytical approach documented in Step 5 of Worksheet #11 and elaborated in Table 14.

Sampling equipment will be decontaminated prior to and in between samples according to the TI-SDC SOP No. 4 Sampling Equipment Decontamination (See Worksheet #21) to minimize the possibility of cross-contamination.

Surface Soil Sampling

TI-SDC will collect discrete surface soil samples throughout AOC 2, AOC 3, AOC FI and the proposed reference area at the identified locations. TI-SDC will collect the surface soil samples from 0 to 1.0 feet bgs, for use in ecological and human risk assessments. Surface sampling will follow procedures documented in SOP No. 5 Soil Sampling. Surface soil sampling will not be carried out when weather conditions preclude the operation of field instruments or isolation of the sample from precipitation, such as heavy rains.

The soil samples will be collected using a stainless-steel hand auger or trowel. If surface soil sample locations coincide with soil boring locations, surface soil samples may be collected by a licensed, professional driller utilizing a DPT, hollow-stem auger, or air rotary drill rig, as required by drilling conditions. Due to the high volume of soil required for all sample analyses, multiple soil borings located immediately adjacent to each other may be necessary to collect a sufficient volume for all analyses. Surface soil samples will be hand-packed into laboratory-provided 4-ounce, 8-ounce glass jars, or other appropriate containers as required by the laboratory. All sample containers will be properly labeled and placed in a cooler with ice pending shipment to the laboratory identified in Worksheet #11 to be analyzed according to the analytical approach documented in Step 5 of Worksheet #11 and in Table 11.

Sampling equipment will be decontaminated prior to and in between samples according to the TI-SDC SOP No. 4 Sampling Equipment Decontamination (See Worksheet #21) to minimize the possibility of cross-contamination.

Subsurface Soil Sampling

TI-SDC will advance soil borings at the Site at the identified locations, for the purposes of collecting subsurface soil samples and obtaining lithologic data. Each soil boring will be advanced by a licensed, professional driller, utilizing a DPT, hollow-stem auger, or air rotary drill rig, as required by drilling conditions.

Each soil boring will be advanced to the depth that groundwater is encountered. If waste material is observed at the depth of groundwater, the soil boring will continue into the saturated zone to attempt to delineate the vertical extent of the waste. Subsurface sampling will follow procedures documented in SOP No. 5 Soil Sampling. Subsurface soil sampling will not be carried out when weather conditions preclude the operation of field instruments or isolation of the sample from precipitation, such as heavy rains.

During soil boring advancement, soil samples will be collected depending on the drilling technology used. If a DPT drill rig is used to advance the boring, soil samples will be collected via a continuous soil core within an acetate sleeve inside the core barrel of the DPT drill rig, to the

depth of groundwater (and beyond if waste material is observed at the groundwater table). If a hollow-stem auger is used, soil samples will be collected via a split-spoon sampler. If refusal occurs while using a hollow-stem auger drilling approach, air rotary drilling will be used to break through the obstruction before switching back to hollow-stem auger to complete the boring and collect samples from a split-spoon sampler. If a DPT drill rig is utilized, the acetate sleeve will be cut open to expose the soil for screening with a PID prior to sample collection from each interval in the vadose zone and above the groundwater table. The exact depth that samples will be collected from each subsurface interval will be the following:

- To provide unbiased data that is representative of overall Site conditions, VOC samples within each subsurface soil sampling interval will be collected from the approximate mid-point of the interval. If during subsurface soil sampling, visible or field instrument-detected contamination is present, VOC sample(s) will also be collected from the interval that the impacts are observed/measured to assist in defining potential source areas and inform the characterization of the nature and spatial extent of contamination. At the completion of the preliminary phase of sampling, all of the data collected during the preliminary phase will be reviewed for usability and representativeness to inform the supplemental phase of sampling. As the preliminary phase of sampling may include biased samples, these biased samples will be assumed to be unusable for demonstrating unacceptable DoD-related contamination, unless it is defensibly demonstrated that the data are usable, representative and appropriate to support the objectives of the supplemental phase of sampling.
- All other analyses will be performed on a composite sample consisting of soil across the entire 4 or 5-ft subsurface interval.

Soil samples for all analyses including VOCs will be collected within the 4 or 5-ft interval as indicated on the Sample ID. VOC samples will be collected first from the intact soil core interval by pushing the T-handle sampler directly into the undisturbed core All other analyses will be performed on a composite sample consisting of soil across the entire 4 or 5-ft subsurface interval. Each core will be sliced vertically and half of the soil will be placed in a stainless-steel bowl. The field team will use stainless-steel spoons to mix and homogenize the soil before placing the required volume of soil for other analyses in sample containers. Any debris in the composite soil mixture will be removed prior to filling sample containers. Soil samples collected for VOCs will be collected with laboratory-provided Terra Core sampling kits, and all other analyses will be hand-packed into laboratory-provided 4-ounce or 8-ounce glass jars. properly labeled and placed in a cooler with ice pending shipment Table 11.

Sampling equipment will be decontaminated prior to and in between samples according to the TI-SDC SOP No. 4 Sampling Equipment Decontamination (See Worksheet #21) to minimize the possibility of cross-contamination.

A licensed geologist will oversee the soil boring advancement activities and perform soil logging. The licensed geologist will visually inspect, classify, and log the soil samples and/or soil core according to the ASTM D2488, *Standard Practice for the Description and Identification of Soils*

(2017). Soil boring logs provided in Appendix H will be completed in accordance with the USACE Engineer Manual 1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous Toxic and Radioactive Waste Sites* (1998).

A portable PID and multi-gas meter will be used in the field to primarily protect worker health and safety. The instruments will be used to monitor the drilling crew's breathing zone and monitor above the open borehole during the soil boring advancement process for VOCs, methane, and hydrogen sulfide. The site-specific APP will be followed for all field activities. Additionally, a portion of soil will be placed in a Ziploc bag so that PID measurements can be recorded from soil collected at each sampling interval.

Hydrated bentonite chips will be used to backfill each borehole to the surface grade.

New Well Installation and Well Gauging and Sampling

TI-SDC will install the additional groundwater monitoring wells, one planned each within AOC 3S, AOC 3N, and AOC FI, and one upgradient of AOC 3, utilizing a licensed, professional driller, and an appropriate drill rig (e.g., hollow-stem auger, air rotary, etc.). Review of existing boring logs indicates a CME-85 drill rig, equipped with 8-inch-diameter, continuous-flight, hollow-stem augers will be sufficient.

Soil samples will be collected by a licensed, professional geologist every five feet, from the surface to the depth of groundwater. Soil sampling will continue into the saturated zone at the new monitoring locations to classify the lithology. Soil samples will be collected using a split-spoon sampler (hollow-stem auger), or from drill cuttings, and utilized for soil logging purposes.

A licensed geologist will oversee the soil boring advancement activities and perform soil logging. The licensed geologist will visually inspect, classify, and log the soil samples and/or soil core according to the ASTM D2488, *Standard Practice for the Description and Identification of Soils* (2017). Soil boring logs (Appendix H) will be completed in accordance with the USACE EM 1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous Toxic and Radioactive Waste Sites* (1998).

A portable PID and multi-gas meter will be used in the field to primarily protect worker health and safety. The instruments will be used to monitor the drilling crew's breathing zone and monitor above the open borehole during the soil boring advancement process for VOCs, methane, and hydrogen sulfide. The site-specific APP will be followed for all field activities.

The monitoring wells will be constructed with 2-inch diameter, Schedule 40, PVC well casings, with 0.010-inch slotted casing. The slotted casing will be installed so that five feet of screen is located above the elevation of the water table, and 10 ft of screen is submerged below the water table. An appropriate filter pack similar to other monitoring wells located at the Site will be placed in the annular space surrounding the screened casing to approximately 2 feet above the top of the slotted section. The filter pack will be surged to instigate settling prior to continuing the well construction. A 2-foot bentonite transition seal above the sand will be installed with hydrated

bentonite chips. Bentonite slurry will be installed above the transition seal to approximately 3 ft bgs (if permitted), and completed with a flush-mounted, traffic-rated well box or steel protective stick-up casing set within a 3-ft deep by 2-ft diameter concrete pad. The monitoring well surface opening will be covered with a locking cap and padlock keyed identical to the other network monitoring wells (if needed). All monitoring wells will be clearly labeled.

Following installation and stabilization of the water table within the wells, the newly installed groundwater monitoring wells will be developed in accordance with Part 5, Subpart 5-2 of the Compilation of the Rules and Regulations of the State of New York, ASTM D5521, and USACE EM 1110-1-4000. Well development will be accomplished by surging the water column located within the well casing using a surge block attached to the CME-85 drill rig, or equivalent vehicle. A minimum of three boreholes volumes of water will be purged from the monitoring wells using either a submersible pump or bailer and until sand-free water is produced. During purging of groundwater from the monitoring wells, water quality parameters (e.g., DO, ORP, pH, conductivity, temperature, and turbidity) will be collected and recorded periodically (log sheet provided in Appendix H) until stabilization occurs over three consecutive readings (see Table 16). If groundwater exists in limited quantity at the Site, the wells will be surged and purged to dryness for two events and will be considered developed following completion of the second event.

The newly installed monitoring well(s) will be gauged and sampled a minimum of 24 hours following well development. Groundwater samples will be collected using the low-flow groundwater purging and sampling method, as detailed in the Well Gauging and Groundwater Sampling section above and in SOP No. 2 Groundwater Sampling.

Soil Gas Sampling

Soil gas sampling will be conducted at locations selected based on field screening of subsurface soils during the soil boring advancement. Soil gas samples will be collected from the same approximate depth as a VOC sample collected from the respective soil boring. Borings for soil gas sampling will be advanced 3 to 5 ft away from select co-located abandoned soil borings and a minimum of 48 hours following soil boring grouting (CalEPA, 2015). Borings will be advanced using DPT with a single use post-run tubing system (PRT). Using the PRT, probe rods are driven to the desired depth and then internal tubing with a PRT fitting is inserted and seated for soil gas sampling. Implementation will follow PRT system operation instructions included in Appendix G. Soil gas sampling will follow procedures documented in SOP No. 14 Soil Gas Sampling. Soil gas sampling should take place when the preceding 72-hours have had less than 0.1 inches of precipitation to ensure that the soil is not saturated which would problems for the collection and analysis of vapor samples.

Integrated samples will be collected at 200 mL/min using a VOC canister sampler capable of filling an initially evacuated canister by action of the flow-controlled pump from vacuum to near atmospheric pressure. The filled canister will be properly labeled and packaged for shipment to the laboratory identified in Worksheet #11 to be analyzed according to the analytical approach documented in Step 5 of Worksheet #11 and in Table 15.

Land Survey

TI-SDC will perform a land survey of all sampling locations and new site features not previously surveyed including new wells, repaired wells, and existing wells where no survey data exists.

Locations of site features such as outfalls and seeps, anomalies identified during the geophysical survey for buried containers and debris, and all newly identified wetland areas determined during the wetland delineation survey will also be surveyed. TI-SDC will utilize a New York-licensed, professional land surveyor to survey all identified features above. Land surveying activities for horizontal and vertical data will utilize the North American Datum of 1983 (NAD83) State Plane Coordinate System (SPCS) New York East Federal Information Processing Standard (FIPS) 3101 (Feet), and the North American Vertical Datum of 1988 (NAVD88), respectively.

Investigation-Derived Waste Disposal

Solid Waste: Any investigation-derived waste (IDW) generated as a result of borehole advancement, soil, and sediment sampling will be containerized into U.S. Department of Transportation (DOT)-approved, 55-gallon steel drums. The containers will be labeled with the following information: date, project name and number, generator name, point of contact (POC) name, applicable contact numbers, contents of drum, and the boring identification number. Empty containers will be labeled as such to avoid confusion. These containers will be stored in a suitable temporary storage area within each AOC for no more than 60 days prior to disposal.

The method of disposal will be determined based on the analytical results from soil samples collected from the respective boreholes. If the soil is determined to be non-hazardous, it will be returned to the AOC it originated. Otherwise, if the soil is determined to be hazardous, it will be properly disposed of offsite by a certified waste-handling contractor at a licensed facility.

Personal Protective Equipment (PPE): Used PPE generated during boring advancement and sampling activities will be placed in plastic bags and drums if visible evidence of contamination is observed. If sampling results indicate that RCRA-characteristic hazardous wastes exist, the PPE will be disposed of according to RCRA standards. Otherwise, the PPE will be disposed of as ordinary solid waste.

Liquid Waste. Equipment decontamination and groundwater purging will generate wastewater. Wastewater will be collected into U.S. DOT-approved, 55-gallon steel drums. The drums will be labeled to include date of collection, generator name, POC name, and the POC's phone number. Empty containers will be labeled to avoid confusion. These containers will be stored in a suitable temporary storage area within each AOC for no more than 60 days prior to disposal. The method for wastewater disposal will be determined based on the analytical results of the sampled wastewater. If the wastewater is determined to be non-hazardous, it will be returned to the AOC it originated. If the liquid waste is determined to be hazardous, it will be properly disposed of offsite by a certified waste-handling contractor at a licensed facility.

Soil and groundwater IDW will be analyzed for PFAS as per the requirements of the disposal facility receiving the waste, since Site media will not be analyzed for PFAS because it is not a chemical believed to be associated with DoD activities at the Former Stewart FUDS property. PFAS results will be compared to applicable PSLs in Worksheets #15-24 and 15-25. If the results are below PSLs, then the associated soil or groundwater IDW will be disposed of onsite with respect to PFAS. If the results are above PSLs, then the associated soil or groundwater IDW will be transported and disposed of at a certified offsite facility.

All waste manifests will be submitted to USACE in the Final Field Report.

Reporting

Following completion of the preliminary RI sampling activities, TI-SDC will prepare a Final Field Report and process and evaluate all data. Groundwater elevation data will be utilized to create new groundwater contour maps for the Site. Data collected during the groundwater elevation survey will be used to create an updated groundwater contour map, and TI-SDC will prepare a technical data completeness summary to serve as the basis for the RI Project Team Meeting to assess what additional data gap sampling is necessary during the supplemental phase of RI sampling. If it is concluded that additional data gap sampling is necessary, the required data gap investigation will be defined in an addendum to QAPP Worksheets #11, #17, and #18 and it will be determined if a contract modification is necessary.

Supplemental RI Sampling

Tasks required for the supplemental phase of RI sampling would follow the same investigation procedures executed for the preliminary phase of RI sampling as necessary.

Reporting

Following completion of the preliminary and supplemental sampling activities, TI-SDC will process and evaluate all data. Sediment, soil, surface water, and groundwater analytical data will be inputted into tables, and utilized to prepare new site figures. TI-SDC will prepare a draft and final RI document, which will provide details regarding all activities, all the raw data collected, details on any deviations from the QAPP, discussion of newly collected analytical data and updated figures, risk assessment summary and results, and any final recommendations. The RI document will be submitted to stakeholders for review, input, and approval of recommendations.

After the RI sampling activities are complete and prior to preparation of the RI document, a formal request for applicable or relevant and appropriate requirements will be submitted to the applicable federal and New York State regulatory agencies so they can be evaluated and identified as per the CERCLA process.

QAPP Worksheets #19 & #30: Sample Containers, Preservation, and Hold Times

(UFP-QAPP Manual Section 3.1.2.2)
(EPA 2106-G-05 Section 2.3.2)

Analytical Group	Matrix	Analytical Method / SOP Reference	Accreditation Expiration Date	Containers (number, size, and type)	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time
VOCs	Water	SW-846 8260C & 8260C SIM/D WI8194	DoD ELAP 11/30/22; NYSDOH 4/1/22	3 x 40 mL glass vial	HCl to pH < 2 or None, 2-6ºC	14 days preserved; 7 days not preserved	14 days preserved; 7 days not preserved	15 business days
VOCs	Water	SW-846 5030B/8260D SIM/EFGS-T-VOA-SOP41108	DoD ELAP 1/19/25	3 x 40 mL glass vial	HCl to pH < 2, 2-4ºC	14 days from sampling to analysis	14 days from sampling to analysis	15 business days
VOCs	Soil	SW-846 5035/8260C/D/ WI8236	DoD ELAP 11/30/22; NYSDOH 4/1/22	Terra Core sampling kits	2-6ºC (for 48-hr hold time)	48-hours	14 days	15 business days
VOCs	Soil Gas	TO-15/SOP #6 - Analysis of Volatile Organic Compounds in Summa™, Batch-Certified Polished Canisters by GC/MS, Modified EPA Method TO-14A and EPA	DoD ELAP 11/30/20; NYSDOH 4/1/21	1L Summa Canister	None, Ambient temperature	NA	30 days	15 business days

Analytical Group	Matrix	Analytical Method / SOP Reference	Accreditation Expiration Date	Containers (number, size, and type)	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time
		Method TO-15 Rev. 3						
Methane and Helium (Fixed Gases)	Soil Gas	ASTM D1946/SOP #8 - Analysis of Helium, Oxygen, Nitrogen, Methane, Ethane, Ethene, Carbon Monoxide, Carbon Dioxide, Hydrogen and NMOC, Modified ASTM Method D1946 Rev. 27	DoD ELAP 11/30/20; NYSDOH 4/1/21	1L Summa Canister	None, Ambient temperature	NA	30 days	15 business days
SVOCs	Water	SW-846 8270D / WI9617; SW-846 8270D SIM / WI9995	DoD ELAP 11/30/22; NYSDOH 4/1/22	2 x 250 mL amber glass bottle	None, 2-6ºC	7 days	40 days	15 business days
SVOCs	Soil	SW-846 8270D / WI9617; SW-846 8270D SIM / WI9995	DoD ELAP 11/30/22; NYSDOH 4/1/22	4 or 8-ounce glass jar	None, 2-6ºC	14 days	40 days	15 business days
OCPs	Water	SW-846 8081B / WI9999	DoD ELAP 11/30/22; NYSDOH 4/1/22	2 x 250 mL amber glass bottle	None, 2-6ºC	7 days	40 days	15 business days
OCPs	Soil	SW-846 8081B / WI9232	DoD ELAP 11/30/22; NYSDOH 4/1/22	4 or 8-ounce glass jar	None, 2-6ºC	14 days	40 days	15 business days

Analytical Group	Matrix	Analytical Method / SOP Reference	Accreditation Expiration Date	Containers (number, size, and type)	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time
PCBs	Water	SW-846 8082A / WI9238	DoD ELAP 11/30/22; NYSDOH 4/1/22	2 x 250 mL amber glass bottle	None, 2-6ºC	365 days	40 days	15 business days
PCBs	Soil	SW-846 8082A / WI10004	DoD ELAP 11/30/22; NYSDOH 4/1/22	4 or 8-ounce glass jar	None, 2-6ºC	365 days	40 days	15 business days
TAL Metals (excluding Mercury)	Water	SW-846 6020B / WI11931	DoD ELAP 11/30/22; NYSDOH 4/1/22	250 mL plastic	HNO_3 to pH < 2, 2-6ºC	6 months	6 months	15 business days
TAL Metals (excluding Mercury)	Soil	SW-846 6020B / WI11931	DoD ELAP 11/30/22; NYSDOH 4/1/22	16or 32-ounce glass jar	None, 2-6ºC	6 months	6 months	15 business days
Explosive Compounds	Water	SW-846 8330B / WI9981	DoD ELAP 11/30/22; NYSDOH 4/1/22	2 x 1,000 mL amber glass bottle	None, 2-6ºC	7 days	40 days	15 business days
Explosive Compounds	Soil	SW-846 8330B / WI9981	DoD ELAP 11/30/22; NYSDOH 4/1/22	4 or 8-ounce glass jar	None, 2-6ºC	14 days	40 days	15 business days
Mercury	Water	SW-846 7470A / WI7965	DoD ELAP 11/30/22; NYSDOH 4/1/22	250 mL plastic	HNO_3 to pH < 2, 2-6ºC	28 days	28 days	15 business days

Analytical Group	Matrix	Analytical Method / SOP Reference	Accreditation Expiration Date	Containers (number, size, and type)	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time
Mercury	Soil	SW-846 7471B / WI7965	DoD ELAP 11/30/22; NYSDOH 4/1/22	4 or 8-ounce glass jar	None, 2-6ºC	28 days	28 days	15 business days
Dioxins	Soil	SW-846 8290A / WI9476	DoD ELAP 11/30/22; NYSDOH 4/1/22	8-ounce amber glass jar	None, 2-6ºC	365 days	365 days	15 business days
Grain Size Distribution	Soil	ASTM D422 / WI11514	DoD ELAP 11/30/22; NYSDOH 4/1/22	16-ounce glass jar	None, 2-6ºC	NA	NA	15 business days
Anions	Water	SW-846 9056A; WI11626	DoD ELAP 11/30/22; NYSDOH 4/1/22	50 mL plastic vial	Cool, 6ºC	NA	28 days	15 business days
TOC	Soil	SW-946 9060A / WI11627	DoD ELAP 11/30/20; NYSDOH 4/1/21	4 or 8-ounce glass jar	None, 2-6ºC	NA	28 days	15 business days
CEC	Soil	SW-846 9081 / CC-ATM-M020	NA	4 or 8-ounce glass jar	None	6 months	6 months	15 business days
ORP	Soil	ASTM D1498 / WI11512	DoD ELAP 11/30/22; NYSDOH 4/1/22	100 g glass	Cool,6ºC	NA	NA	15 business days
Moisture Content	Soil	SM 2540 G-1997 % Moisture Calc / WI10697	DoD ELAP 11/30/22;	50 g plastic or glass jar	Cool,6ºC	NA	7 days	15 business days

Analytical Group	Matrix	Analytical Method / SOP Reference	Accreditation Expiration Date	Containers (number, size, and type)	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time
			NYSDOH 4/1/22					
pH	Soil	SW-846 9045D / WI11518	DoD ELAP 11/30/22; NYSDOH 4/1/22	4 or 8-ounce glass jar	Cool,6ºC	NA	NA	15 business days
Alkalinity	Water	SM 2320B; WI11475	DoD A2LA 11/30/22; NY 4/1/22	250 mL plastic or glass bottle	Cool, 6ºC	NA	14 days	15 business days
Sulfide	Water	SM4500 S2D; WI11483	DoD A2LA 11/30/22; NY 4/1/22	250 mL glass bottle	Cool, 6ºC, no headspace, NaOH, ZnAc	NA	7 days	15 business days
DOC	Water	SM5310; WI11637	DoD A2LA 11/30/22; NY 4/1/22	4 or 8 ounce glass jar	Cool, 6ºC	NA	28 days	15 business days
PFAS	Soil IDW	PFAS for QSM 5.4 Table B-15; WI36459	DoD A2LA 11/30/22	4.5 ounce plastic bottle	None, 2-6 ºC	28 days	28 days	15 business days
PFAS	Water IDW	PFAS for QSM 5.4 Table B-15; WI36458	DoD A2LA 11/30/22	2 x 250 mL HDPE bottle	None, 2-6 ºC	14 days	28 days	

Notes/Legend:
Analyses requiring preservation will have sample containers pre-preserved by the laboratory.
ºC = Degrees Celsius
ASTM= American Society for Testing and Materials
CEC = Cation Exchange Capacity
DI = Deionized
DOC = Dissolved Organic Carbon
DoD = Department of Defense

Analytical Group	Matrix	Analytical Method / SOP Reference	Accreditation Expiration Date	Containers (number, size, and type)	Preservation Requirements	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround Time

ELAP = Environmental Laboratory Accreditation Program
EPA= Environmental Protection Agency
mL = Milliliter
NYSDOH = New York State Department of Health
OCP = Organochlorine Pesticide
ORP = Oxidation-Reduction Potential
PCB = Polychlorinated Biphenyl
SIM = Selective Ion Monitoring
SM = Standard Method
SOP = Standard Operating Procedure
SVOC = Semi-Volatile Organic Compound
TAL = Target Analyte List
TOC = Total Organic Carbon
VOC = Volatile Organic Compound

QAPP Worksheet #20: Field Quality Control Sample Summary

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Analytical Group	Conc. Level	Field Samples	Field Duplicates (10%)	No. of MS/MSDs (5%)	No. of Trip Blanks	No. of Equip-ment Blanks	Other	Total No. of Analyses
Surface Soil	SVOCs	Low	81	8	4	0	0	0	93
Surface Soil	OCPs	Low	50	3	2	0	0	0	55
Surface Soil	PCBs	Low	81	8	4	0	0	0	93
Surface Soil	TAL Metals & Mercury	Low	81	8	4	0	0	0	93
Surface Soil	Explosives	Low	71	7	4	0	0	0	82
Surface Soil	Grain Size Distribution	N/A	81	8	0	0	0	0	89
Surface Soil	TOC	Low	17	2	0	0	0	0	19
Surface Soil	CEC	N/A	81	8	0	0	0	0	89
Surface Soil	ORP	N/A	81	8	0	0	0	0	89
Surface Soil	pH	N/A	81	8	0	0	0	0	89
Surface Soil	Moisture Content	N/A	81	8	0	0	0	0	89
Subsurface Soil	VOCs	Low	82	8	5	1/Cooler	1/Day	0	95 (+TB/EB)

Matrix	Analytical Group	Conc. Level	Field Samples	Field Duplicates (10%)	No. of MS/MSDs (5%)	No. of Trip Blanks	No. of Equip-ment Blanks	Other	Total No. of Analyses
Subsurface Soil	SVOCs	Low	82	8	5	0	0	0	95
Subsurface Soil	OCPs	Low	50	3	2	0	0	0	55
Subsurface Soil	PCBs	Low	82	8	5	0	0	0	95
Subsurface Soil	TAL Metals & Mercury	Low	82	8	5	0	0	0	95
Subsurface Soil	Explosives	Low	72	7	4	0	0	0	83
Subsurface Soil	Dioxins	Low	TBD (≤ 62)	TBD (≤ 6)	TBD (≤ 4)	0	0	0	TBD (≤ 72)
Subsurface Soil	Grain Size Distribution	N/A	82	8	0	0	0	0	90
Subsurface Soil	TOC	Low	20	2	0	0	0	0	22
Subsurface Soil	CEC	N/A	82	8	0	0	0	0	90
Subsurface Soil	ORP	N/A	82	8	0	0	0	0	90
Subsurface Soil	pH	N/A	82	8	0	0	0	0	90
Subsurface Soil	Moisture Content	N/A	82	8	0	0	0	0	90
Soil IDW	PFAS	N/A	4	1	1	0	0	0	6
GW	VOCs	Low	42	4	2	1/Cooler	1/Day	0	48 (+TB/EB)
GW	SVOCs	Low	42	4	2	0	1/Day	0	48 (+EB)
GW	OCPs	Low	35	4	2	0	1/Day	0	41 (+EB)
GW	PCBs	Low	42	4	2	0	1/Day	0	48 (+EB)

Matrix	Analytical Group	Conc. Level	Field Samples	Field Duplicates (10%)	No. of MS/MSDs (5%)	No. of Trip Blanks	No. of Equip-ment Blanks	Other	Total No. of Analyses
GW	TAL Metals & Mercury (Total)	Low	42	4	2	0	1/Day	0	48 (+EB)
GW	TAL Metals & Mercury (Dissolved)	Low	42	4	2	0	1/Day	0	48 (+EB)
GW	Explosives	Low	42	4	2	0	1/Day	0	48 (+EB)
GW	Hardness	N/A	42	0	0	0	0	0	42
GW	Alkalinity	Low	23	2	1	0	0	0	26
GW	Sulfide	Low	23	2	1	0	0	0	26
GW	Chloride	Low	23	2	1	0	0	0	26
GW	Sulfate	Low	23	2	1	0	0	0	26
GW IDW	PFAS	N/A	4	1	1	0	1/Day	1(1)	6 (+EB/OTH)
SW	VOCs	Low	20	2	1	1/Cooler	1/Day	0	23 (+TB/EB)
SW	SVOCs	Low	20	2	1	0	1/Day	0	23 (+EB)
SW	OCPs	Low	11	2	1	0	1/Day	0	14 (+EB)
SW	PCBs	Low	20	2	1	0	1/Day	0	23 (+EB)
SW	TAL Metals & Mercury (Total)	Low	20	2	1	0	1/Day	0	23 (+EB)
SW	TAL Metals & Mercury (Dissolved)	Low	20	2	1	0	1/Day	0	23 (+EB)
SW	Explosives	Low	20	2	1	0	1/Day	0	23 (+EB)
SW	Alkalinity	Low	13	1	1	0	0	0	15
SW	Sulfide	Low	13	1	1	0	0	0	15
SW	Chloride	Low	13	1	1	0	0	0	15
SW	Sulfate	Low	13	1	1	0	0	0	15
SW	DOC	Low	20	2	1	0	0	0	23

Matrix	Analytical Group	Conc. Level	Field Samples	Field Duplicates (10%)	No. of MS/MSDs (5%)	No. of Trip Blanks	No. of Equip-ment Blanks	Other	Total No. of Analyses
Sediment	VOCs	Low	20	0	1	1/Cooler	1/Day	0	21 (+TB/EB)
Sediment	SVOCs	Low	20	0	1	0	0	0	21
Sediment	OCPs	Low	11	0	1	0	0	0	12
Sediment	PCBs	Low	20	0	1	0	0	0	21
Sediment	TAL Metals & Mercury	Low	20	0	1	0	0	0	21
Sediment	Explosives	Low	20	0	1	0	0	0	21
Sediment	Grain Size Distribution	N/A	20	0	0	0	0	0	20
Sediment	TOC	Low	20	0	0	0	0	0	20
Sediment	CEC	N/A	20	0	0	0	0	0	20
Sediment	ORP	N/A	20	0	0	0	0	0	20
Sediment	pH	N/A	20	0	0	0	0	0	20
Sediment	Moisture Content	N/A	20	0	0	0	0	0	20
Soil Gas	VOCs	N/A	17	2	0	0	1/Day	0	19 (+EB)
Soil Gas	Methane Helium	N/A	17	2	0	0	1/Day	0	19 (+EB)

Notes:

(1) One sample of the driller's source water will be collected and analyzed for PFAS to support IDW determination.

MS/MSD samples will be labeled the same as the associated field sample.

Trip Blanks will be labeled as TBX-MMDDYY (where X indicates the sequential number).

Equipment Blanks will be labeled as (where X indicates the sequential number):

- FSA-EBX-GW-MMDDYY (for groundwater)
- FSA-EBX-SW-MMDDYY (for surface water)
- FSA-EBX-SO-MMDDYY (for soil)
- FSA-EBX-SD-MMDDYY (for sediment)

QAPP Worksheet #21: Field SOP References

(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP No. 1	Water Level Measurement (Appendix G)	TI-SDC	Oil-Water Interface Probe	No	
SOP No. 2	Groundwater Sampling (Appendix G)	TI-SDC	Low-Flow bladder pump with Controller	No	
SOP No. 3	Sample Handling and Management (Appendix G)	TI-SDC	N/A	No	
SOP No. 4	Sampling Equipment Decontamination (Appendix G)	TI-SDC	Decontamination of Sampling Equipment, Field Monitoring Equipment and Personnel	No	
SOP No. 5	Soil Sampling for Chemical Analysis (Appendix G)	TI-SDC	Pre-cleaned stainless-steel sampling utensils (spoons, trowel) Terra Core® kits	Yes	
SOP No. 6	IDW Management (Appendix G)	TI-SDC	N/A	No	
SOP No. 7	Drilling and Lithologic Logging (Appendix G)	TI-SDC	DPT and HSA rig, air/fluid rotary rig Munsell Soil Color Chart Soil Boring Log Form, drums for cuttings	Yes	

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP No. 8	Piezometer, Monitoring Well and Injection Point Construction (Appendix G)	TI-SDC	DPT, HSA rig, air/fluid rotary rig, hollow-stem auger drill rig, monitoring well construction diagram, PVC rise pipe and screen, protective casing, lock, concrete form for pads, bollards	Yes	
SOP No. 9	Monitoring Well Development (Appendix G)	TI-SDC	Submersible pump, well development forms	Yes	
SOP No. 10	Surface Water and Sediment Sampling for Chemical Analysis (Appendix G)	TI-SDC	Ponar sampler, Pre-cleaned stainless-steel sampling utensils (trowel).	Yes	
SOP No. 11	Well and Borehole Abandonment (Appendix G)	TI-SDC	Grout machine, tremie pipe	Yes	
SOP No. 13	Soil Boring and Monitoring Well Survey (Appendix G)	TI-SDC	Stakes and surveying equipment.	No	
SOP No. 14	Soil Gas Sampling (Appendix G)	TI-SDC	VOC Summa canister, PID, multi-gas meter, helium detector, vacuum pump, tubing, valves, shroud, particulate filter. and associated sample equipment relating to subatmosheric pressure sampling.	No	
SOP No. 15	Instrument Calibration (Appendix G)	TI-SDC	PID, Horiba U-52[1], Oakton T100 Turbidity Meter[1], ION GasCheck G Helium Detector	No	

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Yes/No)	Comments
SOP No. 16	Multi-Gas Meter Operation (Appendix G)	TI-SDC	Eagle II meter	No	

Legend:
DPT = Direct-Push Technology
HAS = Hollow-Stem Auger
IDW = Investigation-Derived Waste
N/A = Not Applicable
PVC = Polyvinyl Chloride
VOC = Volatile Organic Compounds
1. For the Horiba U-52 and Oakton T100 Turbidity Meter, manual calibration will be performed and a minimum of 2-point calibration selected.

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

Field Equipment	Activity	SOP Reference	Responsible Person	Frequency	Acceptance Criteria	Corrective Action
Horiba U-52 Water Quality Meter	Calibration	SOP #15 Instrument Calibration	Vendor/Field Team Leader	Prior to shipment to the field/Daily	Documentation from Vendor/Auto calibration successful	Re-calibrate if "Er3" or "Er4" appears in display
Horiba U-52 Water Quality Meter	Maintenance	Manufacturers Instruction Manual	Equipment Coordinator	Yearly	Inspection certification	N/A
Oakton T-100 Turbidity Meter	Calibration	SOP #15 Instrument Calibration	Field Team Leader	Daily	Calibration successful	Re-calibrate, as necessary
Oakton T-100 Turbidity Meter	Maintenance	Manufacturers Instruction Manual	Equipment Coordinator	Yearly	Inspection certification	N/A
PID	Calibration	SOP #15 Instrument Calibration	Field Team Leader	Daily	Calibration successful	Re-calibrate, as necessary
PID	Maintenance	Manufacturers Instruction Manual	Equipment Coordinator	Yearly	Inspection certification	N/A
Eagle 2 Multi-Gas Meter	Calibration	SOP #16 Multi-Gas Meter Operation	Field Team Leader	Daily	Calibration successful	Re-calibrate, as necessary
Eagle 2 Multi-Gas Meter	Maintenance	Manufacturers Instruction Manual	Equipment Coordinator	Yearly	Inspection certification	N/A

Field Equipment	Activity	SOP Reference	Responsible Person	Frequency	Acceptance Criteria	Corrective Action
IONScience GasCheck G Helium Detector	Calibration	SOP #15 Instrument Calibration	Field Team Leader	Daily	Calibration successful	Re-calibrate, as necessary
IONScience GasCheck G Helium Detector	Maintenance	Manufacturers Instruction Manual	Equipment Coordinator	Yearly	Inspection certification	N/A
Soil / Groundwater Sampling Equipment	Decontamination	See Worksheet 21	Field Team Leader	Before each use at a sampling location	N/A	N/A
Drilling Rig / Equipment	Decontamination	See Worksheet 21	Field Team Leader	Before each use at a drilling location	N/A	N/A

Legend:
N/A = Not Applicable
PID = Photo-Ionization Detector

QAPP Worksheet #23: Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SOP11880	Balance, Syringe, Pipette, and Labware Verification, Rev 13, effective 07/01/2022	N/A	Maintenance	Balance	ELLE	N
WI7619	GC and GC/MS Instrumentation Maintenance, Rev 9, effective 03/10/2017	N/A	Maintenance	GC/MS	ELLE	N
WI7965	Mercury in Aqueous, Solid, and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.3 rev 3 by Cold Vapor AA, Rev 20, effective 04/27/2022	Definitive	Solid, Liquid, Tissues Metals	ICP	ELLE	N
WI8194	VOCs and GRO by GC/MS in Waters and Wastewaters by Method 8260C/D, Rev 11, effective 05/11/2022	Definitive	Water GC/MS VOCs	GC/MS	ELLE	N
EFGS-T-VOA-SOP41108	Determination of Volatile Organic Compounds by GC/MS Selected Ion Monitoring (Method 8260D), Rev 1, effective 06/11/2021	Definitive	Water Volatiles	GC/MS	EFGS	N
WI8236	VOCs and GRO by GC/MS in Soils and Solids by EPA 8260C/D, Rev 10, effective 05/11/2022	Definitive	Solid GC/MS VOCs	GC/MS	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI8636	Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS, Rev, 27, effective 07/01/2022	N/A	Solid and Tissues Inorganic Preparation SW-846 3050B	N/A	ELLE	N
WI8639	Sample Preparation of Waters for the Analysis of Total Recoverable Metals by Inductively Coupled Plasma Optical Emission Spectroscopy, Rev 19, effective 08/24/2021	N/A	Liquid Inorganic Preparation SW-846 3005A	N/A	ELLE	N
WI9232	Analysis of Pesticides by 8081B in Solid Samples using GC-ECD, Rev 8, effective 02/25/2022	Definitive	Pesticides	GC	ELLE	N
WI9238	Analysis of PCBs by 8082A in Aqueous Samples using GC-ECD, Rev 8, effective 02/25/2022	Definitive	PCBs	GC	ELLE	N
WI9446	Standards Management in the High Resolution Mass Spectrometry Laboratory Rev. 10 05/19/2022	N/A	Standards	N/A	ELLE	N
WI9476	Determination of Tetra- through Octa-Chlorinated Dioxins and Furans in water/solid/food/feed samples using HRGC/HRMS by EPA 1613B or SW-846 Method 8290A, Rev 16, effective 07/21/2022	Definitive	Dioxins and Furans	HRGC/HRMS	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI9488	Soxhlet Extraction Procedure for HRMS Analysis in a Solid Matrix by Methods: 1613B, 8290A, 1668C, and 1668A Rev. 7, Effective 06/16/2022	Definitive	Dioxins and Furans	HRGC/HRMS	ELLE	N
WI9598	GC/MS Preventative and Corrective Maintenance, Rev 6, effective 09/26/2019	N/A	Maintenance	GC/MS	ELLE	N
WI9617	SVOCs by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS, Rev 12.1, effective 04/26/2021	Definitive	Water, Solid, Tissue, Leachate GC/MS SVOCs	GC/MS	ELLE	N
WI9954	Interpretation of Chromatographic Data, Rev 16, effective 02/28/2022	NA	Data Interpretation	GC & HPLC	ELLE Analyst	N
WI9981	Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection, Rev 7, effective 07/13/2022	Definitive	Nitroaromatics/ Nitroamines	HPLC	ELLE	Y[1]
WI9995	Semi-volatiles in Waters and Soils by Method 8270C/D SIM by GC/MS, Rev 19, effective 06/03/2022	Definitive	Water, solid GC/MS SVOCs SIM	GC/MS	ELLE	N
WI9998	Pesticides in Water by Method 8081B using GC-ECD, Rev 17, effective 05/31/2022	Definitive	Pesticides	GC	ELLE	N
WI10004	PCBs in Solid Samples by 8082A using GC-ECD, Rev 11, effective 06/01/2022	Definitive	PCBs	GC	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI10007	Preventive and Corrective GC Maintenance, Rev 7, effective 02/04/2019	N/A	Maintenance	N/A	ELLE	N
WI10008	Preventive and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department, Rev 6, effective 05/17/2013	NA	Maintenance	HPLC	ELLE	N
WI10697	% Moisture Calculation and % Solids Calculation (Gravimetric) by SM 2540 G-1997 and SM 2540 G-2011, Rev 19; effective 05/14/2021	Definitive	Solid	Analytical Balance/over 103-105 degrees	ELLE	N
WI10920	Separatory Funnel Extraction by Method 3510C, 608, 608.3 or 622 for Pesticides and PCBs in Wastewater, Rev 22, effective 04/15/2022	N/A	Organic Preparation Method 3510C	N/A	ELLE	N
WI10926	Microwave Extraction Method 3546 for Pesticides in a Solid Matrix, Rev 11, effective 04/12/2022	N/A	Organic Preparation Method 3546	N/A	ELLE	N
WI10927	Microwave Extraction Method 3546 for PCBs in a Solid Matrix, Rev 10, effective 11/08/2021	N/A	Organic Preparation Method 3546	N/A	ELLE	N
WI10928	Microwave Extraction by Method 3546 for Semi-volatiles, Rev 14, effective 04/15/2022	N/A	Method 3546 Microwave (standard, SIM, and tissue) prep	N/A	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI10942	Extraction of Nitroaromatics and Nitramines by Method 8330/B in Water, Rev. 15, effective 05/25/2022	N/A	Organic Preparation Method 8330/B	N/A	ELLE	N
WI10943	Ultrasonic Extraction of Nitroaromatics and Nitroamines by method 8330/B in Solids, Rev 18.1, effective 03/30/2022	N/A	Organic Preparation Method 8330/B	N/A	ELLE	N
WI11242	Preparation of Vials for Field Preservation of Soils for Volatile Analysis, Rev 18, effective 01/20/2022	N/A	Organic Solids Preparation SW-846 5035,5030A, 5035A	N/A	ELLE	N
WI11432	Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater, Rev 19, effective 07/29/2022	N/A	Method 3510C water prep	N/A	ELLE	N
WI11475	Multi-Parameters in Solids and Waters by ManTech Multi-Parameter System Rev 16.1; effective 10/08/2021	Definitive	Water	ManTech Multi-Parameter System	ELLE	N
WI11483	Colorimetric Sulfide in Waters, Sulfide as H2S, Dissolved Sulfide in Waters by 4500-S2 D-2011, 4500-S2 H-2011, or EPA 376.2, Rev 20, effective 10/08/2021	Definitive	Water	N/A	ELLE	N
WI11512	ORP for Wastewaters and Soils by ASTM D1498, SM 2580 B-2011, Rev 15, effective 12/31/2021	Definitive	Water and Solid	ORP Electrode	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI46354	Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D-422-63 (reapproved 2007) - Modified, Rev 1, effective 11/25/2021	Definitive	Soil	Hydrometer	ELLE	N
WI11518	pH by EPA 9045C, 9045D and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometic Methods, Ver 14, effective 04/30/2021	Definitive	Solid	pH meter	ELLE	N
WI11519	pH Probes and Meters, Rev 15, effective 03/31/2022	NA	Solid	pH Meter	ELLE	N
W11626	Determination of Inorganic Anions by Ion Chromatography in Waters and Soil by EPA 300, SW 846 9056A, and SW 846 9056A, Rev. 23, effective 04/30/2021	Definitive	Water	IC	ELLE	N
WI11627	Determination of TOC and Total Carbon in Solids and Sludges by Combustion, Rev 17.1, effective 07/06/2021	Definitive	Solid	TOC Analyzer	ELLE	N
WI11637	TOC, DOC, and Total Inorganic Carbon (TIC) by SM 5310C or EPA 415.1 in Waters, Rev 18.1, effective 11/12/2021	Definitive	Water	TOC Analyzer	ELLE	N
WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A, Rev 23, effective 05/20/2022	N/A	Liquid Inorganic Preparation SW-846 7470A	N/A	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI11931	Metals by ICP for Methods SW-846 6020/B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous) Rev 15, effective 05/09/2022	Definitive	Solid, Liquid, Tissues Metals	ICP	ELLE	N
WI11933	Metals by ICP-MS for SW-846 Methods 6020/6020A/6020B (aqueous, solid, tissue), and EPA 200.8 (aqueous), Rev 13, effective 07/27/2022	Definitive	Solid, Liquid, Tissues Metals	ICP/MS	ELLE	N
WI11941	Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry, Rev 14, effective 02/08/2022	NA	Liquid Inorganic Preparation SW-846 3010A	N/A	ELLE	N
WI11948	Preparation of Solids by EPA 7471A or B for Mercury Analysis, Rev 22, effective 07/01/2022	N/A	Solid, Tissue and Oil Inorganic Preparation SW-846 7471A & SW-846 7471B	N/A	ELLE	N
WI19229	DFS HRGC/HRMS Preventative and Corrective Maintenance, Rev. 2, Effective 04/23/2019	N/A	Maintenance	N/A	ELLE	N
CC-ATM-MO20	Cation-Exchange Capacity of Soils, Rev. 10, Effective 09/19/22	Definitive	Solid CEC	N/A	Eurofins Corpus Christi	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
CC-ATM-M005	Trace Metals Analysis by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) SW-846 6010B and 200.7 Rev 10, Effective 10/13/2020	Definitive	Solid CEC	N/A	Eurofins Corpus Christi	N
SOP #6	Analysis of Volatile Organic Compounds in Summa™ Polished Canisters by GC/MS, Modified EPA Method TO-14A and EPA Method TO-15 Rev. 39	Definitive	Air-VOCs	GC/MS	Eurofins Air Toxics	N
SOP #8	ASTM D1946 / SOP #8 - Analysis of Oxygen, Nitrogen, Methane, Ethane, Ethene, Carbon Monoxide, Carbon Dioxide, Hydrogen and NMOC, Modified ASTM Method D1946 Rev. 27	Definitive	Air-Methane + Fixed Gases	GC	Eurofins Air Toxics	N
WI36458	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Method 537 Revision 1.1 Modified QSM 5.4 Table B-15 Using LC/MS/MS, Rev 3, effective 05/25/2022	N/A	PFCs	LC/MS/MS	ELLE	N
WI36459	Polyfluorinated Alkyl Substances (PFASs) in Solids by Method 537 Version 1.1 Modified QSM 5.4 Table B-15 Using LC/MS/MS Rev. 2, effective 05/25/2022	N/A	PFCs	LC/MS/MS	ELLE	N
WI23588	Preventative and Corrective Maintenance for the API 4000	N/A	PFCs	LC/MS/MS	ELLE	N

Reference Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
	and AB Sciex 4500 Liquid Chromatograph Mass Spectrometers (LC/MS/MS), Rev 3, effective 02/21/2022					
WI46585	PFAS Leaching Procedure (TCLP, SPLP) by EPA 1311-modified and 1312-modified in Solids and Wastes, Version 1, effective 11/11/2021	N/A	SPLP/TCLP	NA	ELLE	N

Legend:

1. Modifications to Method 8330B will be made because discrete soil samples and not ISM soil samples are being collected in the field (see Worksheet #17 for additional discussion of ISM with regard to the Site.). ISM-related sample processing in the laboratory including drying, sieving, grinding, and subsampling will not be done.

ASTM = American Society for Testing and Materials
CEC = Cation Exchange Capacity
EFGS = Eurofins Frontier Global Sciences
ELLE = Eurofins Lancaster Laboratories Environmental
EPA = Environmental Protection Agency
GC = Gas Chromatograph
GRO = Gasoline Range Organics
HPLC = High Performance Liquid Chromatography
HRMS = High Resolution Mass Spectrometry
HRGC = High Resolution Gas Chromatograph
ICP = Inductively Coupled Plasma
ICS = Ion Chromatography System
MS = Mass Spectrometer
ORP = Oxidation-Reduction Potential
PCB = Polychlorinated Biphenyls
SIM = Selective Ion Monitoring
SVOC = Semi-Volatile Organic Compound
TOC = Total Organic Compound
UV = Ultraviolet
VOC = Volatile Organic Compound

QAPP Worksheet #24: Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

Instrument: GC/MS Volatiles 8260C

Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS Tuning	Tune with BFB before an ICAL and every 12 hours	Per ion abundance criteria in SW-846 method	Retune, injection port maintenance, clean the source and/or change the column	ELLE analyst	WI8194
Initial Calibration with minimum 5 points; Solid and 5 mL waters 1 ppb through 300 ppb; 25 mL waters 0.2 ppb through 25 ppb; 5 mL UST waters 0.5 ppb through 200 ppb	After continuing calibration fails.	%RSD of ≤20% is required for all analytes using an average relative response factor. 10% of the analytes may fail this criterion. For any analytes with a %RSD >20%, a first-degree linear regression can be used providing that the correlation coefficient (CC) is ≥ 0.99 and a minimum of five levels are used. A quadratic curve fit may be used providing that the coefficient of determination is ≥ 0.99 and a minimum of six levels are used. If >10% of the analytes fail, the calibration is not valid and must be repeated. Minimum response factor criteria must be met for select compounds.	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI8194
Retention Time Window Establishment	Once per ICAL and at the beginning of the analytical sequence	Position is set using the midpoint standard of the ICAL curve when ICAL is performed. On days with no ICAL use the initial CCV	NA	ELLE analyst	WI8194
Evaluation of Relative Retention Times (RRT)	With each sample	RRT of each reported analyte within ±0.06 RRT units	Correct problem, then recalibrate	ELLE analyst	WI8194
ICV Standard	After each calibration	All target analytes ≤20% Drift	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE analyst	WI8194
LOD standard	Quarterly	All compounds must be detected	Reprepare and reanalyze LOD	ELLE analyst	WI8194
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE analyst	WI8194

Instrument: GC/MS Volatiles 8260C					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
CCV standard	Every 12 hours and at the end of analytical run	All target analytes ≤20% Drift; Ending CCV - All reported analytes and surrogates within ± 50%.	Reanalyze CCV in duplicate immediately. If both pass, samples can be report. If either fails or if immediate reanalysis of CCV in duplicate cannot be performed all samples since acceptable CCV must be reanalyzed. If the CCV fails high any associated samples that are ND can be reported.	ELLE analyst	WI8194

Instrument: GC/MS Volatiles 8260D SIM					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Check of mass spectral ion intensities (tuning procedure) using BFB (8260B)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Lab Manager / Analyst	EFGS-T-VOA-SOP41108
Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit. (ICAL)	Initial calibration prior to sample analysis	Each analyte must meet one of the three options below: • Option 1: RSD for each analyte ≤ 15% • Option 2: linear least squares regression for each analyte: r2 ≥ 0.99; • Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Terminate analysis; correct the problem; recalibrate. Problem must be corrected. No samples may be run until ICAL has passed.	Lab Manager / Analyst	EFGS-T-VOA-SOP41108
Second-source calibration verification	Once after each ICAL	All project analytes within ±20% of true value.	Correct problem and verify second source standard. Rerun verification. If still fails, repeat initial calibration.	Lab Manager / Analyst	EFGS-T-VOA-SOP41108
Retention Time Window Establishment	Once per ICAL, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	NA	Analyst	EFGS-T-VOA-SOP41108
Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	All reported analytes and surrogates within ± 20% of true value.	Correct problem, then rerun CCV. If that fails, then repeat ICAL. Reanalyze all sample since the last successful CCV.	Lab Manager / Analyst	EFGS-T-VOA-SOP41108
Daily closing calibration verification (CCV)	Daily, at the end of the analytical batch run.	All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Poor performing compounds will be excluded from this requirement. Also, if the closing CCV fails, EFGS will perform reanalysis only for the analytes identified by the clients as critical compounds of	Lab Manager / Analyst	EFGS-T-VOA-SOP41108

Instrument: GC/MS Volatiles 8260D SIM					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
			concern for the project, and to report qualified results for the other analytes, with QAPP approval or written approval from the client. or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.		
Internal Standards	During acquisition of calibration standard.	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager / Analyst	EFGS-T-VOA-SOP41108

Instrument: ICP – 6020B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial Calibration consists of Blank and 1 point: 0 ppm and 50 ppm for Al, Ca, Fe, Mg, K, Na, S, and Si. 0 ppm and 1 ppm for all other metals	Each new run	Passing ICV and ICB	Recalibrate, perform instrument maintenance if calibration cannot conform to criteria, recalibrate	ELLE analyst	WI11931
ICV	After each calibration	±10% of true value, RSD must be <5%	Recalibrate and reanalyze	ELLE analyst	WI11931
ICB	Immediately after the ICV	< ½ LOQ or < 1/10th the amount measured in any sample	Positive result: accept sample results >10X the ICB or < LOD. Negative result: accept results >10x ICB. All other samples must be reanalyzed with compliant ICB	ELLE analyst	WI11931
LOD	Quarterly	Analytes detected	Reprep and reanalyze LOD	ELLE analyst	WI11931
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to	ELLE analyst	WI11931

Instrument: ICP – 6020B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
			ensure they reflect current performance. Raise the spike concentration and the LOQ if required.		
CCV	Immediately after the ICSAB and every 10 samples	±10% of true value, RSD must be <5%	Reanalyze	ELLE analyst	WI11931
CCB	Immediately after the CCV and at a frequency of every 10 samples	< ½ LOQ or < 1/10th the amount measured in any sample	Positive result: accept sample results >10X the ICB or < LOD. Negative result: accept results >10x ICB. All other samples must be reanalyzed with compliant ICB	ELLE analyst	WI11931
Interference Check Sample-A	At the beginning of each run immediately following the LLC	Absolute value of concentration for all non-spiked project analytes <1/2 LOQ	Recalibrate	ELLE analyst	WI11931
Interference Check Sample-AB	At the beginning of each run immediately following the LLC	± 20% of the true value for each analyte	Recalibrate	ELLE analyst	WI11931
Low Level Check (LLC)	Beginning of each sequence and before the interference check samples	± 20% True Value	Reanalyze the sample	ELLE analyst	WI11931
Linear Range	Quarterly	± 10% of true value	Samples > 90% of the linear range must be reanalyzed as a dilution	ELLE analyst	WI11931

Instrument: CVAA: 7470A, 7471B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial Calibration consists of a Blank and 5 points ranging from 0.2 ppb to 5 ppb	Each new run	Correlation coefficient (r) >0.995	Recalibrate, perform instrument maintenance if calibration cannot conform to criteria, recalibrate	ELLE analyst	WI7965
ICV	After each calibration	±10% of true value	Reanalyze	ELLE analyst	WI7965
ICB	Immediately after the ICV	No analytes > LOD	Reanalyze	ELLE analyst	WI7965
LOD	Quarterly	Analytes detected	Reprep and reanalyze LOD	ELLE analyst	WI7965

Instrument: CVAA: 7470A, 7471B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE analyst	WI7965
CCV	Immediately after the CRA and every 10 samples	±10% of true value	Reanalyze	ELLE analyst	WI7965
CCB	Immediately after the CCV and at a frequency of every 10 samples	No analytes > LOD	Reanalyze	ELLE analyst	WI7965
Low level Check (CRA)	Immediately after the ICB	± 20% True Value	Reanalyze	ELLE analyst	WI7965

Instrument: pH: pH meter					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
3 point: 4, 7, 10 buffer	Each new run and continuing calibration per 10 samples	Independent and continuing calibration verification (CCV) within ±10%.	Perform instrument maintenance if calibration cannot conform to criteria, recalibrate	ELLE Analyst	WI11518

Instrument: GC/MS Semi-volatiles 8270D					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
GC/MS Tuning and Performance Check	Tune with DFTPP before an ICAL or CCV	Per ion abundance criteria in SW-846 method; DDT breakdown ≤20%; tailing factors: benzidine ≤2; pentachlorophenol ≤2	Retune, injection port maintenance, clean the source and/or change the column	ELLE analyst	WI9617 WI9995
Initial calibration with a minimum 5 points: Solid, tissue and water 1000 mL= 0.5 ppm through 10 ppm; Water 250 mL= 0.01 ppm through 2.5 ppm	After continuing calibration fails.	Avg RRF is used if % RSD ≤20%, if >20% a linear fit can be used if $r^2 \geq 0.99$. A linear curve fit is a suitable alternative when only 5 calibration standards have been analyzed. When calculating the calibration curves using the linear regression model, a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration calibration standard back into the curve. The	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI9617 WI9995

Instrument: GC/MS Semi-volatiles 8270D					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
		recalculated concentration of the low calibration point should be within ±30% of the standard's true concentration.			
Retention Time Window Establishment	Once per ICAL and at the beginning of the analytical sequence	Position is set using the midpoint standard of the ICAL curve when ICAL is performed. On days with no ICAL use the initial CCV	NA	ELLE analyst	WI9617 WI9995
Evaluation of Relative Retention Times (RRT)	With each sample	RRT of each reported analyte within ±0.06 RRT units	Correct problem, then recalibrate	ELLE analyst	WI9617 WI9995
ICV standard	After each initial calibration	RF for SPCC≥0.050, Target compounds ≤20% drift	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE analyst	WI9617 WI9995
LOD standard	Quarterly	All compound must be detected	Reprep and reanalyze LOD.	ELLE analyst	WI9617 WI9995
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE analyst	WI9617 WI9995
CCV standard	Every 12 hours	RF for SPCC≥0.050, Target compounds ≤20% drift. Ending CCV - All reported analytes and surrogates within ± 50%.	Reanalyze CCV in duplicate immediately. If both pass, samples can be report. If either fails or if immediate reanalysis of CCV in duplicate cannot be performed all samples since acceptable CCV must be reanalyzed. If the CCV fails high any associated samples that are ND can be reported.	ELLE analyst	WI9617 WI9995
SECC standard	End of analytical run	Run within 12 hour tune time; ±50% drift	Reanalyze the SECC if within the 12 hour tune period. If not or if the reanalyzed SECC fails do system maintenance, retune, recalibrate, and reanalyze samples.	ELLE analyst	WI9617 WI9995

Instrument: GC/MS Semi-volatiles 8270D SIM					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
GC/MS Tuning and Performance Check	Tune with DFTPP before an ICAL or CCV	Per ion abundance criteria in SW-846 method; DDT breakdown ≤20%; tailing factors: benzidine ≤2; pentachlorophenol ≤2	Recalibrate, perform instrument maintenance if calibration can't confirm to criteria, recalibrate	ELLE analyst	WI9995
Initial calibration with a minimum 5 points: Solid, tissue and water 1000 mL= 0.05 ppm through 10 ppm; Water 250 mL= 0.01 ppm through 2.5 ppm	After continuing calibration fails.	Avg RRF is used if % RSD ≤20%, if >20% a linear fit can be used if r^2≥0.99. A linear curve fit is a suitable alternative when only 5 calibration standards have been analyzed. When calculating the calibration curves using the linear regression model, a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration calibration standard back into the curve. The recalculated concentration of the low calibration point should be within ±30% of the standard's true concentration.	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI9995
Retention Time Window Establishment	Once per ICAL and at the beginning of the analytical sequence	Position is set using the midpoint standard of the ICAL curve when ICAL is performed. On days with no ICAL use the initial CCV	NA	ELLE analyst	WI9995
Evaluation of Relative Retention Times (RRT)	With each sample	RRT of each reported analyte within ±0.06 RRT units	Correct problem, then recalibrate	ELLE analyst	WI9995
ICV standard	After each initial calibration	All target compounds ≤20% drift	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE analyst	WI9995
LOD standard	Quarterly	All compound must be detected	Reprepare and reanalyze LOD.	ELLE analyst	WI9995
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE analyst	WI9995
CCV standard	Every 12 hours	RF for SPCC≥0.050, Target compounds ≤20% drift	Reanalyze CCV in duplicate immediately. If both pass, samples can be report. If either fails or if immediate reanalysis of	ELLE analyst	WI9995

Instrument: GC/MS Semi-volatiles 8270D SIM					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
			CCV in duplicate cannot be performed all samples since acceptable CCV must be reanalyzed. If the CCV fails high any associated samples that are ND can be reported.		
SECC standard	End of analytical run	Run within 12 hour tune time; ±50% drift	Reanalyze the SECC if within the 12 hour tune period. If not or if the reanalyzed SECC fails do system maintenance, retune, recalibrate, and reanalyze samples.	ELLE analyst	WI9995

Instrument: Thermo Fisher Scientific HRGC/HRMS - Dioxins/Furans SW-846 8290A					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Checking for Resolving Power	Tune before initial calibration	Mass resolution >10,000; mass deviation less than 5 ppm	Retune and recalibrate	ELLE analyst	WI9476
Start and End of every 12 hour tune period - Initial calibration with a minimum 5 points spanning 200-fold concentration	After continuing calibration fails	1. S/N ratio ≥10 2.Ion abundance ratios within ±15% of theoretical ion abundance ratios. 3. 8290: Native compounds must elute with -1 to +3 seconds of the labeled analogue. 4.8290: ≤20% RSD for the response factor for native and labeled analytes.	Recalibrate, perform instrument maintenance. If calibration does not meet method criteria, recalibrate.	ELLE analyst	WI9476
LOD standard	Quarterly	All compound must be detected	Reprep and reanalyze LOD.	ELLE analyst	WI9476
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE analyst	WI9476
ICV	Once with every ICAL	RPDs ±20% of avg RF for native compounds and ±30% for labeled compounds	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.	ELLE analyst	WI9476
CPS	The start of every 12 hour shift	> 25% chromatographic resolution of 2,3,7,8-TCDD or 2,3,7,8-TCDF	Perform column maintenance and/or replace the column and repeat CPS	ELLE analyst	WI9476

Instrument: Thermo Fisher Scientific HRGC/HRMS - Dioxins/Furans SW-846 8290A					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
CCV	Every 12 hours	RPDs ±20% of avg RF for native compounds and ±30% for labeled compounds	Reanalyze the CCV. If CCV fails again do system maintenance, recalibrate, and reanalyze affected samples.	ELLE analyst	WI9476
Ending CCV (method 8290 only)	End of each 12 hour tune period	RPDs ±25% of avg RF for native compounds and ±35% for labeled compounds	Reanalyze the ending CCV. If ending CCV fails again do system maintenance, recalibrate, and reanalyze affected samples.	ELLE analyst	WI9476

Instrument: Gas Chromatography OC Pesticides 8081B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial calibration with a minimum 5 points. Ranges from a standard at or near the reporting limits through 20x the first level	After continuing calibration fails	% RSD ≤20%, if >20% then alternate fit linear r^2 ≥0.99 or quadratic r2 ≥0.99. Must use 6 points for quadratic curve.	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI9232 & WI9999
Breakdown Standard	Before ICAL, after every 10 field samples and at end of sequence	DDT Breakdown ≤15%; Endrin Breakdown ≤15%	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI9232 & WI9999
ICV Standard	After each initial calibration	Target compounds +/- 20% of the nominal concentration and within established retention time windows	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE analyst	WI9232 & WI9999
LOD Standard	Quarterly	All compounds must be detected	Reprep and reanalyze LOD	ELLE analyst	WI9232 & WI9999
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE analyst	WI9232 & WI9999
CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the sequence. Toxaphene	Target compounds +/- 20% of the nominal concentration and within established retention time windows. Also evaluate toxaphene and chlordane standards once per day for samples requiring toxaphene and chlordane.	All samples since acceptable CCV must be reanalyzed. If the CCV fails high, any associated samples that are ND can be reported.	ELLE analyst	WI9232 & WI9999

Instrument: Gas Chromatography OC Pesticides 8081B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
	and chlordane must run prior to samples only.				
Confirmation of positive results	All positive results	Calibration and QC criteria are the same for the confirmation analysis as for primary analysis. RPD for results between primary and confirmation is ≤40%	Flag outliers	ELLE analyst	WI9232 & WI 9999

Instrument: Gas Chromatography PCBs 8082A					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial calibration with a minimum 5 points. Ranges from 2 ug/L to 200 ug/L	After continuing calibration fails	% RSD ≤20%, if >20% then alternate fit linear r^2 ≥0.99 or quadratic r2 ≥0.99. Must use 6 points for quadratic curve.	Perform more aggressive instrument maintenance and recalibrate	ELLE analyst	WI9238 & WI10004
ICV Standard	After each initial calibration	Target aroclors +/- 20% of the nominal concentration and within established retention time windows	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE analyst	WI9238 & WI10004
LOD Standard	Quarterly	All compounds must be detected	Reprep and reanalyze LOD	ELLE analyst	WI9238 & WI10004
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.		
CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	Target aroclors +/- 20% of the nominal concentration and within established retention time windows	All samples since acceptable CCV must be reanalyzed. If the CCV fails high, any associated samples that are ND can be reported.	ELLE analyst	WI9238 & WI10004
Confirmation of positive results	All positive results	Calibration and QC criteria are the same for the confirmation analysis as for primary analysis. RPD for results between primary and confirmation is ≤40%	Flag outliers	ELLE analyst	WI9238 & WI10004

Instrument: HPLC Nitroaromatics and Nitroamines 8330B					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial calibration with a minimum 5 points. Ranges from a standard at or near the reporting limit through 80x the first level	After continuing calibration fails	% RSD ≤15%, if >15% then alternate fit linear r^2 ≥0.99 or quadratic r2 ≥0.99. Must use 6 points for quadratic curve.	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI9981
ICV Standard	After each initial calibration	Target compounds +/- 20% of the nominal concentration and within established retention time windows	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE Analyst	WI9981
LOD Standard	Quarterly	All compounds must be detected	Reprep and reanalyze LOD	ELLE Analyst	WI9981
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.	ELLE Analyst	WI9981
CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	Target compounds +/- 20% of the nominal concentration and within established retention time windows	All samples since acceptable CCV must be reanalyzed. If the CCV fails high, any associated samples that are ND can be reported.	ELLE Analyst	WI9981
Confirmation of positive results	All positive results	Calibration and QC criteria are the same for the confirmation analysis as for primary analysis. RPD for results between primary and confirmation is ≤40%	Report both columns in data package	ELLE Analyst	WI9981

Instrument: Oxidation-reduction combination electrode					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
CCV	Beginning of batch, every 10 samples, and at the end of a batch	±30mV	Correct problem and reanalyze associated samples.	ELLE Analyst	WI11512

Instrument: % Moisture					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Use at least two Class 1 weights that bracket expected mass typically ranging from 0.01-50.0g	daily	+/- 0.5 g	Perform balance internal calibration, tag out of operation and contact outside support	ELLE Analyst	WI10697

Instrument: pH electrode: pH; Alkalinity					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Calibration using at least 3 points, sloped with pH 4, 7, and 10 buffers	Daily	percent slope between 92% and 102%	Correct the problem and recalibrate	ELLE Analyst	WI11518, WI11475
LOD	Quarterly	Detect the analyte	Re-analyze the LOD		
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.		
CCV Standard	After each calibration, every 10 samples, and end of batch	±10% D	Correct the problem, recalibrate and reanalyze affected samples		

Instrument: Sulfide					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Calibration using at least 5 points ranging from 0.10 to 2.0 mg/l	Every 3 months or when a new reagent is prepared	Correlation coefficient must be ≥0.995	Correct the problem and recalibrate	ELLE Analyst	WI11483

LOD	Quarterly	Detect the analyte	Re-analyze the LOD		
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.		
CCV Standard	Beginning of each batch, every 10 samples, and end of batch	±10% D	Correct the problem, recalibrate and reanalyze affected samples		

Instrument: IC Anions 9056A					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial calibration with a minimum of 5 points with a concentration span of 15x or 30x depending on the analyte	Monthly or when CCV fails	R^2 >0.995; Level 1 standard must recover ≥50% of the true value	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI11626
ICB	After each initial calibration	No analytes detected > ½ LOQ	Correct problem and reanalyze the ICB. Recalibrate if needed.		
ICV	After each initial calibration	Within +/- 10% of the nominal concentration	If ICV fails again do system maintenance and recalibrate.		
LOD	Quarterly	Detect the compound	Reanalyze the LOD		
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.		
CCV	If instrument is idle > 4 hours, after every 10 field samples, and at the end of the sequence	Within +/- 10% of the nominal concentration	Recalibrate; reanalyze affected samples		
CCB	If instrument is idle > 4 hours, after every 10 field samples, and at the end of the sequence	No analytes detected > ½ LOQ	Recalibrate; reanalyze affected samples		

Instrument: TOC Analyzer: TOC & DOC					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Initial calibration with a minimum 4 points ranging from 0.3 mg C to 6 mg C	Monthly or after continuing calibration fails	$r^2 \geq 0.995$	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI11637 (5310C)
ICB Standard	After each initial calibration	No analytes detected > ½ LOQ	Perform more aggressive instrument maintenance and recalibrate		
ICV Standard	After each initial calibration	Within +/- 10% of the nominal concentration	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.		
LOD	Quarterly	Detect the compound	Reanalyze the LOD		
LOQ verification	Quarterly	Recovery range is 20% wider than the associated LCS control limits (i.e., 20% lower than the LCS lower limit and 20% higher than the LCS upper limit), but not lower than 10%.	Correct method or instrument performance and repeat the verification. Evaluate the established control limits to ensure they reflect current performance. Raise the spike concentration and the LOQ if required.		
CCV Standard	If instrument is idle > 4 hours, after every 10 field samples, and at the end of the sequence	Within +/- 10% of the nominal concentration	All affected samples are reanalyzed		
CCB Standard	If instrument is idle > 4 hours, after every 10 field samples, and at the end of the sequence	No analytes detected > ½ LOQ	All affected samples are reanalyzed		

Instrument: GC/MS					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Bromofluorobenze (BFB)Tuning	Prior to initial calibration and every 24 hours during sample analysis	EPA Method TO-15 Ion abundance criteria	Retune instrument and verify.	Bench Analyst/Scientist	SOP #6 (Eurofins Air Toxics)
ICAL - 5 point minimum for target analytes, lowest concentration standard at the reporting limit	Initially, after the BFB Tune Check, and as needed thereafter	< 30% RSD for target analytes; Area response at each calibration level within 40% of IS mean area response over the ICAL range; Retention time for each IS within 0.33 min of the mean retention time over the ICAL range.	Correct problem then repeat Initial Calibration	Bench Analyst/Scientist	SOP #6 (Eurofins Air Toxics)
Initial Calibration Verification (ICV) Second Source Standard	After each ICAL and prior to sample analysis	±30% Recovery for target analytes	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the	Bench Analyst/Scientist	SOP #6 (Eurofins Air Toxics)

Instrument: GC/MS					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
			source of error. Re-calibrate the instrument if the primary standard is found to be in error		
Continuing Calibration Verification (CCV)	Daily, after BFB tune check, before sample analysis, after every 24 hours of analysis time and at the end of the analytical batch	≤30%D for target analytes	Check the system, two consecutive passing CCVs must be analyzed, re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.	Bench Analyst/Scientist	SOP #6 (Eurofins Air Toxics)

Instrument: GC					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
ICAL - 5 point minimum	As needed/prior to sample analysis	≤15% RSD	Correct problem then repeat ICAL	Bench Analyst/Scientist	SOP #8 (Eurofins Air Toxics)
Initial Calibration Verification (ICV) Second Source Standard	After each ICAL	85-115% Recovery * If specified by the project, in-house generated control limits may be used	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.	Bench Analyst/Scientist	SOP #8 (Eurofins Air Toxics)
Continuing Calibration Verification (CCV)	Daily prior to sample analysis and as an End Check	±15 % D	Check the system, two consecutive passing CCVs must be analyzed, re-prepare the standard if necessary. Re-calibrate the instrument if the criteria cannot be met.	Bench Analyst/Scientist	SOP #8 (Eurofins Air Toxics)

Instrument: LC/MS/MS PFAS in accordance with QSM, Table B-15					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
Mass Calibration	Initially, annually, and after performing major maintenance	Per manufacturer specifications	NA	ELLE Analyst	W36458 & WI36459
Tuning of LC/MS/MS	When masses fall outside ± 0.5 amu of true masses	Within 0.5 amu of true value	Retune and verify. If tuning fails acceptance criteria, perform a mass calibration and repeat the tune check.	ELLE Analyst	W36458 & WI36459
Mass Spectral Acquisition Rate	Each analyte, labeled analyte, and injection internal standard	A minimum of 10 spectra scans are acquired across each chromatographic peak	NA	ELLE Analyst	W36458 & WI36459
Initial calibration with a minimum 5 points	After continuing calibration fails	S/N ratio ≥10:1 for all ions used for quantification. % RSD of the RFs for all analytes must be <20%. Linear or non-linear calibrations must have a r2 ≥0.99. Must use at least 6 points for a	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	W36458 & WI36459

Instrument: LC/MS/MS PFAS in accordance with QSM, Table B-15					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
		quadratic. Analytes must be within 70-130% of their true value for each calibration standard.			
Instrument Sensitivity Check	Prior to analysis and every 12 hours using a standard with analyte concentrations at the LOQ	Recover within ±30% of their true value	Correct problem and rerun ISC. If problem persists, repeat ICAL	ELLE Analyst	W36458 & WI36459
ICV Standard	Once with every ICAL	Within ±30% of their true value	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE Analyst	W36458 & WI36459
LOD standard	Quarterly	All compound must be detected	Reprep and reanalyze LOD.	ELLE Analyst	W36458 & WI36459
LOQ Verification	Quarterly	Within 50% of true value	Reprep and reanalyze LOQ.	ELLE Analyst	W36458 & WI36459
CCV Standard	Every 10 samples and at the end of a sequence	Alternate analyte concentrations range from the LOQ to the mid-level of the calibration curve. Recover within ±30% of their true value	Reanalyze CCV in duplicate immediately. If both pass, samples can be report. If either fails or if immediate reanalysis of CCV in duplicate cannot be performed all samples since acceptable CCV must be reanalyzed. If the CCV fails high any associated samples that are ND can be reported.	ELLE Analyst	W36458 & WI36459
Instrument Blanks	Immediately following the highest standard analyzed and daily at start of a sequence	Concentration of each analyte must be ≤1/2 LOQ	If criteria not met after highest calibration standard, must decrease that standard's concentration until criteria is met. If criteria not met for sample, run additional instrument blanks until criteria is met.	ELLE Analyst	W36458 & WI36459
Retention Time Window Position Check	One per ICAL and at the beginning of each sequence	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA	ELLE Analyst	W36458 & WI36459
Retent Time Window Width Check	Every field sample, standard, blank and QC samples	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples	ELLE Analyst	W36458 & WI36459
Ion transitions (Precursor --> Product)	Every field sample, standard, blank and QC samples	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80	NA	ELLE Analyst	W36458 & WI36459

Instrument: LC/MS/MS PFAS in accordance with QSM, Table B-15					
Calibration Procedure	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
		PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed			

Legend:
BFB = Bubbling Fluidized Bed
CC = Correlation Coefficient
CCB = Continuing Calibration Blank
CCC = Continuing Calibration
CCV = Continuing Calibration Verification
CVAA = Cold Vapor Atomic Absorption
DFTPP = Decafluorotriphenylphosphine
EIS = Extracted internal standard
ELLE = Eurofins Lancaster Laboratories Environmental
GC/MS = Gas Chromatography / Mass Spectrometry
HRGC = High Resolution Gas Chromatograph
HRMS = High Resolution Mass Spectrometry
ICAL = Initial Calibration for All Analytes
ICB = Initial Calibration Blank
ICP = Inductively Coupled Plasma
ICV = Initial Calibration Verification
LLC = Low Level Check
LOD = Limit of Detection
LOQ = Limit of Quantitation
MDL = Method Detection Limit
mL = Milliliter
N/A = Not Applicable
ND = Not-Detected
PCB = Polychlorinated Biphenyl
% = Percent
ppm = Parts Per Million
QC = Quality Control
RF = Retardation Factor
RL = Reporting Limit
RPD = Relative Percent Difference
RRF = Relative Retention Factor
RRT = Relative Retention Time
RSD = Relative Standard Deviation
SOP = Standard Operating Procedure
TCDD = Tetrachlorodibenzo-p-dioxin
TOC = Total Organic Carbon
USEPA = United States Environmental Protection Agency
VOC = Volatile Organic Compounds

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.2.3)
(EPA 2106-G-05 Section 2.3.6)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Thermo Fisher Scientific HRGC/HRMS	Injection port, column, ion source, others as needed	Calibration Check	Visual	As needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	ELLE Analysts	WI9478
TOC Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11637, WI11627, 29-48, & WI10038
Hydrometer	Visual inspection	Inspection for cracks or breaks	Inspection for cracks or breaks	Each day of use	No cracks or breaks	Replace hydrometer	ELLE analyst	WI11514
Thermo 6000 Series ICP-AES	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI11931
Leeman Labs Hydra II Mercury Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI7965
Analytical balance	Assure the balance is in a vibration-free area, is level, and the interior housing is clean.	Verification with ASTM certified weights	Visual inspection and weight verification	Each day of use	The reading must be ±0.1% or ±0.5mg, whichever is greater.	1) verify cleanliness of weights 2) remove balance from service and place a call to service firm 3) management must evaluate data generated since last acceptable reading to determine any potential impacts to data quality	ELLE analyst	SOP11880
Analytical balance	Annual calibration and maintenance	Annual calibration and maintenance	Annual calibration and maintenance	Annual	As per vendor's specifications in compliance with ISO certification	As per vendor's specifications in compliance with ISO certification	Professional calibration vendor (ISO 17025 certified)	SOP11880
Oxidation-reduction combination electrode	Remove traces of foreign matter and oily residue	Performance	Visual inspection of components	Each day of use	Performance	Re-clean	ELLE Analyst	WI11512
Gas Chromatograph, HP5890, HP 6890, and HP7890 with ECD Detector	Injection port maintenance; ECD maintenance	Calibration Check All analytes within +/- 20% of the nominal concentration and within established retention time windows	Visual Inspection	As needed	Initial calibration after maintenance is within specifications	Perform maintenance again	GC analyst	WI10007

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
pH/ISE Meter	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11518
8270 Agilent 6890 or 7890 GC/5973, 5975, or 5977 MSD (or equivalent)	As needed, replacement of components (Injection port; column, ion source; other)	Continuing calibration verification (CCV) and DFTPP per 12 hour tune period	Visual inspection of components	Daily routine maintenance (injection port); as needed for other components	Initial calibration or continuing calibration verification passes method criteria	Perform maintenance again; re-calibration if necessary	Analysts or group leaders	WI7619 & WI9598
Agilent 7500 CE	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI11933
Agilent 7700X	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI11933
HPLC, HP1100 with 2HPLC UV detectors	Replacing frits and check valves	Calibration Check All analytes within +/- 15% of the nominal concentration and within established retention time windows	Visual Inspection	As needed	Initial calibration after maintenance is within specifications	Perform maintenance again	HPLC analyst	WI10008
Analytical Balance	Annual Calibration/ Verification	Daily Check with Class 1 weights	Visual inspection	Annual Calibration/ Daily Check	The reading must be ±0.1% or ±0.5mg, whichever is greater. Weight must be 1000X heavier than sensitivity of balance.	1) verify cleanliness of weights 2) remove balance from service and place a call to service firm 3) management must evaluate data generated since last acceptable reading to determine any potential impacts to data quality	Outside vendor for calibration/ Analyst for daily checks	SOP11880
Agilent 6890 GC/5973 MSD	As needed, replacement of components	CCV	Visual inspection of components	As needed	Initial calibration or continuing calibration verification passes method criteria	Perform additional maintenance prior to instrument calibration or CCV	Analysts or group leaders	WI7619 and WI9598
ICP-8, ICP-9	Replace tubing	--	--	Daily			Primary Analyst	M-601 (USEPA 6020B)
	Run Torch alignment	Internal standard	--	Daily	<1%D	Clean, re-align		
	Clean Air Filters	--	--	Weekly				
	Clean or Replace Purge Windows	--	--	Weekly				
	Clean nebulizer	--	--	Weekly				
	Replace Drain pump tubing	--	--	Weekly				
	Inspect O-rings	--	--	Monthly		Replace		
	Inspect coolant solution levels	--	--	Monthly		Replace		

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Mantech Autotitrator	As needed replacement of components	Continuing calibration verification (CCV)	Visual inspection of components	As needed	Initial calibration or continuing calibration verification passes method criteria	Perform maintenance again; re-calibration if necessary	Analysts or group leaders	WI11475
pH/ISE Meter	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11518, WI11519
UV Spectrophotometer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11483
IC	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks (95-105% for method 218.6)	Recalibration	ELLE Analyst	WI11626
TOC Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11637 (5310C waters)
GC/MS	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	EFGS Chemist	EFGS-T-VOA-SOP41108
GC/MS	Change septum, clean injection port, change or clip column, install new liner, change trap	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	EFGS Chemist	EFGS-T-VOA-SOP41108
GC/MS	Preventative maintenance	Instrument performance checks	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	Varies from daily to every 6 months and as needed	See Worksheet #24	Correct the problem and repeat calibration or calibration verification	Bench Analyst/Scientist/Engineer	SOP #6 (Eurofins Air Toxics)
GC	Preventative maintenance	Methane, fixed gases	Detectors, injector liner, column, column flow	As needed	See Worksheet #24	Correct the problem and repeat calibration or calibration verification	Bench Analyst/Scientist/Engineer	SOP #8(Eurofins Air Toxics)
LC/MS/MS	Backflush of column, injection port and pre-columns, cleaning of ion spray cone, adjustment of collision energies, others as needed	Calibration Check	Visual	As Needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	ELLE Analysts	WI23588

Legend:
% = Percent
ASTM = American Society for Testing and Materials
CCV = Continuing Calibration Verification
DFTPP = Decafluorotriphenylphosphine
EFGS = Eurofins Frontier Global Sciences
ELLE = Eurofins Lancaster Laboratories Environmental
ECD = Electron Capture Detector
GC = Gas Chromatography
ICP = Inductively Coupled Plasma
ICP AES = Inductively Coupled Plasma Atomic Emission Spectroscopy
ISE = Ion Selective Electrode
ISO = International Organization for Standardization
mg = Milligram
MSD = Matrix Spike Duplicate
SOP = Standard Operating Procedure
TOC = Total Organic Carbon
USEPA = United States Environmental Protection Agency

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference

HP = Hewlett Packard
HRGC = High Resolution Gas Chromatograph
HRMS = High Resolution Mass Spectrometry
UV = Ultraviolet

QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal

(UFP-QAPP Manual Attachment A)
(EPA 2106-G-05 Section 2.3.3)

Sampling Organization: TI-SDC

Laboratories: Eurofins Lancaster Laboratories Environmental, Eurofins Corpus Christi, Eurofins Frontier Global Sciences, Eurofins Air Toxics

Method of sample delivery: Overnight delivery shipment to laboratory

Number of Days from Reporting until sample disposal: 45 days after the final report is issued

Activity	Organization and Title of person responsible for activity	SOP Reference
Sample Collection	Field Sampling Team: TI-SDC	SOP No. 3 - Sample Handling and Management (Appendix K)
Sample Labeling	Field Sampling Team: TI-SDC	SOP No. 3 - Sample Handling and Management (Appendix K)
Chain-of-Custody Form Completion	Field Sampling Team: TI-SDC	SOP No. 3 - Sample Handling and Management (Appendix K)
Packaging	Field Sampling Team: TI-SDC	SOP No. 3 - Sample Handling and Management (Appendix K)
Shipping Coordination	Field Sampling Team: TI-SDC	--
Sample Receipt	Laboratory Sample Custodian: ELLE, Eurofins Corpus Christi, EFGS, Eurofins Air Toxics	--
Sample Custody and Storage	Laboratory Sample Custodian: ELLE, Eurofins Corpus Christi, EFGS, Eurofins Air Toxics	--
Entry of Samples Requiring Subcontracting/Workshare	Laboratory Sample Administrator: ELLE	SOP S-SA-WI10717
Homogenization, Sample Splitting, and Subsampling of Solid Waste Samples	Laboratory Sample Preparation Technician: ELLE	SOP S-SS-WI10686

Activity	Organization and Title of person responsible for activity	SOP Reference
Sample Preparation	Laboratory Sample Preparation Technician: ELLE, Eurofins Corpus Christi, EFGS, Eurofins Air Toxics	--
Sample Determinative Analysis	Laboratory Analytical Chemist: ELLE, Eurofins Corpus Christi, EFGS, Eurofins Air Toxics	--
Sample Disposal	Laboratory Sample Custodian: ELLE, Eurofins Corpus Christi, EFGS, Eurofins Air Toxics	--

Legend:
EFGS = Eurofins Frontier Global Sciences
ELLE = Eurofins Lancaster Laboratories Environmental
SOP = Standard Operating Procedure

QAPP Worksheet #28: Analytical Quality Control and Corrective Action

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

QAPP WORKSHEET #28 TABLE INDEX

QAPP Worksheet #28-1A: Volatile Organic Compounds by 8260C
QAPP Worksheet #28-1B: Volatile Organic Compounds by 8260D SIM
QAPP Worksheet #28-2: Semi-Volatile Organic Compounds
QAPP Worksheet #28-3: Organochlorine Pesticides
QAPP Worksheet #28-4: Polychlorinated Biphenyls
QAPP Worksheet #28-5: Metals
QAPP Worksheet #28-6: Mercury
QAPP Worksheet #28-7: Explosive Compounds
QAPP Worksheet #28-8: Dioxins
QAPP Worksheet #28-9: Hardness
QAPP Worksheet #28-10: Alkalinity
QAPP Worksheet #28-11: Sulfide
QAPP Worksheet #28-12: Chloride/Sulfate
QAPP Worksheet #28-13: Dissolved Organic Carbon
QAPP Worksheet #28-14: pH
QAPP Worksheet #28-15: Grain Size Distribution
QAPP Worksheet #28-16: Total Organic Carbon
QAPP Worksheet #28-17: Cation Exchange Capacity
QAPP Worksheet #28-18: Oxidation-Reduction Potential
QAPP Worksheet #28-19: Moisture Content
QAPP Worksheet #28-20: Volatile Organic Compounds in Air by TO-15
QAPP Worksheet #28-21: Methane and Helium
QAPP Worksheet #28-22: PFAS

QAPP Worksheet #28-1A - VOCs – Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: VOCs
Analytical Method/SOP Reference: 8260C / WI8194

QC Sample	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).	If obvious matrix interference report data with a comment. Otherwise, re-analyze.	ELLE Analyst	Results within acceptance limits
Method blanks	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Reanalyze to confirm detections. If detects confirm reanalyze samples that are not ND or not >10x the blank value or regulatory limit	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits); RPD ≤20%	Flag outliers	ELLE Analyst	Results within acceptance limits
LCS/LCSD	1 per prep batch of up to 20 samples	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits); RPD ≤20%	Analytes in the LCS that fail high and are ND in the samples can be reported. For all others reanalyze LCS and samples. If it still fails, perform instrument maintenance, restart the tune period and reanalyze all QC and samples.	ELLE Analyst	Results within acceptance limits
Internal standards	Per sample (including MS/MSD, LCS, and blanks)	-50% to + 100% of internal standard area of 12-hour STD. RT change	Check the instrument for possible problems and then reanalyze samples. If reinject confirms, report with a comment.	ELLE Analyst	Results within acceptance limits

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

QAPP Worksheet #28-1B - VOCs – Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water
Analytical Group: VOCs
Analytical Method/SOP Reference: 8260D SIM/ EFGS-T-VOA-SOP41108

QC Sample	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory statistical limits).	If obvious matrix interference report data with a comment. Otherwise, re-analyze.	EFGS Analyst	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits)
Method blanks	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. For common laboratory contaminants, no analytes detected >LOQ in accordance with DoD QSM 5.3 requirements	Re-extract and reanalyze samples. See Section 9.3 of SOP for additional requirements.	EFGS Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits)	Identify problem; if not related to matrix interference, reanalyze MS/MSD and all associated batch samples in accordance with QSM 5.3 requirements	EFGS Analyst	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits)
LCS/LCSD	1 per prep batch of up to 20 samples	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits); RPD ≤20%	Correct problem, then reanalyze the LCS and all associated batch samples in accordance with QSM 5.3 requirements	EFGS Analyst	Recovery limits per QSM 5.3. Laboratory statistical limits for compounds not in QSM 5.3 (see Appendix M for laboratory limits)
Internal standards	Per sample (including MS/MSD, LCS, and blanks)	Retention time ± 10 seconds from RT of the midpoint standard in ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning in accordance with DoD QSM requirements	EFGS Analyst	Results within acceptance limits

Legend:
EFGS = Eurofins Frontier Global Sciences
EICP = Extracted Ion Current Profile
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation MS = Matrix Spike
MSD = Matrix Spike Duplicate
QC = Quality Control
QSM = Quality Systems Manual
SIM = Selective Ion Monitoring
SOP = Standard Operating Procedure

QAPP Worksheet #28-2 – SVOCs – Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: SVOCs
Analytical Method/SOP Reference: 8270D /WI9617; 8270D SIM / WI9995

QC Sample	Frequency / Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	If obvious matrix interference report data with a comment. Otherwise, re-extract and re-analyze.	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
Method blanks	1 per prep batch of up to 20 samples	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Flag outliers	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
LCS/LCSD	1 per prep batch of up to 20 samples	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
Internal standards	Per sample (including MS/MSD, LCS, and blanks)	Flag data	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SIM = Selective Ion Monitoring
SOP = Standard Operating Procedure

QAPP Worksheet #28-3 - Organochlorine Pesticides - Analytical Quality Control and Corrective Action -

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: Pesticides
Analytical Method/SOP Reference: 8081B / WI9232; 8081B / WI9999

QC Sample	Frequency / Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	If obvious matrix interference report data with a comment. Otherwise, re-extract and re-analyze.	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Method blanks	1 per prep batch of up to 20 samples	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Flag outliers	ELLE Analyst	Results within acceptance limits per QSM 5.3.
LCS/LCSD	1 per prep batch of up to 20 samples	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Results within acceptance limits per QSM 5.3.

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

QAPP Worksheet #28-4 – PCBs - Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: PCBs
Analytical Method/SOP Reference: 8082A / WI10004**;** 8082A / WI9238

QC Sample	Frequency / Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and Blanks)	If obvious matrix interference report data with a comment. Otherwise, re-extract and re-analyze.	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Method blanks	1 per prep batch of up to 20 samples	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per prep batch of up to 20 samples	Flag outliers	ELLE Analyst	Results within acceptance limits per QSM 5.3.
LCS/LCSD	1 per prep batch of up to 20 samples	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Results within acceptance limits per QSM 5.3.

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

QAPP Worksheet #28-5 – TAL Metals - Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: Metals
Analytical Method/SOP Reference: SW-846 6020B / WI11931

QC Sample	Frequency / Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method Blank	1 per prep batch of up to 20 samples	Reanalyze blank to confirm detections. If detects confirm, re-digest samples that are not ND or not >10x the blank value.	ELLE Analyst	No analytes detected > 1/2 RL or >1/10 the amount measured in any sample
MS/MSD	1 per prep batch of up to 20 samples	Analyze post digestion spike and serial dilution	ELLE Analyst	Results within acceptance limits per QSM 5.3.
LCS/LCSD	1 per prep batch of up to 20 samples	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-digested and reanalyzed.	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Duplicate	1 per prep batch of up to 20 samples	Flag data	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Serial Dilutions	Must be prepared with each background sample, evaluated only when analyte concentrations are >50x the LOQ	Flag data	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Post Digestion Spike	Prepare with each background sample	No specific action needed unless required by the project. PDS is reported in data package	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Internal Standard	Every sample and QC	Reanalyze at a dilution	ELLE Analyst	Results within acceptance limits per QSM 5.3.

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

QAPP Worksheet #28-6 – Mercury - Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: Mercury
Analytical Method/SOP Reference: SW-846 7470A and 7471B / WI7965

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method Blank	1 per prep batch of up to 20 samples	Reanalyze blank to confirm detections. If detects confirm, re-digest samples that are not ND or not >10x the blank value.	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample
MS/MSD	1 per prep batch of up to 20 samples	Flag outliers	ELLE Analyst	Results within acceptance limits per QSM 5.3.
LCS/LCSD	1 per prep batch of up to 20 samples	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-digested and reanalyzed.	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Duplicate	1 per prep batch of up to 20 samples	Flag data	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Post Digestion Spike (PDS)	One batch per prep batch if MS/MSD fails	None, unless required by project	ELLE Analyst	Results within acceptance limits per QSM 5.3.
Method of Standard Addition (MSA)	When dilution fails or project requires it	NA	ELLE Analyst	Document in data package

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

QAPP Worksheet #28-7 – Explosive Compounds - Analytical Quality Control and Corrective Action

Matrix: Groundwater / Surface Water / Soil / Sediment
Analytical Group: Explosive Compounds
Analytical Method/SOP Reference: 8330B / WI9981

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Surrogate Spike (organics)	Per sample (including MS/MSD, LCS, and Blanks)	If obvious matrix interference report data with a comment. Otherwise, re-extract and re-analyze.	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
Method blanks	1 per 20 samples	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per 20 samples	Evaluation in conjunction with LCS results	ELLE Analyst	Results within acceptance limits per QSM 5.3.
LCS	1 per 20 samples	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Results within acceptance limits per QSM 5.3.

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure

QAPP Worksheet #28-8 – Dioxins - Analytical Quality Control and Corrective Action

Matrix: Soil
Analytical Group: Dioxins
Analytical Method/SOP Reference: SW-846 8290A / WI9476

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Labeled compounds	Per sample (including MS/MSD, LCS, and Blanks)	Re-extract sample. However, if the labeled compound fails high and the associated native is ND, the sample can be reported.	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
Method blanks	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample
MS/MSD	1 per prep batch of up to 20 samples	Flag outliers	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
OPR (Ongoing Precision and Recovery)	1 per prep batch of up to 20 samples	Analytes in the OPR that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Results within acceptance limits per QSM 5.3. Laboratory statistical limits for compounds not in the QSM 5.3 (see Appendix M for laboratory specific limits).
Sample EMPC	Every sample with a response S/N ≥2.5 for both quantitation ions.	Indication criteria per method must be met, and the S/N of response for both quantitation ions must be ≥2.5.	NA	NA
Sample 2,3,7,8-TCDD TEQ concentration	All positive detections.	Per method.	NA	NA
Internal standards	Per sample (including MS/MSD, OPR, and blanks)	Correct problem, then re-extract and analyze the samples with failed IS	ELLE Analyst	Results within acceptance limits per QSM 5.3.

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
EMPC = Estimated Maximum Possible Concentration
LCS = Laboratory Control Sample
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
OPR = Ongoing Precision and Recovery
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedure
TEQ = Toxicity Equivalent

QAPP Worksheet #28-9 – Hardness - Analytical Quality Control and Corrective Action

Matrix: Groundwater
Analytical Group: Hardness
Analytical Method / SOP Reference: Calculation using SM 2340B

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Hardness by SM 2340B is determined by calculation using Ca and Mg data by ICP/MS from Method 6020B. Therefore, Corrective Action criteria for Method 6020B listed in Worksheet #28-5 will be applied prior to the calculations of hardness.				

Legend:
QC = Quality Control
SOP = Standard Operating Procedures

QAPP Worksheet #28-10 – Alkalinity - Analytical Quality Control and Corrective Action

Matrix: Groundwater and Surface Water
Analytical Group: Alkalinity
Analytical Method/SOP Reference: SM 2320B; WI11475

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method blank	1 per prep batch of up to 20 samples	Reanalyze blank to confirm detections. If detects confirm, reanalyze samples that are not ND or not >10x the blank value.	ELLE Analyst	No analytes detected > LOQ or >1/10 the amount measured in any sample
MS	1 per 20 samples	Flag outliers	ELLE Analyst	Laboratory statistical limits (see Appendix M).
LCS	1 per prep batch of up to 20 samples	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-analyzed.	ELLE Analyst	Laboratory statistical limits (see Appendix M).
Duplicate	1 per 10 samples	Flag data	ELLE Analyst	Results within acceptance limits (≤ 10% RPD)

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SM = Standard Method
SOP = Standard Operating Procedure

QAPP Worksheet #28-11 – Sulfide - Analytical Quality Control and Corrective Action

Matrix: Groundwater and Surface Water
Analytical Group: Sulfide
Analytical Method/SOP Reference: SM 4500 S2 D; WI11483

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method blank	1 per prep batch of up to 20 samples	Reanalyze blank to confirm detections. If detects confirm, reanalyze samples that are not ND or not >10x the blank value.	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample
MS	1 per 10 samples	Flag outliers	ELLE Analyst	Laboratory statistical limits (see Appendix M).
LCS	1 per prep batch of up to 20 samples	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-analyzed.	ELLE Analyst	Laboratory statistical limits (see Appendix M).
Duplicate	1 per 10 samples	Flag data	ELLE Analyst	Results within acceptance limits (≤ 29% RPD)

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SM = Standard Method
SOP = Standard Operating Procedure

QAPP Worksheet #28-12 – Chloride/Sulfate – Analytical Quality Control and Corrective Action

Matrix: Groundwater and Surface Water
Analytical Group: Chloride/Sulfate
Analytical Method/SOP Reference: USEPA Method 9056A; WI11626

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method blanks	1 per prep batch of up to 20 samples	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample
MS	1 per 10 samples	Flag outliers	ELLE Analyst	Recovery limits per QSM 5.3.
LCS	1 per prep batch of up to 20 samples	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	Recovery limits per QSM 5.3.
Duplicate	1 per 10 samples	Flag outliers	ELLE Analyst	RPD ≤ 4.0% for chloride and RPD ≤ 4.1% for sulfate

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LOQ = Limit of Quantitation
MS = Matrix Spike
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SOP = Standard Operating Procedure
USEPA = United States Environmental Protection Agency

QAPP Worksheet #28-13 – Dissolved Organic Carbon - Analytical Quality Control and Corrective Action

Matrix: Surface Water
Analytical Group: Dissolved Organic Carbon
Analytical Method/SOP Reference: SM 5310C; WI11637

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method blanks	1 per prep batch of up to 20 samples	Reanalyze blank to confirm detections. If detects confirm, re-prep samples that are not ND or not >10x the blank value.	ELLE Analyst	No analytes detected > MDL or >1/10 the amount measured in any sample
MS	1 per 10 samples	Flag outliers	ELLE Analyst	Laboratory statistical limits (see Appendix M).
LCS	1 per prep batch of up to 20 samples	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	Laboratory statistical limits (see Appendix M).
Duplicate	1 per 10 samples	Flag data	ELLE Analyst	Results within acceptance limits (≤ 10% RPD)

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LOQ = Limit of Quantitation
MS = Matrix Spike
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SM = Standard Method
SOP = Standard Operating Procedure

QAPP Worksheet #28-14 – pH - Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: pH
Analytical Method/SOP Reference: SW-846 9045D / WI11518 (Soil / Sediment)

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Laboratory Control Standard	1 per batch	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	95-105% Recovery
Laboratory Duplicates	1 per 10 samples	No corrective action, matrix related	ELLE Analyst	4% RPD

Legend:
ELLE = Eurofins Lancaster Laboratories
LCS = Laboratory Control Sample
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SOP = Standard Operating Procedure

QAPP Worksheet #28-15 – Grain Size Distribution - Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: Grain Size Distribution
Analytical Method/SOP Reference: ASTM D422 / WI11514

QC Sample	Frequency / Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Duplicate (when duplicate volume is provided)	1 per batch	No corrective action, matrix related	ELLE Analyst	Laboratory statistical limits (see Appendix M).

Legend:
ASTM = American Society for Testing and Materials
ELLE = Eurofins Lancaster Laboratories Environmental
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operating Procedures

QAPP Worksheet #28-16 - Total Organic Carbon - Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: Total Organic Carbon
Analytical Method/SOP Reference: SW-946 9060A / WI11627

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method blanks	1 per prep batch of up to 20 samples	Reanalyze blank to confirm detections. If detects confirm, re-prep samples that are not ND or not >10x the blank value.	ELLE Analyst	No analytes detected > LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater
MS/MSD	1 per 10 samples	Flag outliers	ELLE Analyst	Laboratory statistical limits (see Appendix M).
LCS	1 per prep batch of up to 20 samples	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	Laboratory statistical limits (see Appendix M).
LCSD	For batches where an MSD is not supplied	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	Laboratory statistical limits (see Appendix M).
Duplicate	1 per 10 samples	Flag data	ELLE Analyst	Laboratory statistical limits (see Appendix M).

Legend:
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
ND = Not Detected
QC = Quality Control
QSM = Quality Systems Manual
SOP = Standard Operation Procedure

QAPP Worksheet #28-17 - Cation Exchange Capacity - Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: Cation Exchange Capacity
Analytical Method/SOP Reference: 9081 / CC-ATM-M020

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method Blank	1 per prep batch of up to 20 samples	Re-prepare and re-analyze batch	Primary analyst; preparatory technician	<LOQ
MS	1 per prep batch of up to 20 samples	Examine LCS; re-prepare and re-analyze if necessary.	Primary analyst; preparatory technician	75-125% Recovery
MSD	1 per prep batch of up to 20 samples	Examine LCS; re-prepare and re-analyze if necessary.	Primary analyst; preparatory technician	75-125% Recovery. 20% RPD
LCS	1 per prep batch of up to 20 samples, only required if MS fails	Re-prepare and re-analyze batch	Primary analyst; preparatory technician	80-120% Recovery. 20% RPD

Legend:
LCS = Laboratory Control Sample
LOQ = Limit of Quantitation
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SOP = Standard Operating Procedure

QAPP Worksheet #28-18 - Oxidation-Reduction Potential – Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: Oxidation-Reduction Potential
Analytical Method/SOP Reference: ASTM D1498 / WI11512

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
LCS/LCSD	1 per prep batch of up to 20 samples	Re-extract and reanalyze LCS and all associated samples.	ELLE Analyst	98-102% Recovery. 20% RPD
Batch Duplicate	1 per 10 samples	Flag outliers	ELLE Analyst	Results within acceptance limit of 5% RPD
Duplicate Readings	Every sample	Flag outliers	ELLE Analyst	Results within acceptance limit of 5%

Legend:
ASTM = American Society for Testing and Materials
ELLE = Eurofins Lancaster Laboratories Environmental
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
QC = Quality Control
RPD = Relative Percent Difference
SOP = Standard Operating Procedure

QAPP Worksheet #28-19 - Moisture Content - Analytical Quality Control and Corrective Action

Matrix: Soil / Sediment
Analytical Group: Moisture Content
Analytical Method/SOP Reference: SM 2540 G-1997 / WI10697

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Laboratory Control Standard	1 per batch of up to 20 samples	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	Laboratory statistical limits (see Appendix M).
Duplicate	1 per 10 samples	No corrective action, matrix related	ELLE Analyst	RPD ≤ 5%

Legend:
ELLE = Eurofins Lancaster Laboratories
LCS = Laboratory Control Sample
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SM = Standard Method
SOP = Standard Operating Procedure

QAPP Worksheet #28-20 - Air VOCs - Analytical Quality Control and Corrective Action

Matrix: Soil Gas
Analytical Group: VOCs
Analytical Method/SOP Reference: TO-15 QUAD /SOP#6

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Inspect the system and re-analyze the blank.	Bench Analyst/Scientist	No analytes detected >1/2 laboratory LOQ; Common lab contaminants must not be detected > LOQ.
LCS	One per analytical batch	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.	Bench Analyst/Scientist	Recovery limits and RPDs per QSM 5.3 published limits Table C-43; RPD <30%
LCSD; Initial and Closing CCV can serve as the LCS/LCSD	One per analytical batch	Investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.	Bench Analyst/Scientist	Recovery limits and RPDs per QSM 5.3 published limits Table C-43; RPD <30%
Internal Standards	All standards, blanks, and samples	For blanks: inspect the system and reanalyze the blank. For samples: re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate	Bench Analyst/Scientist	Recovery limits and RPDs per QSM 5.3

Legend:
ASTM = American Society for Testing and Materials
IS = Internal Standards
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SOP = Standard Operating Procedure

QAPP Worksheet #28-21 - Methane and Helium- Analytical Quality Control and Corrective Action

Matrix: Soil Gas
Analytical Group: Fixed Gases (Methane and Helium)
Analytical Method/SOP Reference: ASTM D1946/SOP#8

QC Sample	Frequency/ Number	Corrective Action	Person(s) Responsible for Corrective Action	Measurement Performance Criteria
Method Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Inspect the system and re-analyze the blank.	Bench Analyst/Scientist	No targets >1/2 laboratory LOQ except for common lab contaminants which are <LOQ.
LCS	One per analytical batch	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.	Bench Analyst/Scientist	85-115% Recovery, RPD <30%, Initial and Closing CCV - see Worksheet #24
LCSD; Initial and Closing CCV can serve as the LCS/LCSD	One per analytical batch	Investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.	Bench Analyst/Scientist	85-115% Recovery, RPD <30%, Initial and Closing CCV - see Worksheet #24

Legend:
ASTM = American Society for Testing and Materials
CCV = Continuing Calibration Verification
LCS = Laboratory Control Sample
LCSD = Laboratory Control Sample Duplicate
LOQ = Limit of Quantitation
QC = Quality Control
QSM = Quality Systems Manual
RPD = Relative Percent Difference
SOP = Standard Operating Procedure

QAPP Worksheet #28-22 - PFAS - Analytical Quality Control and Corrective Action

Matrix: Groundwater IDW/ Soil IDW
Analytical Group: PFAS
Analytical Method/SOP Reference: LC/MS/MS in accordance with QSM, Table B-15

For all PFAS compounds if EIS recovery is <50%, ELLE will check for laboratory error and correct if identified. If no laboratory error is identified, additional corrective action will be performed if EIS recovery is <10%. If EIS recovery is >10% and samples have detections above the reporting limit, no additional corrective action is performed. If EIS recovery is >10% and samples have no detections for associated native analytes, the native analyte response will be evaluated to confirm the validity of the reporting limit. Reporting limits will be proportionately increased as necessary and appropriate to ensure that reported values accurately reflect the sensitivity of the analysis.

For all PFAS compounds, if EIS recovery is >150%, ELLE will check for laboratory error and correct if identified. If no laboratory error is identified, additional corrective action will be performed only when field samples have detections above the reporting limits for the associated native target analytes and EIS recovery is >200%.

If persistent matrix effects are observed for multiple samples from a given project that necessitate a high rate of additional corrective actions, these matrix effects will be mitigated prior to sample preparation and analysis, typically by processing a smaller sample mass or volume.

QAPP Worksheet #29: Project Documents and Records

(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

Documents and Records	On-Site Analysis Documents and Records	Generation	Verification	Storage Location/Archival
Sample Collection				
Field data collection sheets	Equipment calibration logs	Field Team Lead	Project Manager	Project File and FUDSChem
C-o-C Records	Equipment maintenance	Field Team Lead	Project Manager	Project File and FUDSChem
Air Bills	Testing and Inspection logs	Field Team Lead	Project Manager	Project File
Custody Seal	Corrective Action Forms	Field Team Lead	Project Manager	Project File
Telephone Logs	Telephone Logs	Field Team Lead	Project Manager	Project File
Corrective Action Forms	DQCRs	Field Team Lead	Project Manager	Project File
Documentation of deviations from methods / SOPs	Field notes and DQCRs	Field Team Lead	Project Manager	Project File
Identification of QC samples	Soil boring logs	Field Team Lead	Project Manager	Project File
Photographs	Well/soil boring construction diagrams	Field Team Lead	Project Manager	Project File
Sampling instrument calibration logs	Well purging/ water quality forms; PID monitoring forms	Field Team Lead	Project Manager	Project File and FUDSChem
Sampling locations and sampling plan	Field notes and DQCRs	Field Team Lead	Project Manager	Project File and FUDSChem
Sampling notes and drilling logs	Field notes and soil boring logs	Project Geologist	Project Manager	Project File and FUDSChem
Project Assessments				
Equipment maintenance, testing, and inspection logs	Field notes and DQCRs	Field Team Lead	Project Manager	Project File and FUDSChem
Corrective Action Forms	Field notes and DQCRs	Field Team Lead	Project Manager	Project File

Documents and Records	On-Site Analysis Documents and Records	Generation	Verification	Storage Location/Archival
Reported results for QC checks, instrument tunes, and QC samples	Field notes and DQCRs	Field Team Lead, Laboratory	Project Manager	Project File
Data Validation Report	Not Applicable	LDC	Project Manager	Project File and FUDSChem
Laboratory Reports				
Analytical Report	Not Applicable	Laboratory Project Manager	Project Chemists	Project File and FUDSChem

Legend:
C-o-C = Chain of Custody
DQCR = Daily Quality Control Reports
LDC = Laboratory Data Consultants
PID = Photo-Ionization Detector
QC = Quality Control
SOP = Standard Operating Procedure

QAPP Worksheets #31, 32, & 33: Assessments and Corrective Action

(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)
(EPA 2106-G-05 Section 2.4 and 2.5.5)

In addition to following the 2012 Optimized UFP-QAPP Worksheet guidance for Worksheet #31, 32 & 33 Assessments and Corrective Action, this worksheet also describes the Quality Assurance/Quality Control procedures that would otherwise be covered in the Quality Assurance/Quality Control portion of a Work Plan.

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Chemistry Field Sampling Technical Systems Audit	Project Chemist TI-SDC	At start of sampling and regularly thereafter	5 days after audit	Written Field Audit	10 days after receiving notification
Fixed Laboratory Technical Systems Audit	Project Chemist TI-SDC	Prior to sampling. As needed afterwards.	5 days after audit	Written Audit Report	14 days after receiving notification
DoD Environmental Laboratory Accreditation Program	Validation Coordinator DoD Laboratory	Every 2 years	30 days after audit	Written Audit Report	30 days after receiving notification
Chemistry Data Audit	Project Chemist TI-SDC	Periodically	5 days after audit	Written Audit Report	14 days after receiving notification
Data Validation System Audit	Project Manager TI-SDC	Periodically	5 days after audit	Written Audit Report	14 days after receiving notification

Assessment Response and Corrective Action:

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for monitoring Corrective Action implementation
Chemistry Field Sampling Technical Systems Audit	Field Team Lead TI-SDC	Corrective Action Plan	10 days after receiving notification	Field Team Lead TI-SDC	Project Chemist TI-SDC
Fixed Laboratory Technical Systems Audit	QA Coordinator or Technical Operations Manager Contract Laboratory	Corrective Action Plan	30 days after receiving notification	QA Coordinator or Technical Operations Manager Contract Laboratory	Project Chemist TI-SDC
DoD Environmental Laboratory Accreditation Program	QA Coordinator or Technical Operations Manager Contract Laboratory	Corrective Action Plan	30 days after receiving notification	QA Coordinator or Technical Operations Manager Contract Laboratory	DoD ELAP Coordinator
Chemistry Data Audit	QA Coordinator or Technical Operations Manager Contract Laboratory	Corrective Action Plan, Re-submission of data	30 days after receiving notification	QA Coordinator or Technical Operations Manager Contract Laboratory	Project Chemist TI-SDC
Data Validation System Audit	QA Coordinator or Technical Operations Manager Contract Laboratory	Corrective Action Plan, Re-submission of data	30 days after receiving notification	QA Coordinator or Technical Operations Manager Contract Laboratory	Project Manager TI-SDC

Management Reports:

Type of Report	**Frequency** (Daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Verbal Status Reports	Daily/Weekly	Daily/weekly conference calls	TI-SDC field personnel, technical team members	TI-SDC field personnel, technical team members
Technical Meetings or Teleconferences	Monthly during Field Work, or as needed	Monthly during Field Work, or as needed	Contractor and regulatory attendees. Meeting minutes prepared by TI-SDC and sent to project members via email.	Contractor and regulatory agency team members
Email status Reports during Field Work	Weekly	Weekly	Project Manager, TI-SDC	USACE, and NYSDEC
DQCR	Daily	Ongoing	Field Team Lead TI-SDC	TI-SDC PM, USACE PM
Data Validation Reports	With each analytical batch reported by the laboratory	Ongoing	Project Chemist, TI-SDC	TI-SDC PM, USACE PM
Automated Data Validation	With each analytical batch reported by the laboratory	Ongoing	Project Chemist, TI-SDC	TI-SDC PM, USACE PM

Legend:
DoD = Department of Defense
DQCR = Daily Quality Control Reports
ELAP = Environmental Laboratory Accreditation Program
NYSDEC = New York State Department of Environmental Conservation
PM = Project Manager
QA = Quality Assurance
USACE = United States Army Corps of Engineers

Quality Assurance/ Quality Control

All work performed under this DO will adhere to TI-SDC's Quality Control Plan (QCP) developed for this contract (TI-SDC, 2019), and will be conducted in accordance with the most recent versions of USACE SOPs. Additionally, a site-specific UFP-QAPP has been prepared to define a project-specific set of procedures and performance criteria to assure delivery of data that meet the client's expectations, acceptable scientific and engineering standards, and TI-SDC's project quality objectives. The TI-SDC QC Manager has responsibility for implementing and overseeing the quality system and ensuring project personnel adhere to corporate and contract-specific QA/QC requirements.

This section presents requirements for field QC documentation and was developed in accordance with applicable federal standards. The objective is to establish the project QC systems by defining the processes and organization that will ensure project activities conform to project objectives. TI-SDC is responsible for QC of work related to the performance of the DO. TI-SDC will implement an effective QC system, consisting of the procedures outlined herein, operations procedures, training, and a defined QC organization.

Quality Control Responsibilities

The project will use a three-phase control system for all aspects of the work; procedures for scheduling, reviewing, certifying, and managing submittals; control, verification, and acceptance testing procedures; reporting procedures; a list of the definable features of the work; and procedures for tracking deficiencies from identification through acceptable corrective action. The three phases of control include Preparatory, Initial, and Follow-Up phases, which are described in detail in Section 7.4.

It is TI-SDC's policy to allocate personnel with the appropriate training and authority to develop, refine, and implement our quality systems. A QC Manager and sufficient number of additional qualified personnel have been assigned to the project to ensure contract compliance. A qualified member of the QC organization will be at the site at all times during progress of the work, and will have complete authority to take any action necessary to ensure compliance with the contract.

Personnel and Respective Authorities

See UFP-QAPP Worksheets 5 through 7 for responsibilities and authorities of the project.

Subcontractor Management

TI-SDC will maximize project control by retaining program, task order, and site management (safety and QC) functions. Subcontracts will be formulated to reflect the detailed scope, performance objectives, and specifications of the project. Provisions of the basic contract, health and safety requirements, and QA/QC requirements will be 'flowed-down' as appropriate. Other provisions will include strict procedures for implementing subcontractor change orders, expediting dispute resolutions, and implementing corrective actions. Subcontractors may perform work

utilizing their own QC procedures provided they are approved by TI-SDC, and consistent with the quality management program outlined in this section.

The performance baseline will be developed jointly with key team subcontractors. Discrete tasks and milestones will be formally entered into the management control system. Performance against the fiscal and project schedule baseline will be monitored informally by the Project Manager on a weekly basis, and formally each month as part of the total project status review and routine progress reporting. The field performance of all subcontractors will be monitored at all times by the Site Supervisor and Site Safety and Health Officer (SSHO), who will record observations of progress in a formal daily log and discuss project status daily with the Project Manager. Deviations from the baseline will be closely monitored. Negative subcontractor performance trends will instigate an interim performance review and discussions with TI-SDC's contract management personnel. As required, a corrective action plan will be developed to bring schedule/cost performance back in line with the baseline.

Reporting and Deliverables

TI-SDC will comply with the reporting and deliverable procedures specified in the Performance Work Statement (PWS; USACE, 2019) for the Former Stewart AFB Remedial Investigation activities. These include meetings, presentations, informal and formal correspondence, teleconferences, project status reports, technical memoranda, and final reports. TI-SDC's Project Manager will be responsible for reviewing and certifying that all submittals follow the contract DO requirements. Documents will be submitted according to the timeframes specified in the PWS in order to allow sufficient time for review and comment prior to initiation of work activities. UFP-QAPP Worksheet 16 presents the project schedule/timeline table.

The Project Manager will ensure that all deliverables are submitted to the appropriate USACE, regulatory, and stakeholder recipients; and in the quantity and format specified; as identified in the PWS (USACE, 2019). TI-SDC will maintain a complete, up-to-date file of all submittals, and all appropriate CERCLA documentation will be submitted to the Project Repository. Documents will be produced with client draft, draft, and final versions unless otherwise approved or indicated. TI-SDC will respond to comments and promptly furnish a corrected submittal in the format and number of copies specified in the PWS. All documents will be identified as draft until completion of the required response to comments (RTC) and approval from the USACE Project Manager, at which time they will become final.

Control, Verification, Acceptance and Testing Procedures

This section includes the control, verification, and acceptance testing procedures for each specific analytical test to be performed.

TI-SDC will collect representative sediment, soil, surface water, and groundwater samples for laboratory analysis. Upon request, TI-SDC will furnish to the Government duplicate samples for possible testing by the Government, if required. All sample analytical results will be provided on

industry standard forms. Sample collection, analysis, and reporting are included in the UFP-QAPP worksheets.

TI-SDC or an approved subcontractor will perform the following activities, and will record and provide the following data:

- Verify that testing procedures comply with performance objectives.
- Verify that facilities and testing equipment are available and comply with testing standards.
- Check test instrument calibration data against certified standards.
- Verify that recording forms and test identification control number system, including all the test documentation requirements, have been prepared.
- Record results of all tests taken, both passing and failing, on the report for the date taken. Actual test reports will be submitted later with a reference to the test and date taken.

Quality Control Methods

Contractor quality control is the means by which the Contractor ensures that the work, to include that of subcontractors and suppliers, complies with the requirements of the task order for each definable feature of the work, as specified in the APP (Appendix I).

TI-SDC will perform three phases of control for each definable feature of work. The three phases of control include Preparatory, Initial, and Follow-Up. Preparatory Phase control will be used to establish quality prior to mobilization and commencement of site activities, and delivery of materials. Initial Phase control will verify that all necessary procedures have been instituted to ensure conformance with the project plans. Follow-Up Phase control will include daily checks and documentation of project requirements to ensure that quality work will be produced throughout the duration of the project. Data Quality Control Reports (DQCRs) will be prepared during all phases of RI activities.

Example forms that will be used to document each of the three phases of control are provided in Appendix K, and include:

- Preparatory Phase Inspection Checklist.
- Initial Phase Inspection Checklist.
- Follow Up Phase Inspection Checklist.
- DQCR.

Preparatory Phase

This phase will be performed prior to beginning work on each definable feature of the work, and after all the required work plans are approved. The preparatory phase inspection includes a review of all work requirements, a physical examination of all required materials and equipment, an examination of the work areas, and a demonstration of field activity preparation. Work cannot begin on a definable feature of work until the preparatory phase is complete. The Preparatory Inspection Checklist is included in Appendix K.

The following activities will also be performed during the Preparatory Phase:

- Review of regulations and contract requirements.
- Review of plans, maps, and drawing.
- Identification of project team.
- Identification and completion of training.
- Verification that all materials and/or equipment are on hand or have been scheduled for acquisition at the proper time, and have been tested, submitted, and approved.
- Review of provisions made to provide required control inspections and testing.
- Physical check of instruments, logbooks, forms, reference documents, sample packaging and shipping supplies, materials, and equipment to confirm they are on-site, and conform to project requirements.
- Examination of the work areas to assure that all preliminary and preparatory work has been completed, and the work areas are ready for the start of activities.
- Review of the appropriate activity hazard analyses (AHA) to assure safety requirements are met.
- Discussion of procedures for controlling the quality of the work, including repetitive deficiencies.
- Documentation of workmanship standards for each feature of work; and
- Review of sampling procedures, materials, equipment calibration, decontamination, labeling, IDW procedures, and shipping requirements.

Included in this phase is a meeting conducted by the Project Manager and/or Site Superintendent and attended by TI-SDC staff and the subcontractor(s) for the definable feature of work (if applicable). The results of the preparatory phase action will be documented in the DQCR, and in the Preparatory Phase Checklist.

Initial Phase

The Initial Phase is defined as the beginning of a definable feature of work. The initial checklist is included in Appendix K. The following will be accomplished during the Initial Phase:

- Check preliminary work including the review of the preparatory meeting minutes.
- Check new work to ensure that it is in full compliance with performance objectives.
- Verify the adequacy of controls to ensure full compliance and verify the required control inspection and testing.
- Establish the level of workmanship and verify that it meets minimum acceptable workmanship standards. Field notes will be inspected, equipment calibration observed and verified, labels and shipping will be inspected, and an inspection of QA/QC requirements and compliance will be completed.
- Check for omissions and resolve all differences of interpretation with USACE Project Manager.

- Check safety activities to include compliance with and upgrading of the APP/SSHP and AHAs, as necessary.
- Complete general check of dimensional requirements (e.g., proposed sample locations).
- Review the APP/SSHP, including the AHAs, with each worker and document the review on the daily report. Have each worker sign the appropriate form in the APP/SSHP stating that they have reviewed and understand the APP/SSHP.
- Repeat the Initial Phase for each new crew member on-site, or any time acceptable specified quality standards are not being met. Document all new crew member orientations.

The Contracting Officer and USACE Project Manager will be notified in advance of the beginning of the Initial Phase. TI-SDC's Project Manager and/or Site Superintendent will lead the Initial Phase Meeting, and the meeting will be attended by the Subcontractor Field Lead responsible for that definable feature of work.

Follow-Up Phase

Daily checks will be performed until completion of the particular feature of work to assure continued compliance with performance standards established at the initial phase in conjunction with project requirements. The daily check will accomplish the following tasks:

- Check that the work is in compliance with project requirements.
- Check that the quality of performance is maintained, as required.
- Check that the testing is performed by the approved laboratory.
- Check that the rework items are being corrected.
- Perform daily tailgate safety briefings and site safety inspections.

The checks will be recorded on the DQCR. Final follow-up checks will be conducted, and all deficiencies corrected prior to the start of additional features of work that may be affected by the deficient work. The TI-SDC Team will not build upon nor conceal non-conforming work.

Documentation

TI-SDC will maintain current records of all control activities, inspections, and sampling documentation. These will include factual evidence that the required control phases and tests have been performed, including the number and results, nature of defects, causes for rejection, proposed remedial action, corrective actions taken, conforming and defective features, and a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. These records will include the work of subcontractors and suppliers. TI-SDC will ensure that the records are available for review by the Government, and all documentation will be submitted to the USACE Project Manager upon request. Otherwise, the documentation will be included in an appendix of the final report for the project. Project documentation will be maintained for a minimum of 10 years, or for the length of time specified by the client or

regulatory agencies. Items to be documented when appropriate include, but are not limited to, the following:

- Instrument calibration and maintenance records.
- Field notebooks and daily activity logs.
- Sample collection logs.
- Field monitoring/screening results and associated data sheets.
- Equipment inspection checklists.
- Sample labels and chain-of-custody records.
- Training records.
- Pre-entry health and safety briefings and daily tailgate safety meetings.
- Weight tickets.
- Manifests.
- Submittal Status Log.
- Testing Plan and Log.
- Rework Items List.
- DQCR.

The DQCR will include the following information:

- Date.
- Weather conditions.
- Contractor/subcontractor personnel on site.
- General description of field activities performed (investigations, boring installations, well construction, aquifer tests, sampling, excavations, operational checks, etc.).
- Significant accomplishments/observations.
- Quality control activities performed (including field calibrations and inspections).
- Problems or deficiencies encountered/corrective actions taken.
- Future field activities.
- Additional documentation (test results, checklists, health and safety, etc.).

These records will cover both conforming and deficient conditions. All calendar days during the site-specific fieldwork will be accounted for. At a minimum, one report will be prepared and submitted to account for each time period when no fieldwork is being performed. Reports will be signed and dated. The DQCR is included in Appendix K.

An approved copy of the applicable Work Plan and associated UFP-QAPP, as well as copies of all completed daily reports, will be maintained by TI-SDC at the job site. All quality control documents will be available for review by the Government QA representatives and/or Contracting Officer. At

the completion of the project, quality control documents will be included as an appendix to the project's Final Report, both in hard copy and electronic formats.

Additional Quality Control

Additional quality control measures for the sampling and analysis to be conducted at the Site are discussed in the other Worksheets of the QAPP.

Completion Inspections

This section describes the completion inspections and procedures for tracking investigation/construction deficiencies from identification through acceptable corrective action. It also defines the verification procedures to ensure that the identified deficiencies have been corrected.

Punch-Out Inspection

The Site Superintendent will conduct an inspection of work near completion for major definable work features specified in the AHA (Appendix I). The Site Superintendent will develop a punch list of items that do not conform to the approved work plan. The punch list of deficiencies will be included in the QC documentation and will include the estimated date by which the deficiencies will be corrected.

The Project Manager and/or Site Superintendent will make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, TI-SDC will notify the USACE Project Manager that the site is ready for the USACE Pre-Final Inspection.

Pre-Final Inspection

The USACE may choose to perform this inspection to verify that the work is complete, and a USACE Pre-Final Punch List may be developed as a result of this inspection. The Project Manager and/or Site Superintendent will ensure that all items on this list have been corrected before notifying the USACE that a Final Inspection can be scheduled. Any items noted on the Pre-Final Inspection will be corrected in a timely manner. These inspections and any deficiency corrections required will be accomplished within the time slated for completion of the entire work, or any particular increment thereof, if the project is divided into increments by separate completion dates.

Final Acceptance Inspection

The Project Manager and/or Site Superintendent, and USACE personnel, may attend this inspection. The Final Acceptance Inspection, if desired, will be formally scheduled by USACE based upon results and resolution of any issues from the Pre-Final Inspection.

Notification of Noncompliance

USACE will notify TI-SDC of any detected noncompliance with the foregoing requirements. TI-SDC will take immediate corrective action after receipt of such notice. When such a notice is delivered to TI-SDC at the work site, it will be deemed sufficient for the purpose of notification.

Quality Assurance Comments

During the course of the project, TI-SDC may receive various QA comments from USACE that will reflect site activity corrections or reflect outstanding or future items needing attention. TI-SDC will acknowledge receipt of these comments on the DQCR, and the DQCR will also reflect when these items are specifically completed or corrected to permit USACE verification.

QAPP Worksheet #34: Data Verification and Validation Inputs

(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA 2106-G-05 Section 2.5.1)

Item	Description	Verification (completeness)	Validation (conformance to specifications)
	Planning Documents/Records		
1	Approved QAPP	X	
2	Approved Accident Prevention Plan/ Site Safety and Health Plan (APP / SSHP)	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
	Field Records		
5	Field Logbooks	X	
6	Equipment Calibration Logs	X	
7	Chain-of-Custody records	X	
8	Sampling diagrams/notes	X	
9	Drilling logs	X	
10	Monitoring well construction forms	X	
11	Groundwater sampling forms	X	
12	DQCRs	X	
	Analytical Data Package		
13	Cover Sheet	X	X
14	Case narrative	X	X
15	Internal laboratory Chain-of-custody	X	X
16	Sample Receipt records	X	X
17	Sample chronology	X	X
18	Sample results	X	X
19	LOD / LOQ Establishment and verification	X	X
20	Standards traceability	X	X
21	Instrument calibration records	X	X
22	Definition of laboratory qualifiers	X	X
23	QC sample results	X	X
24	Corrective Action reports	X	X
25	Raw data	X	X
26	Electronic data deliverable	X	X
27	Data Validation Report	X	X

Legend:
APP = Accident Prevention Plan
DQCR = Daily Quality Control Reports
LOD = Level of Detection
LOQ = Limit of Quantitation
QAPP = Quality Assurance Project Plan
QC = Quality Control
SOP = Standard Operation Procedure
SSHP = Site Safety and Health Plan

QAPP Worksheet #35: Data Verification Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Field Logbook	QAPP, Field SOPs	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed, and results are documented.	Daily – Field Team Lead At conclusion of field activities - Project Manager
Chain-of-custody forms	QAPP, Field SOPs	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Daily - Field Team Lead At conclusion of field activities - Project Chemist
Laboratory Deliverable	QAPP, Lab SOPs	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the chain-of-custody forms to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release - Laboratory Project Manager Upon receipt - Project Chemist

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Data Validation Reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan. Establish that all QAPP required QC samples were run and met the required limits for precision and accuracy. Verify that sample results met the project quantitation limits specified in the QAPP. Conduct a Stage 4 validation (i.e., review of raw data to confirm laboratory calculations) on 10% of samples.	LDC – Project Chemist

Legend:
LDC = Laboratory Data Consultant
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QAPP = Quality Assurance Project Plan
QC = Quality Control
SOP = Standard Operation Procedure

QAPP Worksheet #36: Data Validation Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

The data deliverable requirements for this project are SEDD Stage 2a. In addition to the Stage 2a requirements, electronic data files will contain additional instrument performance information such as instrument tune and/or calibration data. All hardcopy data packages will be prepared at SEDD Stage 4. All laboratory data will undergo data validation by LDC, utilizing the ADR.net software. Data validation will also be conducted by FUDSChem ADR to Stage 2A, a process done automatically when SEDD files are uploaded to FUDSChem. For data validation elements not provided in the laboratory EDD, LDC will manually validate. These elements may include, but are not limited to, instrument tuning and calibration, initial and continuing calibration blanks, surrogate standards, and internal standards. The validation criteria will follow a hierarchy starting with the QAPP, followed by QSM v 5.3, the laboratory SOP (listed below), and the published method (listed below). DoD Validation Guidelines Modules that are finalized prior to issuing the final QAPP will be used, and National Functional Guidelines (NFG) (USEPA, 2020c) will be applied in the absence of a final DoD Module.

Analytical Group	Data Deliverable requirements	Analytical Specifications	Measurement Performance Criteria	% of data packages to be validated	% of raw data received	% of results to be calculated	Validation Procedure[1]	Validation Code
VOCs (USEPA 8260C/8260C SIM)	SEDD Stage 2a	SOP WI8194 / WI8236; WS #28-1	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
TSVOCs (USEPA 8270D/8270D SIM)	SEDD Stage 2a	SOP WI9617 / WI9995; WS #28-2	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Organochlorine Pesticides (USEPA 8081B)	SEDD Stage 2a	SOP WI9997 / WI9999; WS #28-3	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM

Analytical Group	Data Deliverable requirements	Analytical Specifications	Measurement Performance Criteria	% of data packages to be validated	% of raw data received	% of results to be calculated	Validation Procedure[1]	Validation Code
PCBs (USEPA 8082A)	SEDD Stage 2a	SOP WI9328 / WI10004; WS #28-4	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
TAL Metals (USEPA 6020B)	SEDD Stage 2a	SOP WI11931; WS #28-5	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Mercury (USEPA 7470A or 7471B)	SEDD Stage 2a	SOP WI7965; WS #28-6	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Explosive Compounds (USEPA 8330B)	SEDD Stage 2a	SOP WI9981; WS #28-7	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Dioxins (USEPA 8290A)	SEDD Stage 2a	SOP WI9476; WS #28-8	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Hardness (SM 2340B)	SEDD Stage 2a	WS #28-9	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Alkalinity	SEDD Stage 2a	SOP WI11475; WS #28-10	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Sulfide	SEDD Stage 2a	SOP WI11483; WS #28-11	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Chloride/Sulfate	SEDD Stage 2a	SOP WI11626; WS #28-12	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM

Analytical Group	Data Deliverable requirements	Analytical Specifications	Measurement Performance Criteria	% of data packages to be validated	% of raw data received	% of results to be calculated	Validation Procedure[1]	Validation Code
Dissolved Organic Carbon	SEDD Stage 2a	SOP WI11637; WS #28-13	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
pH (USEPA 9045D)	SEDD Stage 2a	SOP WI11518; WS #28-14	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
pH	SEDD Stage 2a	SOP WI11475; WS #28-14	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Grain Size Analysis (ASTM D422)	SEDD Stage 2a	SOP WI11514; WS #28-15	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
TOC (USEPA 9060A)	SEDD Stage 2a	SOP WI11627; WS #28-16	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Cation Exchange Capacity (USEPA 9081; 6020B)	SEDD Stage 2a	SOP CC-ATM-M020; WS #28-17	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
ORP (ASTM D1498)	SEDD Stage 2a	SOP WI11512; WS #28-18	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Moisture Content (SM2540G-1997, % Moisture Calculation	SEDD Stage 2a	SOP WI10697; WS #28-19	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM

Analytical Group	Data Deliverable requirements	Analytical Specifications	Measurement Performance Criteria	% of data packages to be validated	% of raw data received	% of results to be calculated	Validation Procedure[1]	Validation Code
VOCs (TO-15)	SEDD Stage 2a	SOP #6; WS#28-20	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM
Methane and Helium (ASTM D1946)	SEDD Stage 2a	SOP #8; WS#28-21	QAPP	100%	10%	10%	90% Stage 2a; 10% Stage 4	S2aVEM; S4VEM

Legend:
OCP = Organochlorine Pesticide
ORP = Oxidation-Reduction Potential
PCB = Polychlorinated Biphenyl
SEDD = Staged Electronic Data Deliverable
SIM = Selective Ion Monitoring
SOP = Standard Operating Procedure
SVOC = Semi-Volatile Organic Compound
TAL = Target Analyte List
TOC = Total Organic Carbon
USEPA = United States Environmental Protection Agency
VOC = Volatile Organic Compound

1. Data to undergo Stage 4 validation will be selected to include samples across all types of media and locations expected to be affected by historical DoD activities. In addition, Stage 4 validation will be directed to sample delivery groups that have higher rates of failure in associated QA samples.

Validation Code and Label Identifier Table (Reference: EPA 540-R-08-005)

Validation Code	Validation Label
S1VE	Stage 1 Validation Electronic
S1VM	Stage 1 Validation Manual
S1VEM	Stage 1 Validation Electronic and Manual
S2aVE	Stage 2a Validation Electronic
S2aVM	Stage 2a Validation Manual
S2aVEM	Stage 2a Validation Electronic and Manual
S2bVE	Stage 2b Validation Electronic
S2bVM	Stage 2b Validation Manual
S2bVEM	Stage 2b Validation Electronic and Manual
S3VE	Stage 3 Validation Electronic
S3VM	Stage 3 Validation Manual
S3VEM	Stage 3 Validation Electronic and Manual
S4VE	Stage 4 Validation Electronic
S4VM	Stage 4 Validation Manual
S4VEM	Stage 4 Validation Electronic and Manual

QAPP Worksheet #37: Data Usability Assessment

(UFP-QAPP Manual Section 5.2.3)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

The Data Usability Assessment (DUA) will be performed by the Project Chemist of TI-SDC. Assessment of the usability of the data set is an iterative, ongoing process, conducted as the investigation progresses. It should be conducted, for example, before data are used in risk assessment and before details for subsequent investigation phases are settled. Additionally, TI-SDC will initiate the DUA tool within FUDSChem that will also be completed.

After the Data Usability Assessment has been performed, data deemed appropriate for use will then be used for its various purposes, i.e., to define nature and extent of potential contamination and support risk assessment. Data Usability Assessments will be presented in the Remedial Investigation Report.

The following items will be assessed, and conclusions drawn based on their results:

Precision – Precision is measured through analysis of field and laboratory QC samples, namely field duplicates and MSDs. Field sampling precision is evaluated by calculating the RPD for target compounds detected in the parent sample and it's duplicate. Target compounds detected in both the parent sample and its field duplicate equal to or above the quantitation limit will be presented in tabular format and the RPD calculated. The RPDs will be checked against the measurement performance criteria presented on Worksheet #12, and RPDs exceeding criteria will be identified on the tables.

Laboratory precision is evaluated through calculation of RPDs for all target compounds spiked into a field-designated MS and MSD sample. Any outliers identified (i.e., those compounds with RPDs outside control limits) will be reviewed to determine the source of the error. Sources of error include matrix interference, instrument error, and/or sampling error. Any conclusions about the precision of the analyses will be drawn, and any limitations on the use of the data will be described.

Accuracy / Bias Contamination – Results for all laboratory method blanks, equipment blanks, and trip blanks will be evaluated. The results for of any target compound detected will be checked against the measurement performance criteria presented on Worksheet #12. Results for target compounds that exceed criteria will be tabulated. A discussion will follow summarizing the results of the laboratory accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Analytical Accuracy / Bias – Analytical accuracy and bias will be evaluated through matrix spikes, surrogate recoveries, laboratory control samples (LCSs), and second source calibration verification. Outliers will be evaluated and tabulated, using acceptance criteria presented on Worksheet #12. A discussion will follow summarizing analytical accuracy/bias and whether the

source of the error is instrument, matrix, or sampling related. Conclusions about the analytical accuracy/bias of the analyses will be drawn, and any limitations on the use of the data will be described.

Sensitivity – The results for target compounds will be checked against the measurement performance criteria presented on Worksheet #12 and cross-checked against the quantitation limits presented on Worksheet #15. Results for target compounds with elevated quantitation limits will be identified and noted. A discussion will follow summarizing the results of the laboratory sensitivity. Any conclusions about the sensitivity of the analyses will be drawn and any limitations on the use of the data will be described.

Representativeness – The soil, sediment, surface water, and groundwater samples required for this project will be collected using standardized procedures, and at carefully selected locations. The sampling design includes the collection of 163 "representative" soil samples, 20 "representative" sediment samples, 20 "representative" surface water samples, and 42 "representative" groundwater samples. Standardized, accepted analytical methods will be used to ensure that accurate, reproducible data are generated. To verify sample representativeness, field sample collection procedures, sample containers, and holding times will be reviewed for SOP conformance. Non-representative samples will be identified, narrated, and the impact on data quality objectives discussed.

Comparability – The site-wide analytical data set will be comparable to historical analytical data in select circumstances, through use of the same sampling points (monitoring wells), sample collection, and analytical SOPs. Any deviations will be noted, and conclusions drawn on the usability of the data.

Completeness – A completeness check will be done on all of the data generated by the laboratory. Preliminary completeness goals will be assessed for each target compound for the Site as follows. For each target compound, completeness will be calculated as the number of data points for each compound that are not rejected, divided by the total number of data points for each compound. Completeness criteria is 95%. A discussion will follow summarizing the calculation of data completeness. Any conclusions about the completeness of the data for each analyte will be drawn and any limitations on the use of the data will be described.

In addition, a completeness check will be done following the preliminary phase of RI sampling activities and receipt of analytical data. This will include an assessment of whether all planned samples were collected in the field and identification of any data gaps that exist in the adequate delineation of the nature and extent of impacts from historical DoD activities as well as completion of the risk assessments. Final inferences regarding contamination and exceedances of reference/background will be made after the supplemental phase of RI sampling is done along with statistical analyses of random samples collected over the DUs/EUs.

Reconciliation – Each of the Data Quality Objectives (DQOs) presented on Worksheet #12 will be examined to determine if the objective was met. This examination will include a combined overall

assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of the major impacts observed from the Data Validation, Data Quality Indicators, and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the DQO was met and whether project screening levels were exceeded. The final report will include a summary of all the points that went into the reconciliation of each objective. As part of the reconciliation of each objective, conclusions will be drawn and any limitations on the usability of any of the data will be described.

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FIGURES

Figure 1. Site Vicinity Map

Figure 2. Site Location Map

Figure 3. Site Map Showing Current and Previous Landfill Boundaries and Features

Figure 4. Site Map Showing Historical Road Construction Plan

Figure 5. Graphic Depiction of Conceptual Site Model

Figure 6A. Preliminary Human Health Conceptual Site Model for AOC-2 (Former Southern Landfill)

Figure 6B. Preliminary Human Health Conceptual Site Model for AOC-3N (Debris Area)

Figure 6C. Preliminary Human Health Conceptual Site Model for AOC-3S (Unsuitable Fill Area)

Figure 6D. Preliminary Human Health Conceptual Site Model for AOC-FI (Former Incinerator)

Figure 7. Preliminary Ecological Conceptual Site Model

Figure 8. Site Map Showing Topographic Contours

Figure 9. Site Location Map Showing Select Surface Water Features

Figure 10. Site Map Showing Identified Wetland Locations

Figure 11. Bedrock Geology Map

Figure 12. Surficial Geology Map

Figure 13. Fracture Trace Analysis (RRI, 2001)

Figure 14. Overburden Groundwater Elevation Contours (HDR, 2009a)

Figure 15. Historical Soil Sample and Referenced Boring Locations

Figure 16. Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells

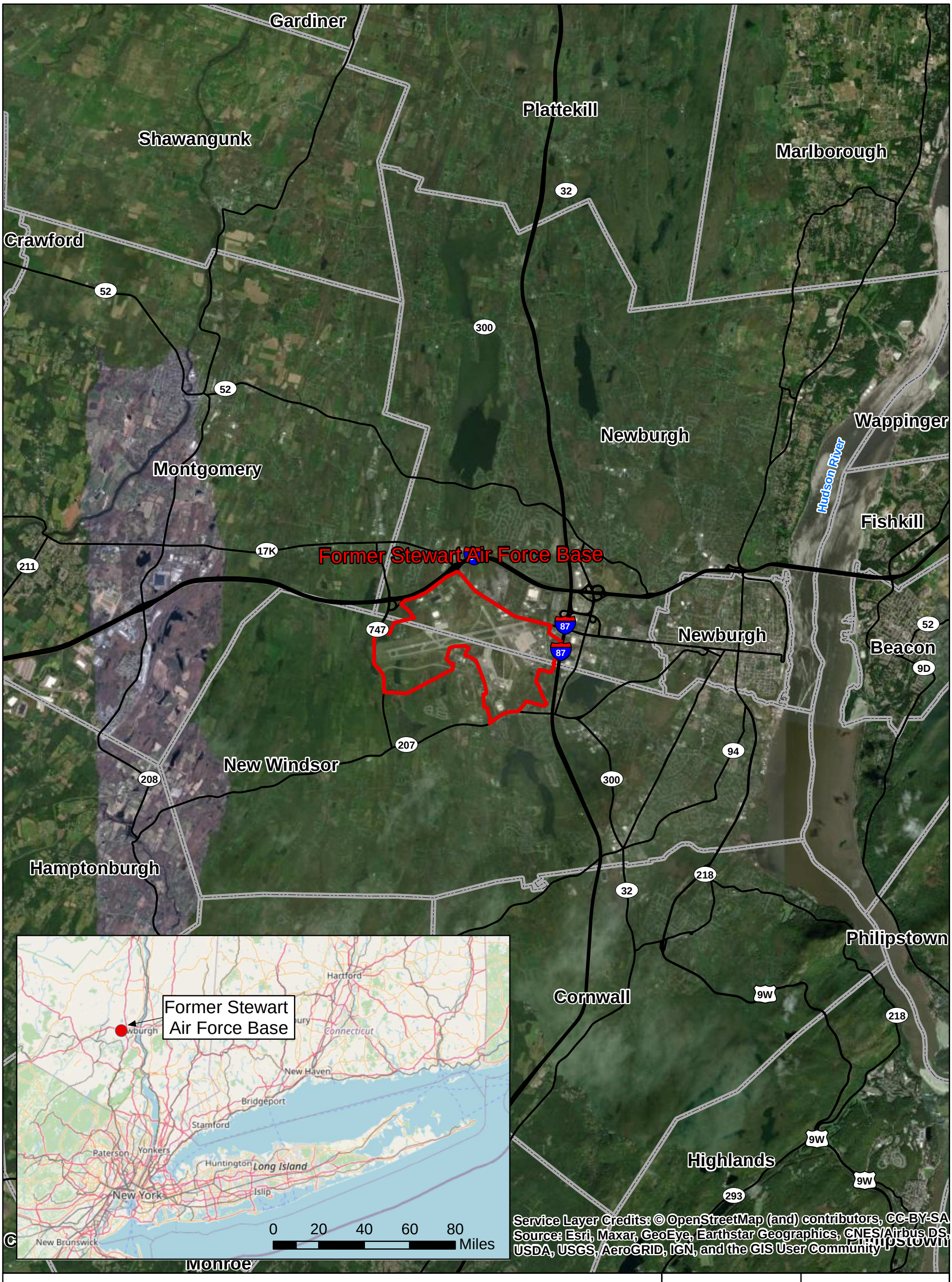
Figure 17. Historical Sediment and Surface Water Sampling Locations

Figure 18. Historical Landfill Extent, Contents, and Landfill Gas Sampling Locations

Figure 19. Proposed Surface and Subsurface Soil Sampling Locations

Figure 20. Proposed Groundwater Monitoring Locations

Figure 21. Proposed Sediment and Surface Water Sampling Locations



Legend

- Former Stewart Air Force Base
- Major Roads
- Town Boundaries

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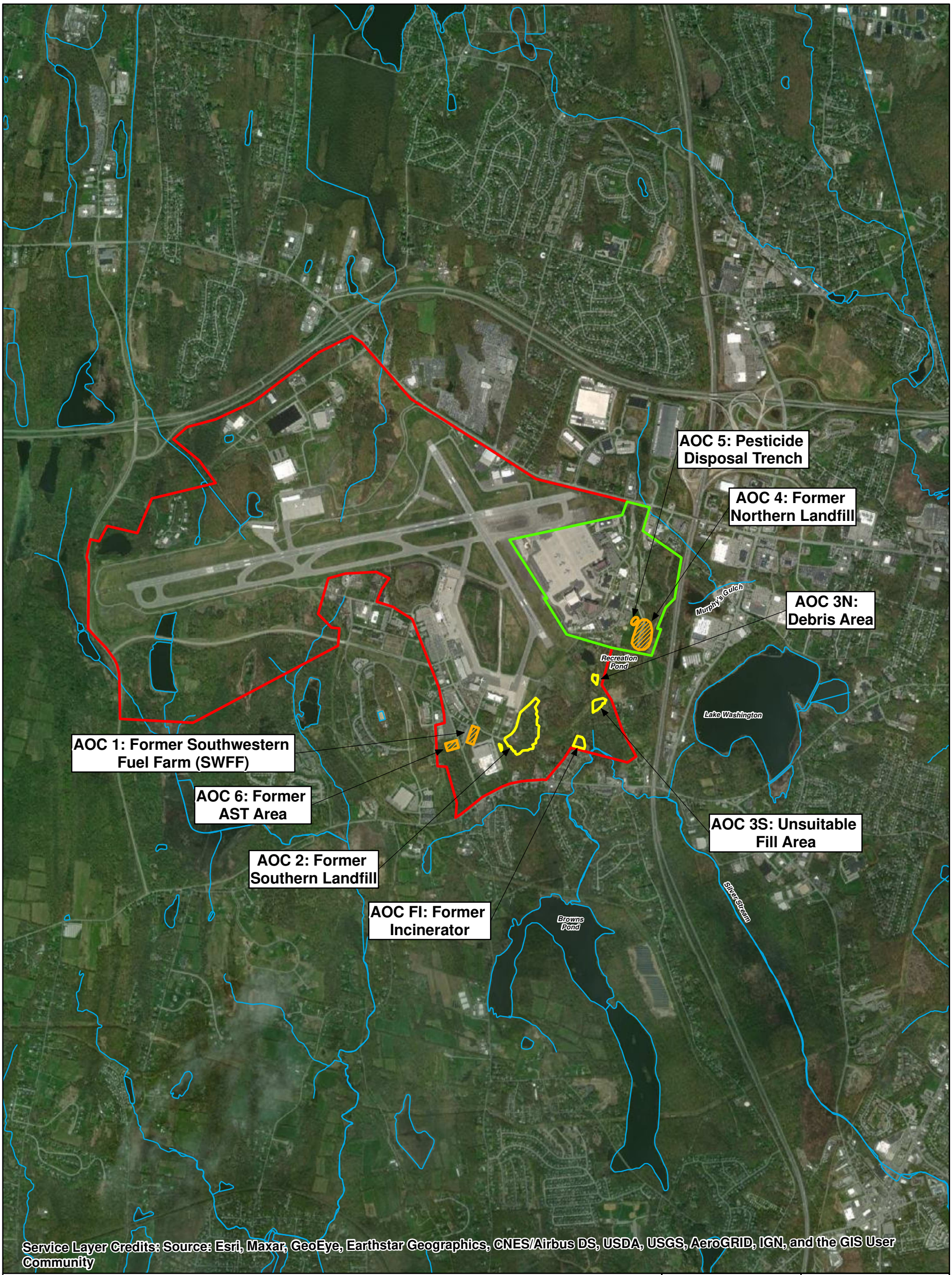
0 1 2 3 4 Miles

FIGURE 1

Site Vicinity Map

Former Stewart Air Force Base, New York

Nov 2020



Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- AOC Not Included in Remedial Investigation
- New York Air National Guard (NYANG) Base
- Former Stewart Air Force Base
- Streams
- Major Roads
- Water Bodies

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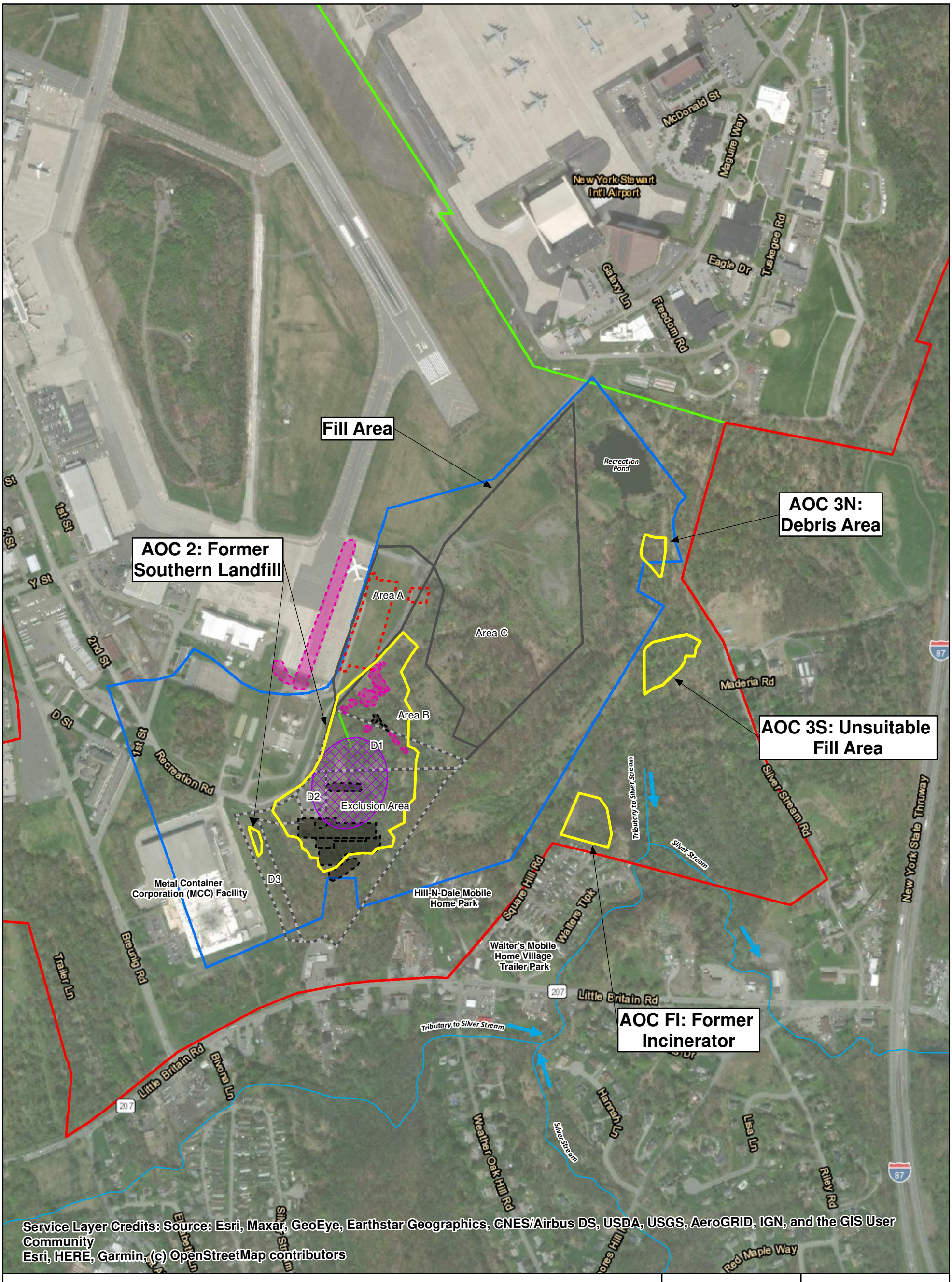
0 1,700 3,400 5,100 6,800 Feet

FIGURE 2

Site Location Map

Former Stewart Air Force Base, New York

Dec 2021



Legend

- Fill area involving non-DoD Activities from 1980s through 2000s. Interpreted from USAGC Report (USAGC, 2019).
- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- New York Air National Guard (NYANG) Base
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Area D Reapportionment Areas D1, D2, D3 and Exclusion Area (HDR, 2009b)
- Largest Southern Landfill Boundary (LMS, 2003b)
- Older Base Landfill (E.C. Jordan, 1989)
- Trench from 2021 Geophysical Investigation
- Disposal Trench
- Stained Soil
- Former Stewart Air Force Base
- Proposed Hanger Facility
- Streams
- Surface Water Flow Direction
- Water Bodies

N W E S

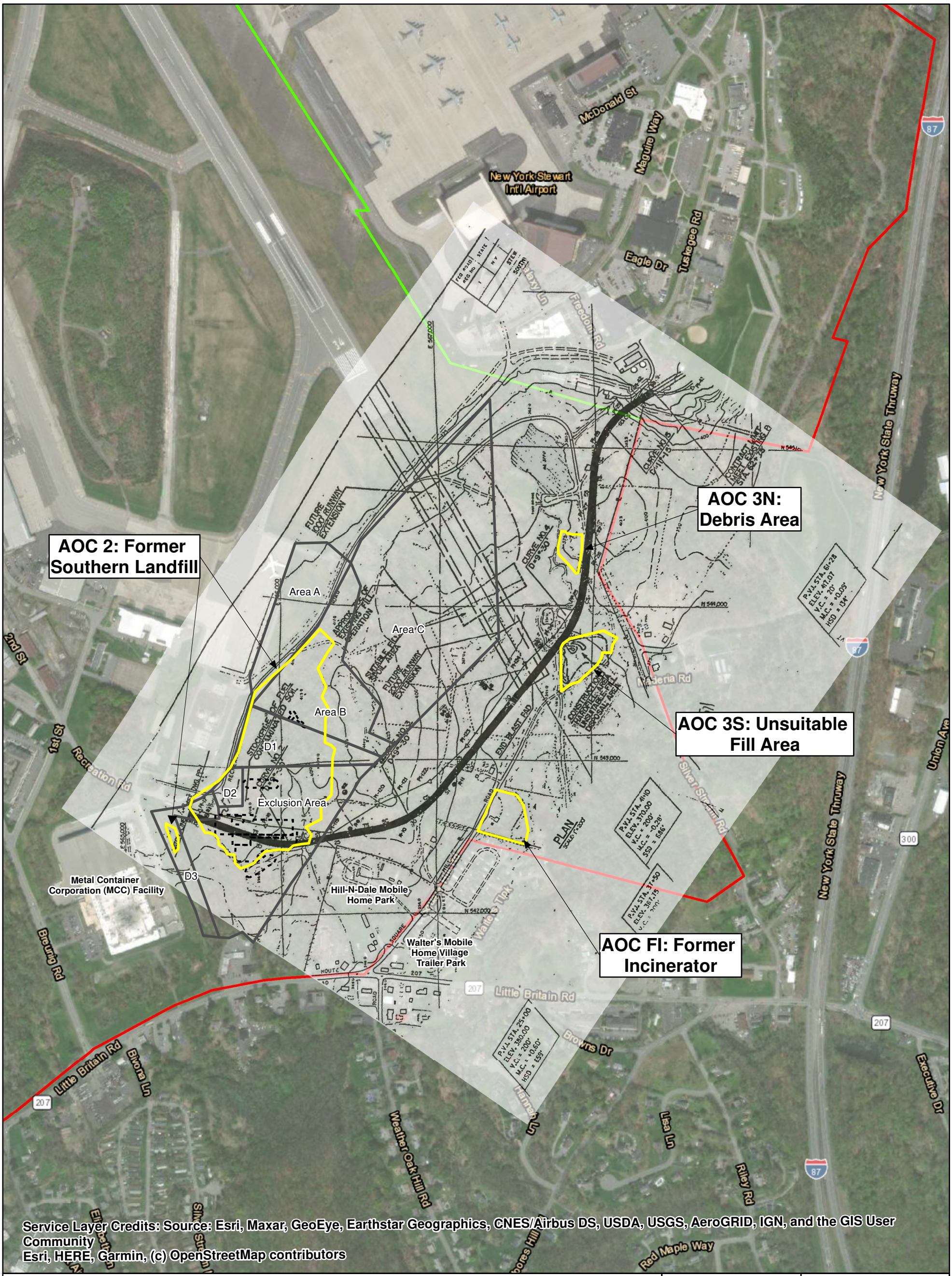
0 400 800 1,200 1,600 Feet

FIGURE 3

Site Map Showing Current and Previous Landfill Boundaries and Features

Former Stewart Air Force Base, New York

Dec 2021



Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- New York Air National Guard (NYANG) Base
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force Base
- Disposal Trench

N W E S

0 400 800 1,200 1,600 Feet

FIGURE 4

Site Map Showing Historical Road Construction Plan

Former Stewart Air Force Base, New York

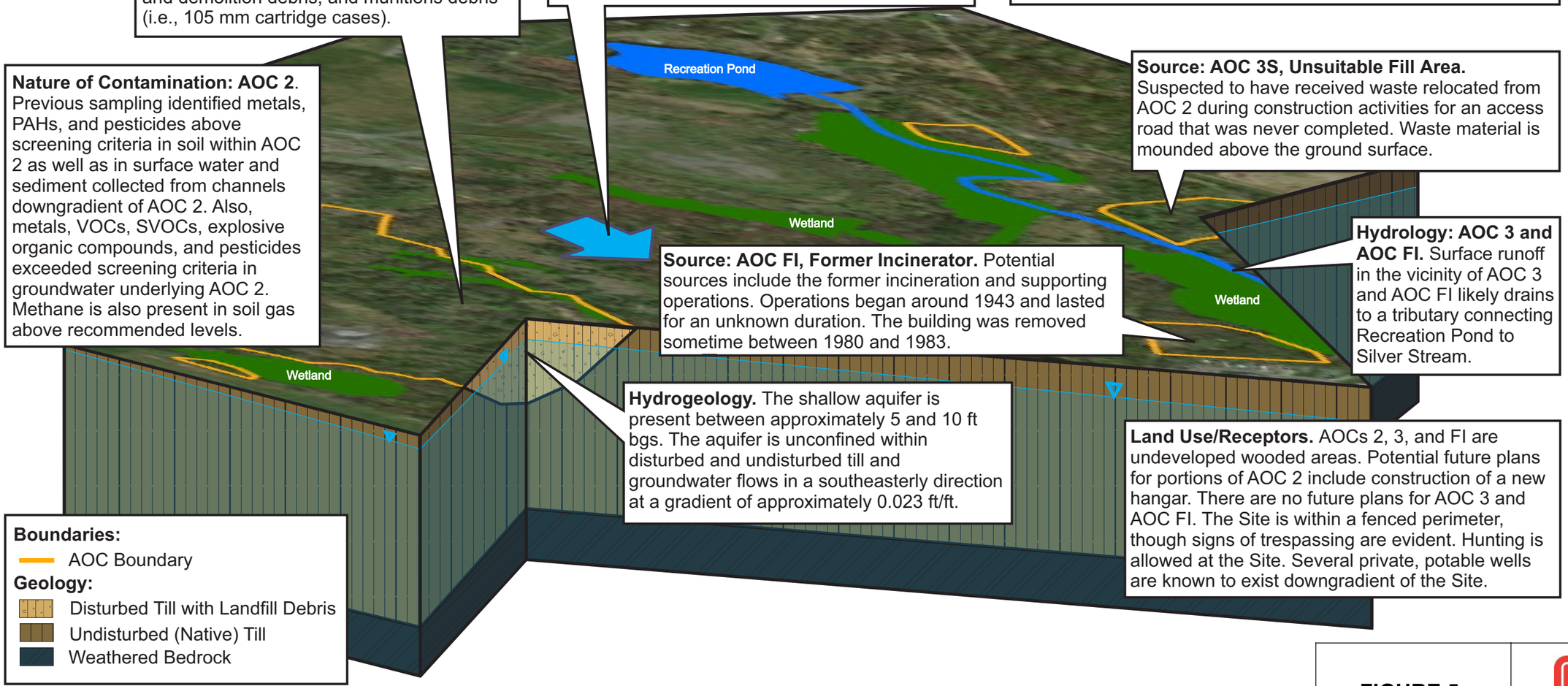
Dec 2021

Source: AOC 2, Former Southern Landfill. Used as a landfill between the mid- to late-1940s and the early 1970s; determined to contain municipal solid waste, construction and demolition debris, and munitions debris (i.e., 105 mm cartridge cases).

Hydrology: **AOC 2**. Surface runoff in the vicinity of AOC 2 likely drains via ephemeral channels that generally flow in a general southeasterly direction. Rust-colored groundwater was also noted to seep into an ephemeral channel on the east side of the landfill. On the western edge of AOC 2, surface runoff may discharge to the adjacent wetland.

Nature of Contamination: AOC 3 and AOC FI. No soil investigations have been performed at AOC 3S. Limited previous groundwater sampling near AOC 3S found only metals in exceedance of screening criteria. Test pits confirmed the presence of debris and waste materials at AOC 3S. No investigations have been performed at AOC 3N. No investigations have been performed at AOC FI.

Nature of Contamination: AOC 2. Previous sampling identified metals, PAHs, and pesticides above screening criteria in soil within AOC 2 as well as in surface water and sediment collected from channels downgradient of AOC 2. Also, metals, VOCs, SVOCs, explosive organic compounds, and pesticides exceeded screening criteria in groundwater underlying AOC 2. Methane is also present in soil gas above recommended levels.



Source: AOC 3S, Unsuitable Fill Area. Suspected to have received waste relocated from AOC 2 during construction activities for an access road that was never completed. Waste material is mounded above the ground surface.

Source: AOC FI, Former Incinerator. Potential sources include the former incineration and supporting operations. Operations began around 1943 and lasted for an unknown duration. The building was removed sometime between 1980 and 1983.

Hydrology: AOC 3 and AOC FI. Surface runoff in the vicinity of AOC 3 and AOC FI likely drains to a tributary connecting Recreation Pond to Silver Stream.

Hydrogeology. The shallow aquifer is present between approximately 5 and 10 ft bgs. The aquifer is unconfined within disturbed and undisturbed till and groundwater flows in a southeasterly direction at a gradient of approximately 0.023 ft/ft.

Land Use/Receptors. AOCs 2, 3, and FI are undeveloped wooded areas. Potential future plans for portions of AOC 2 include construction of a new hangar. There are no future plans for AOC 3 and AOC FI. The Site is within a fenced perimeter, though signs of trespassing are evident. Hunting is allowed at the Site. Several private, potable wells are known to exist downgradient of the Site.

Boundaries:
- AOC Boundary

Geology:
- Disturbed Till with Landfill Debris
- Undisturbed (Native) Till
- Weathered Bedrock

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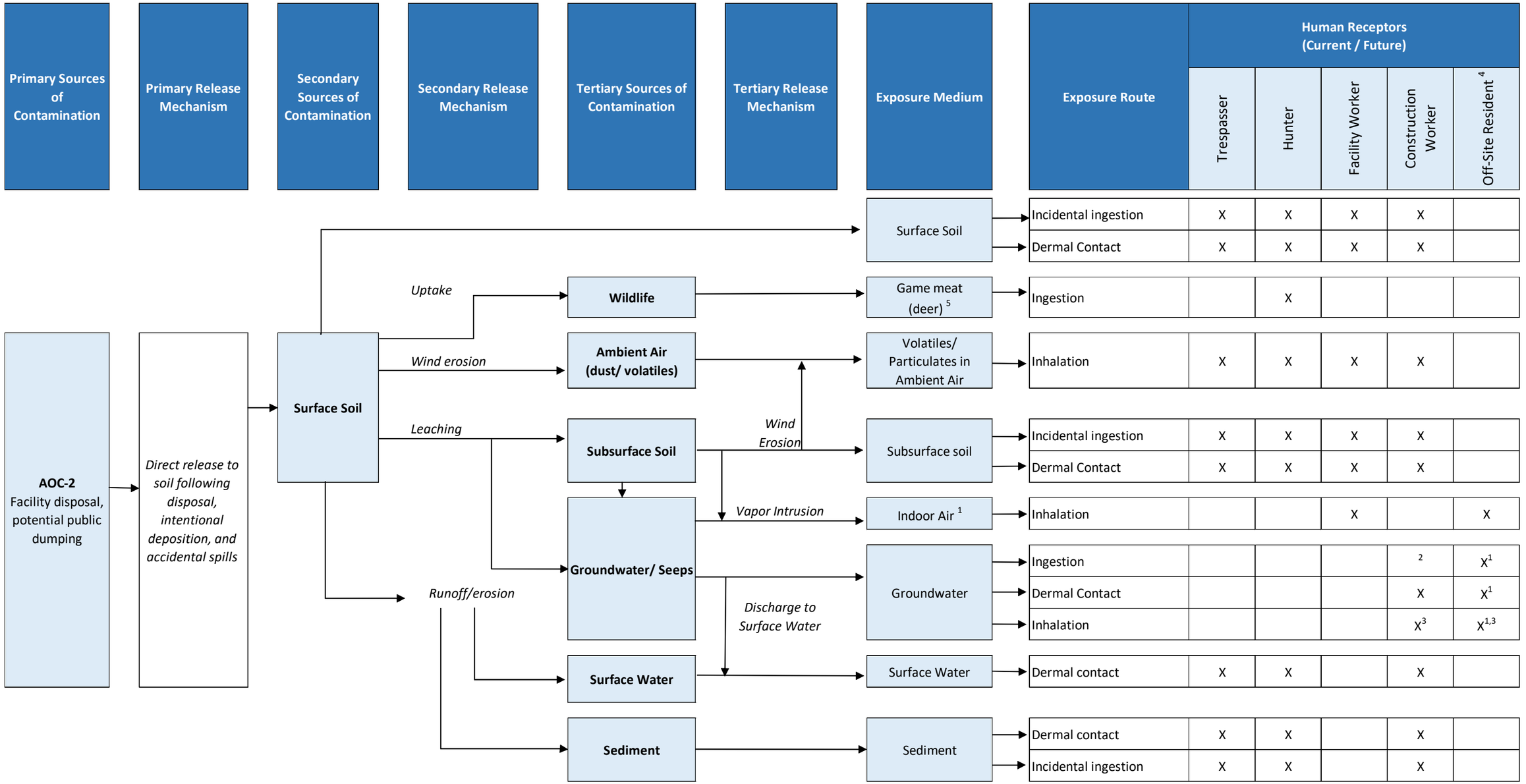
Not to Scale

FIGURE 5

Graphic Depiction of Conceptual Site Model

Former Stewart Air Force Base, New York

Dec 2021



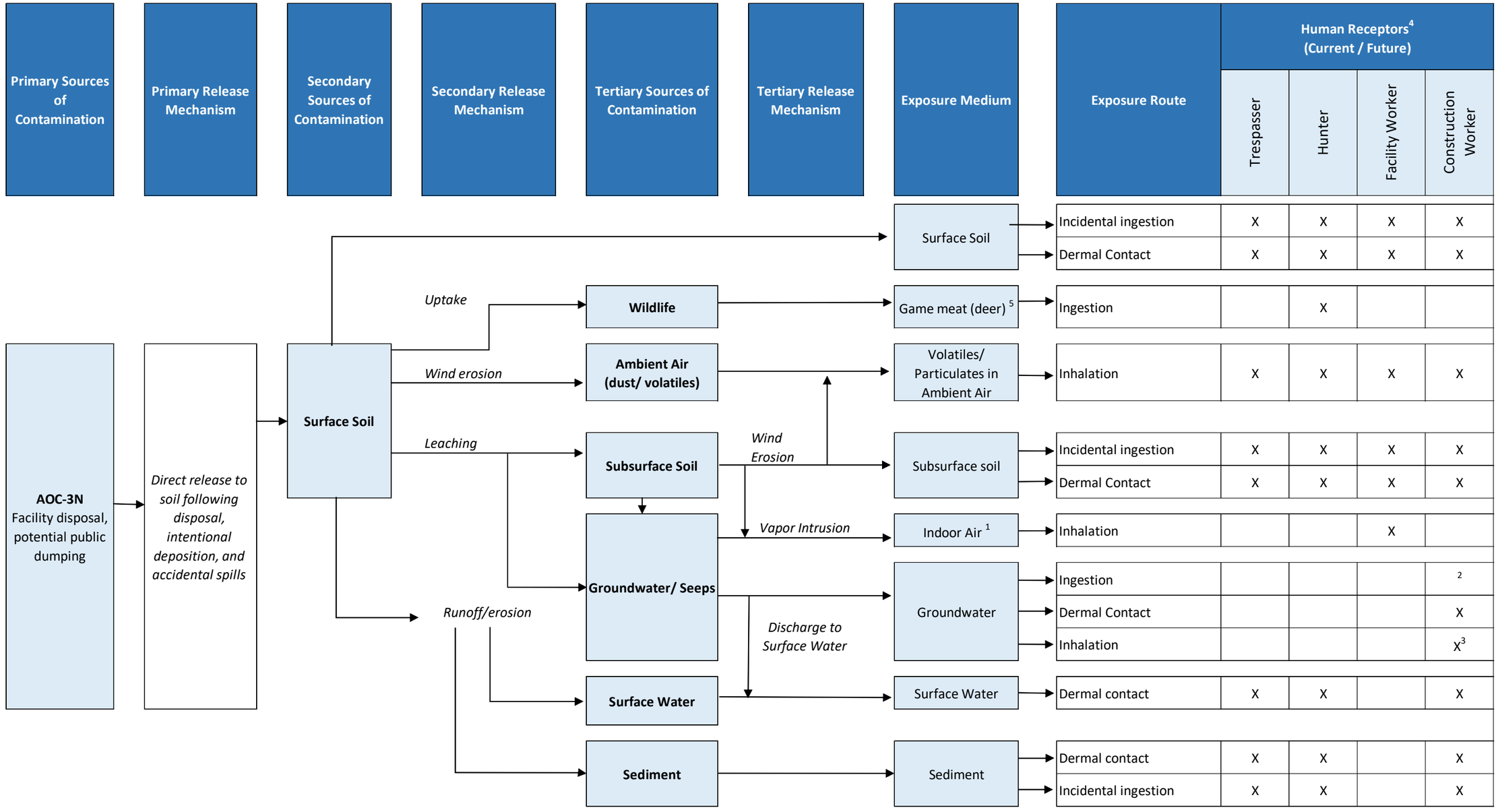
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media.
3. Inhalation routes for groundwater: Construction workers may inhale VOCs from standing water within an excavation pit/trench, whereas off-site residents may inhale VOCs during showering/bathing.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes are considered incomplete at this stage. Complete or potentially complete exposure routes for indoor air and groundwater are applicable to off-site residents.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6A

Preliminary Human Health Conceptual Site Model for AOC-2 (Former Southern Landfill)

Former Stewart Air Force Base, New York

Aug 2022



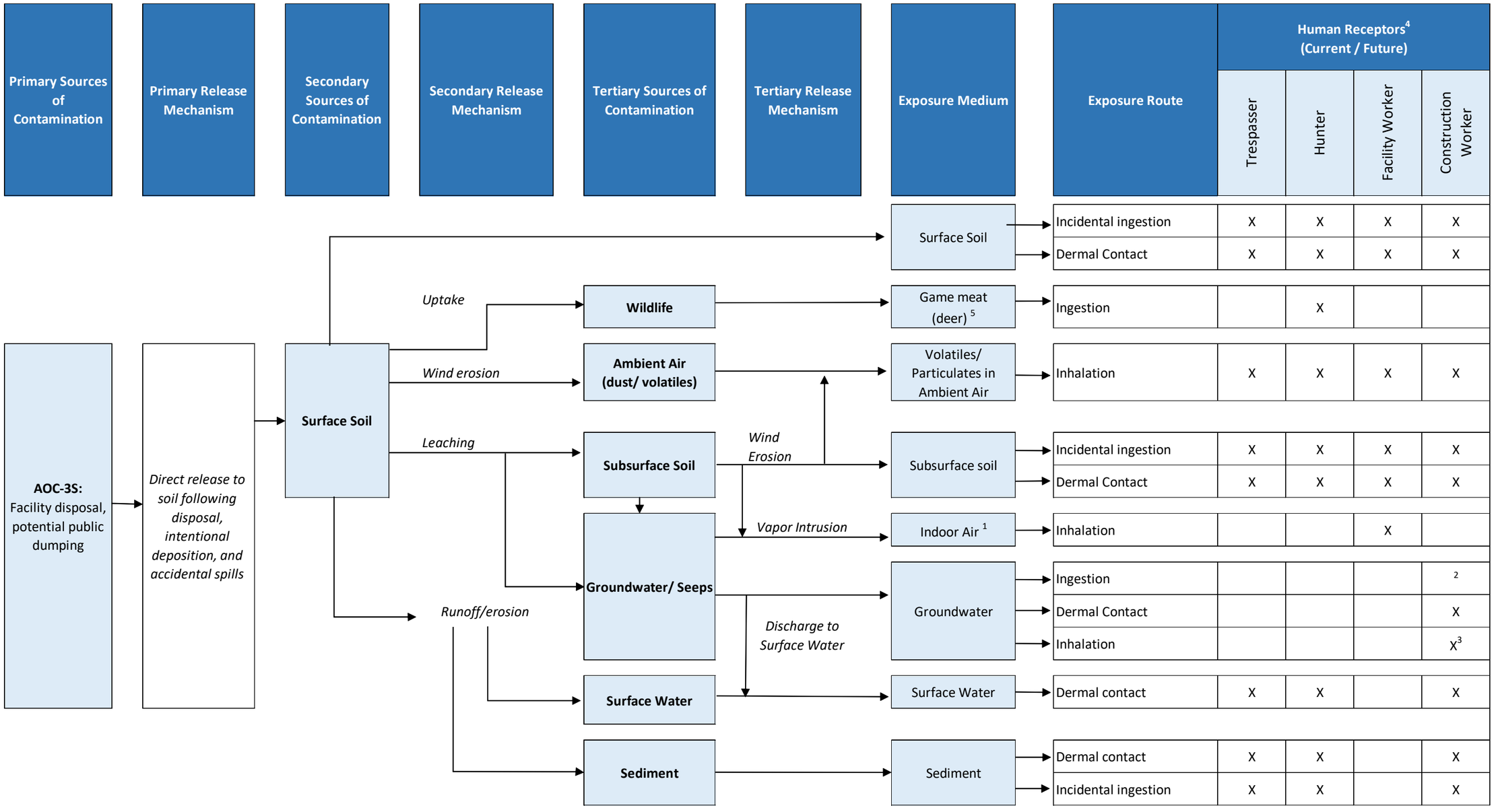
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media .
3. Construction workers may inhale VOCs from standing water within an excavation pit/trench.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes are considered incomplete at this stage.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6B

Preliminary Human Health Conceptual Site Model for AOC-3N (Debris Area)

Former Stewart Air Force Base, New York

Aug 2022



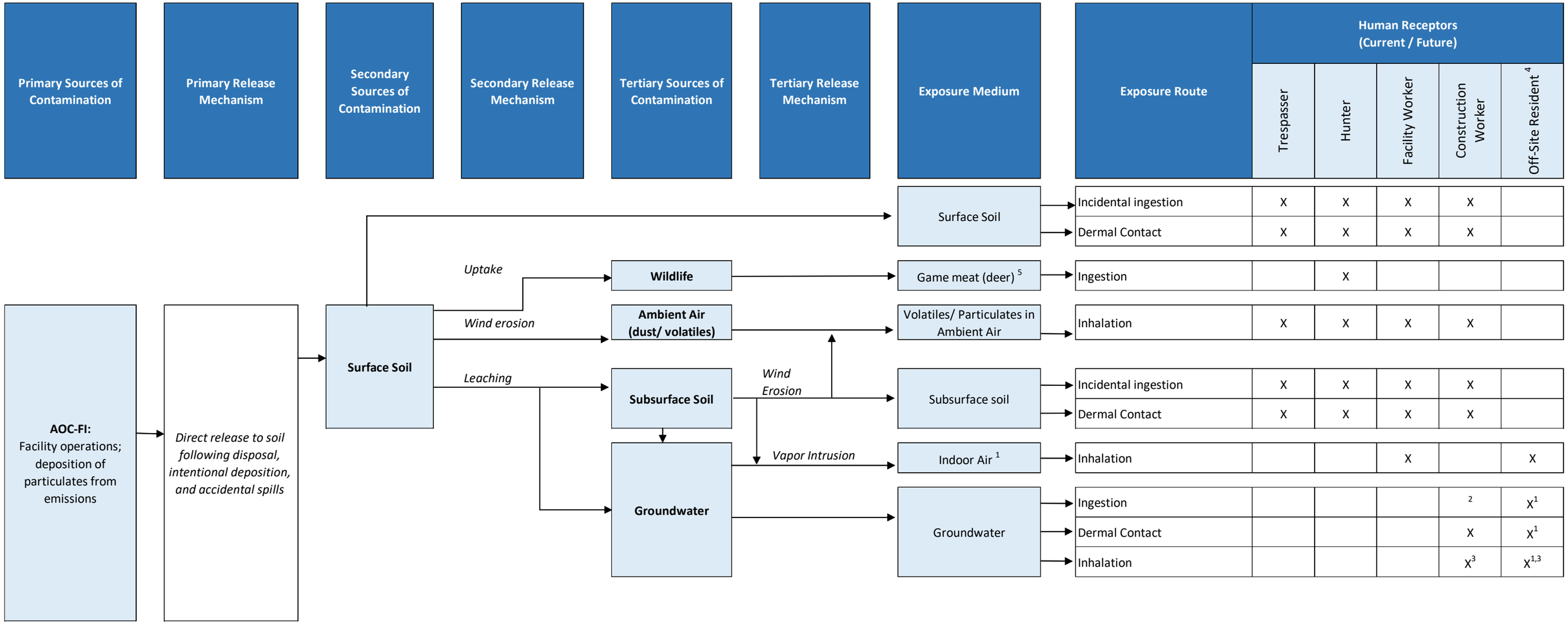
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media.
3. Construction workers may inhale VOCs from standing water within an excavation pit/trench.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes are considered incomplete at this stage.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6C

Preliminary Human Health Conceptual Site Model for AOC-3S (Unsuitable Fill Area)

Former Stewart Air Force Base, New York

Aug 2022



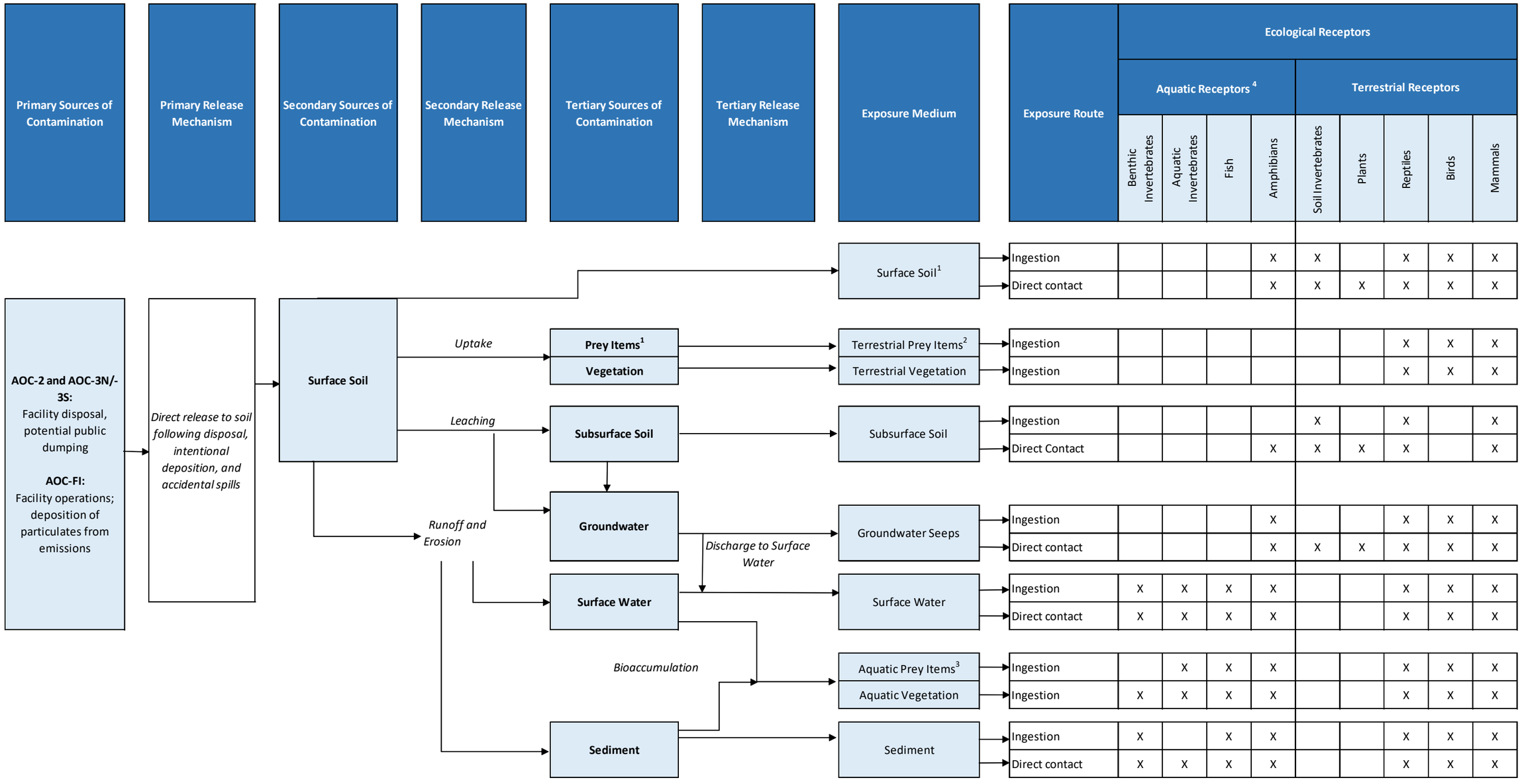
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media .
3. Inhalation routes for groundwater: Construction workers may inhale VOCs from standing water within an excavation pit/trench, whereas off-site residents may inhale VOCs during showering/bathing.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes for a resident receptor are considered incomplete at this stage. Complete or potentially complete exposure routes for indoor air and groundwater are applicable to off-site residents.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6D

Preliminary Human Health Conceptual Site Model for AOC-FI (Former Incinerator)

Former Stewart Air Force Base, New York

Aug 2022



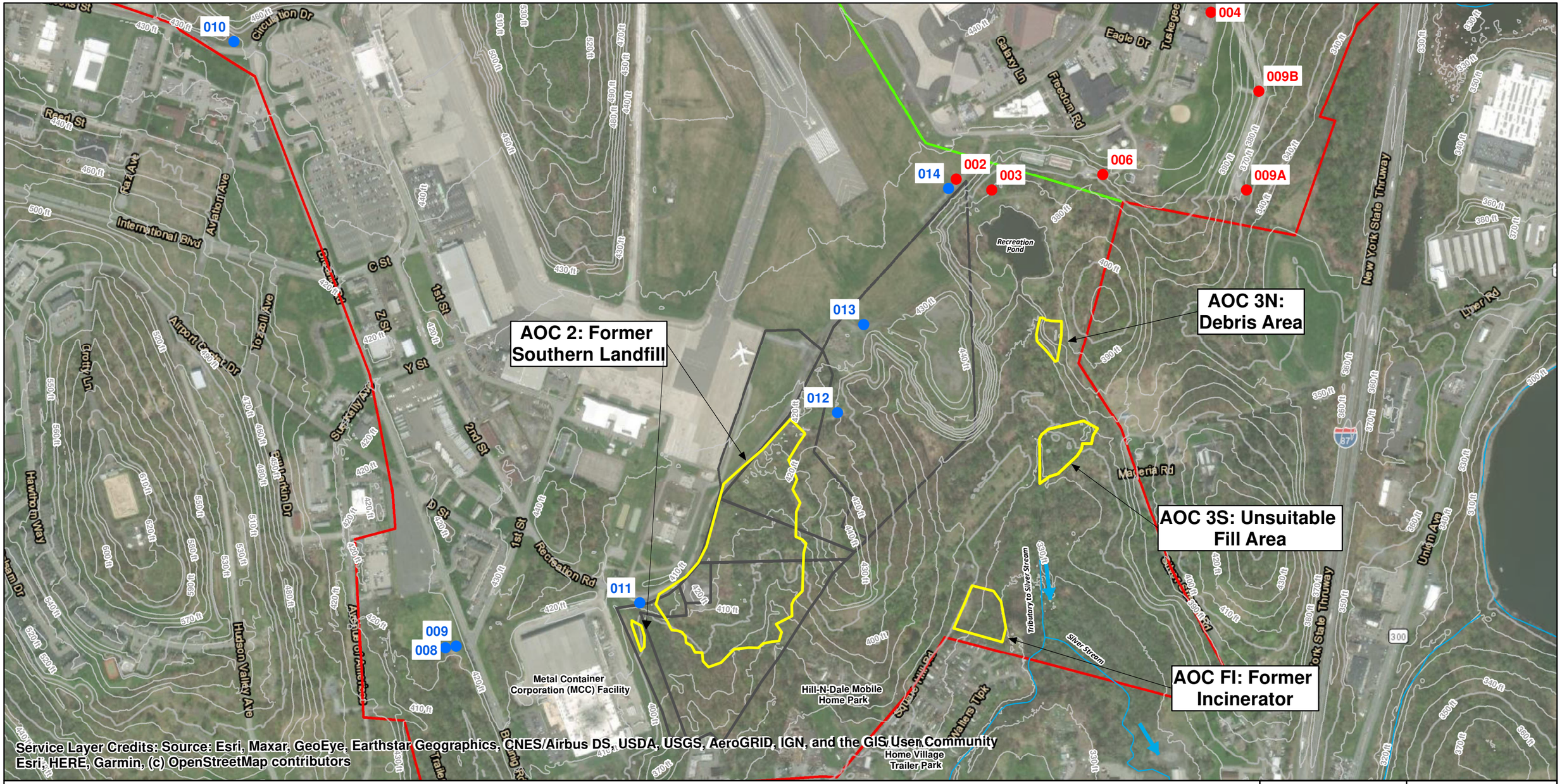
NOTES:
AOC = Area of Concern
X = Assumed to be complete or potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
1. Includes moist wetland soils
2. Prey items may consist of invertebrates, birds, mammals, fish, amphibians and reptiles
3. Prey items may consist of invertebrates, amphibians, and small fish.
4. Includes invertebrate and amphibian species associated with the vernal pools identified at the Site.

FIGURE 7

Preliminary Ecological Conceptual Site Model

Former Stewart Air Force Base, New York

Apr 2022



Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- New York Air National Guard (NYANG)
- Former Stewart Air Force
- SWF Outfall Locations
- NYANG Outfall Locations
- Streams
- Surface Water Flow Direction
- Water Bodies

NOTE:
Topography based on 2014 Orange County LiDAR collection.

N W E S

0 400 800 1,200 1,600 Feet

FIGURE 8

Site Map Showing Topographic Contours

Former Stewart Air Force Base, New York

Dec 2021

AOC 3N: Debris Area

Murphy's Gulch

Recreation Pond

Tributary to Silver Stream

Lake Washington

AOC 2: Former Southern Landfill

AOC 3S: Unsuitable Fill Area

Tributary to Silver Stream

Unnamed Pond

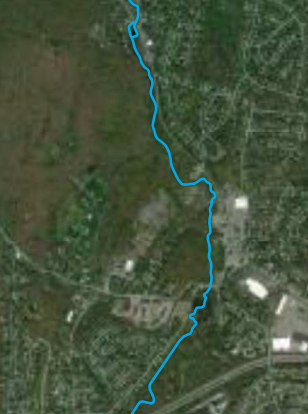
Silver Stream

Browns Pond

AOC FI: Former Incinerator

Silver Stream

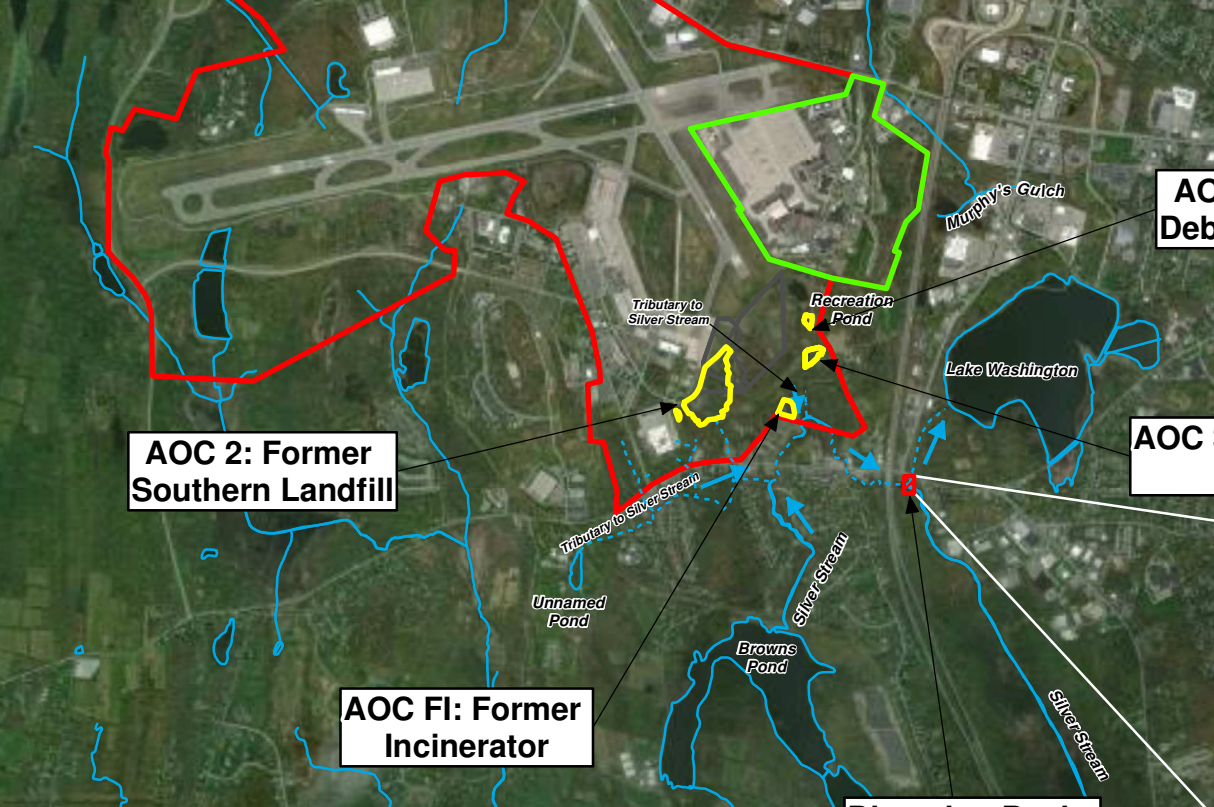
Diversion Basin with Turn Valve



HUDSON RIVER

Moodna Creek

Moodna Creek



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- New York Air National Guard (NYANG) Base
- Former Stewart Air Force Base
- SWF Outfall Locations
- NYANG Outfall Locations
- Streams
- Drainage Line
- Surface Water Flow Direction
- Major Roads
- Water Bodies

N W E S

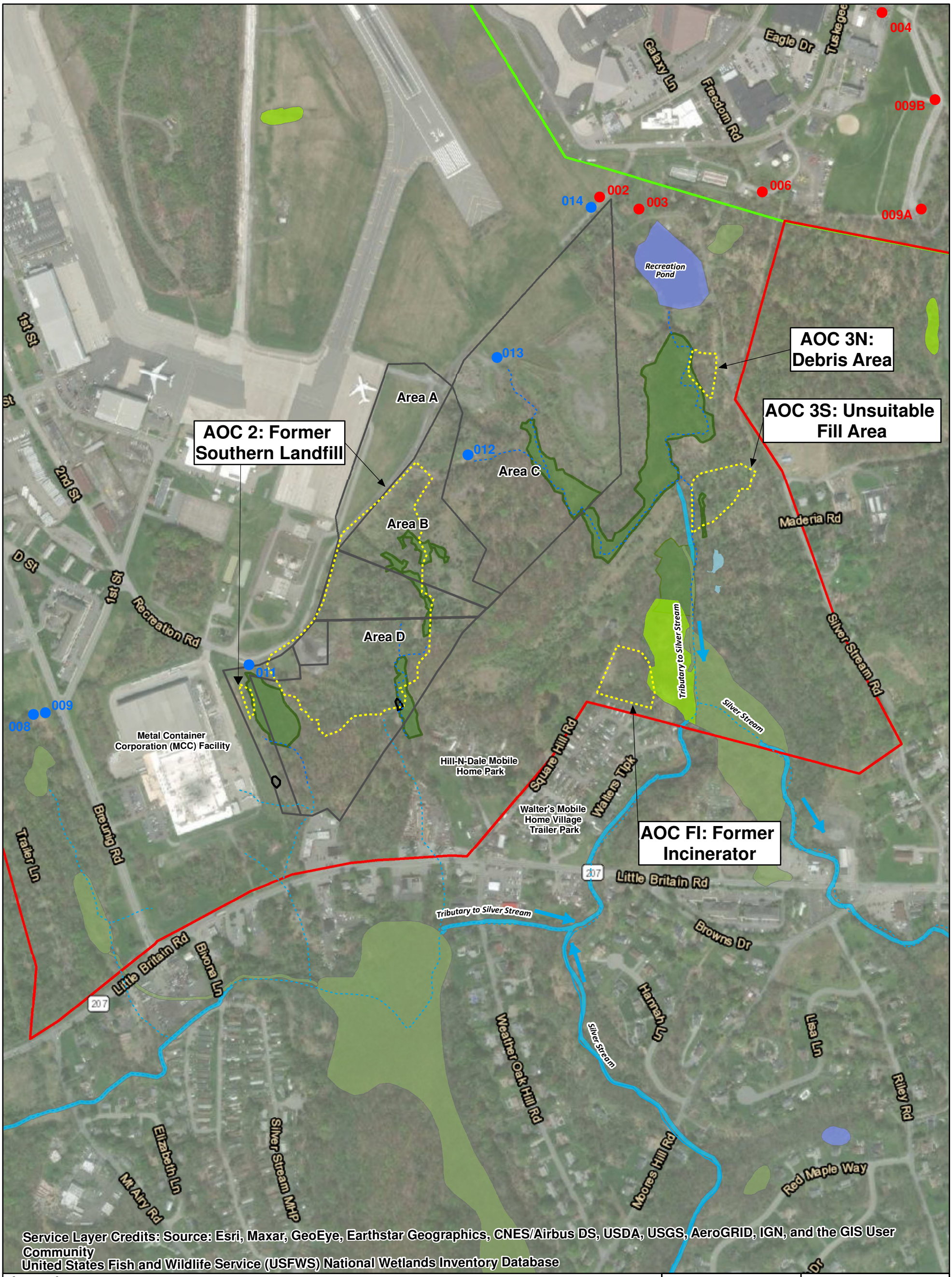
0 2,500 5,000 7,500 10,000 Feet

FIGURE 9

Site Location Map Showing Select Surface Water Features

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
United States Fish and Wildlife Service (USFWS) National Wetlands Inventory Database

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- New York Air National Guard (NYANG) Base
- Former Stewart Air Force Base
- Seep
- SWF Outfall Locations
- NYANG Outfall Locations
- Field Delineated Streams
- Water Bodies
- Field Delineated Wetlands
- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riverine
- Vernal Pools
- Surface Water Flow Direction
- Streams
- Drainage Line

N W E S

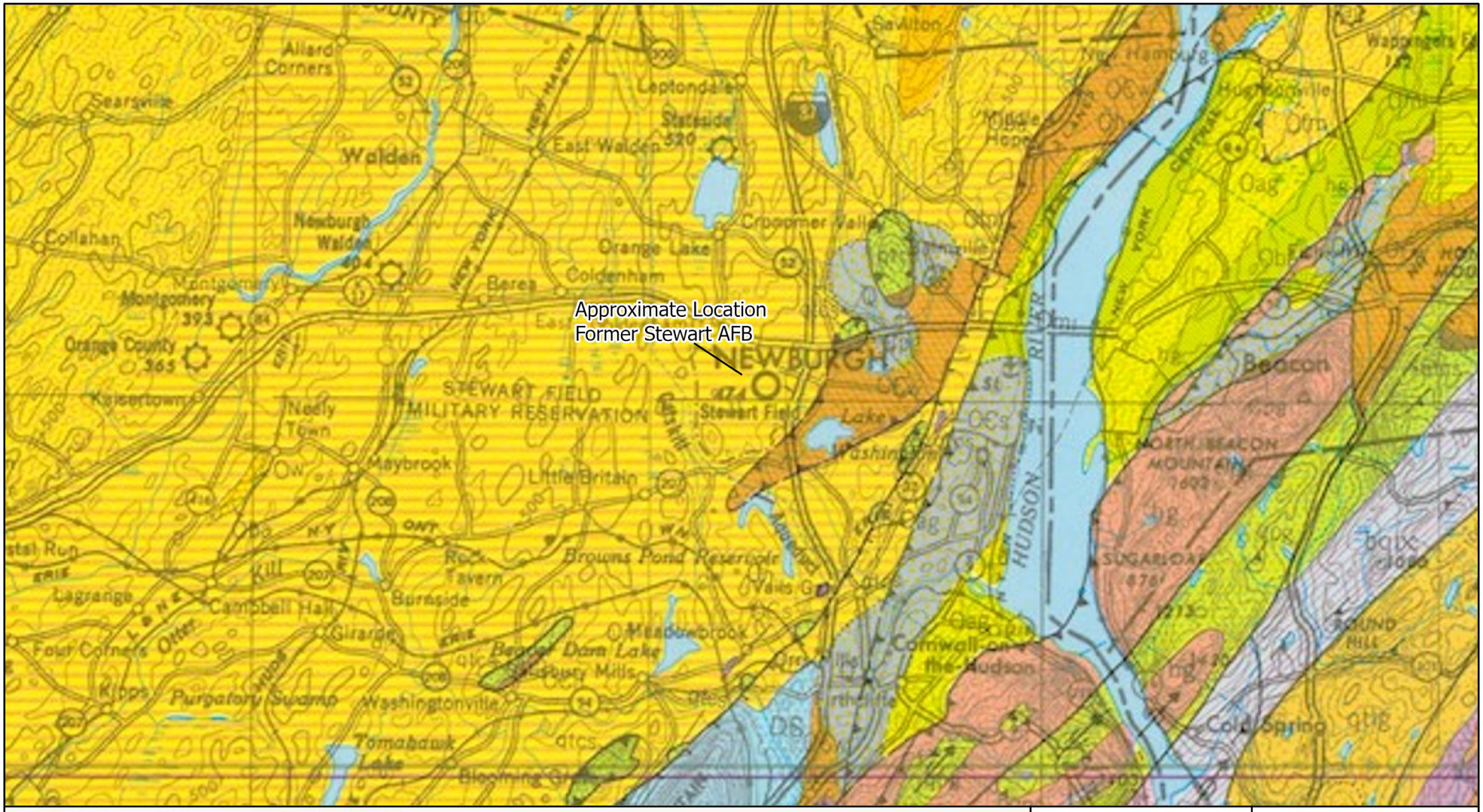
0 350 700 1,050 1,400 Feet

FIGURE 10

Site Map Showing Identified Wetland Locations

Former Stewart Air Force Base, New York

Dec 2021



TRENTON GROUP AND METAMORPHIC EQUIVALENTS
up to 8,000 ft. (2400 m.)

Oqu Quassaic Quartzite — quartzite, sandstone, conglomerate.

Oag Austin Glen Formation—graywacke, shale.

On Normanskill Formation—shale, argillite, siltstone.

Owl Walloomsac Formation—phyllite, schist, metagraywacke.

?Om Manhattan Formation, undivided — pelitic schists, amphibolite; Units ?Omb, ?Omc, and ?Omd may be Cambrian eugeosynclinal rocks thrust upon Oma; ?Omd — sillimanite - garnet - muscovite - biotite - plagioclase - quartz gneiss; ?Omc — sillimanite - garnet - muscovite - biotite - quartz - plagioclase schistose gneiss, sillimanite nodules, local quartz - rich layers; ?Omb — discontinuous unit of amphibolite and ?Omc - type schist; Oma — sillimanite - garnet - muscovite - biotite - quartz -plagioclase schists; calcite marble and calcsilicate rock at base.

Oba Balmville Limestone.

Otm Taconic Mélange—chaotic mixture of Early Cambrian thru Middle Ordovician pebble—to block-size clasts in a pelitic matrix of Middle Ordovician (Barneveld) age. Rims and floors earlier submarine gravity slides of Taconian Orogeny.

OCs Cambrian thru Middle Ordovician (Barneveld) carbonate rocks occurring as slivers along thrusts of later allochthones, or carbonate blocks in Taconic Mélange.

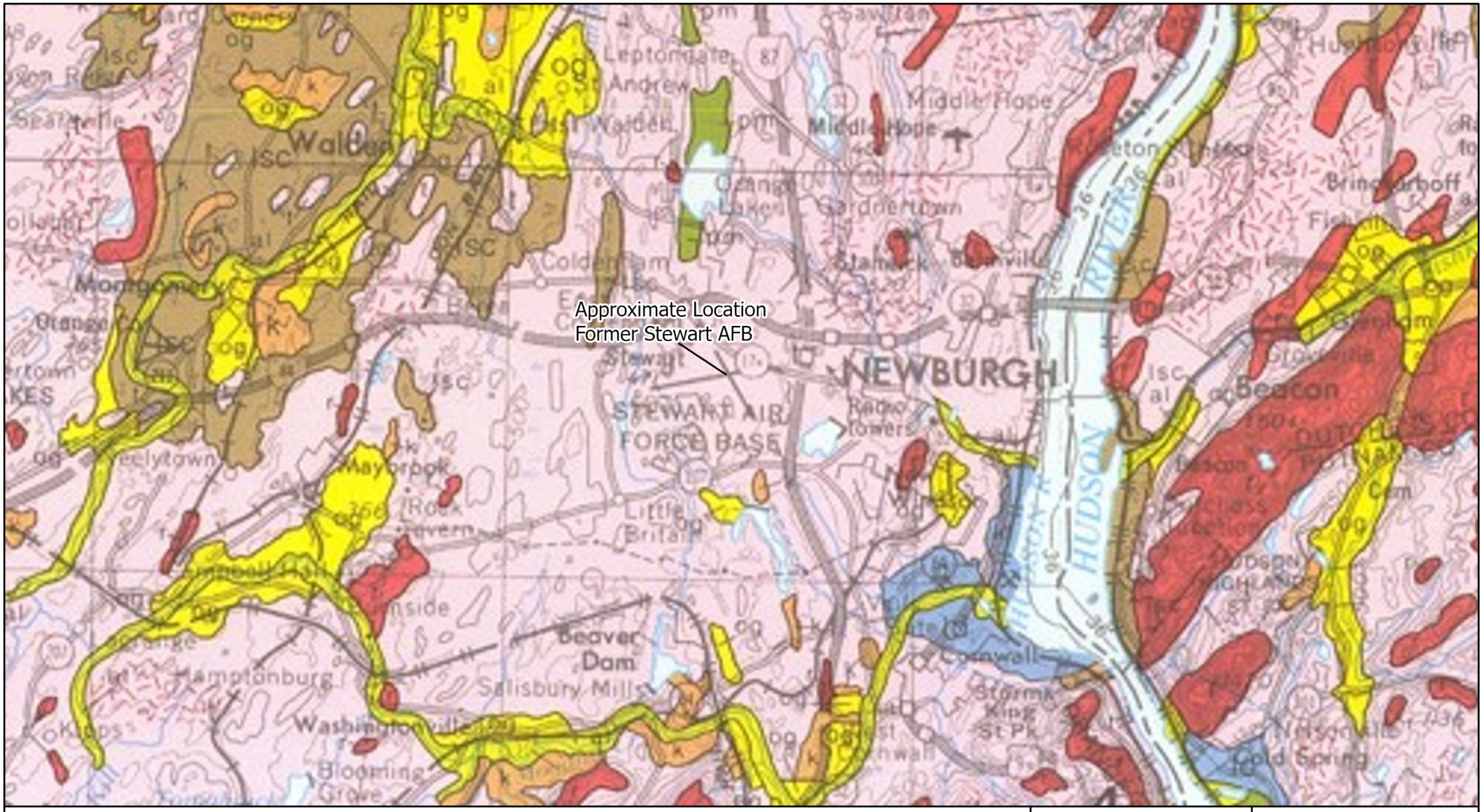
Fisher, et al. 1970. Geological Map of New York. New York State Museum and Science Service, Map and Chart Series No. 15.

FIGURE 11

Bedrock Geology Map

Former Stewart Air Force Base, New York

Nov 2020



t — Till
Variable texture (e.g. clay, silt-clay, boulder clay), usually poorly sorted diamict, deposition beneath glacier ice, relatively impermeable (loamy matrix), variable clast content — ranging from abundant well-rounded diverse lithologies in valley tills to relatively angular, more limited lithologies in upland tills, tends to be sandy in areas underlain by gneiss or sandstone, potential land instability on steep slopes, thickness variable (1-50 meters).

Bedrock stipple overprint
Bedrock may be within 1-3 meters of surface, may sporadically crop out, variable mantle of rock debris and glacial till.

og — Outwash sand and gravel
Coarse to fine gravel with sand, proglacial fluvial deposition, well rounded and stratified, generally finer texture away from ice border, thickness variable (2-20 meters).

r — Bedrock
Exposed or generally within 1 meter of surface.

ld — Lacustrine delta
Coarse to fine gravel and sand, stratified, generally well sorted, deposited at a lake shoreline, thickness variable (3-15 meters).

pm — Swamp deposits
Peat-muck, organic silt and sand in poorly drained areas, un-oxidized, may be overlying marl and lake silts, potential land instability, thickness generally 2-20 meters.

lsc — Lacustrine silt and clay
Generally laminated silt and clay, deposited in proglacial lakes, generally calcareous, potential land instability, thickness variable (up to 100 meters).

k — Kame deposits
Includes kames, eskers, kame terraces, kame deltas, coarse to fine gravel and/or sand, deposition adjacent to ice, lateral variability in sorting, coarseness and thickness, locally firmly cemented with calcareous cement, thickness variable (10-30 meters).

Cadwell, 1989. Surficial Geologic Map of New York. New York State Museum - Geological Survey Map and Chart Series #40

FIGURE 12

Surficial Geology Map

Former Stewart Air Force Base, New York

Nov 2020



Figure shown is Figure 19 from RRI, 2000. "Site Specific Fracture Trace Analysis: 1991 Aerial Photographs." The red lines indicate lineaments and 'H' and 'L' indicate some relative highs and lows.

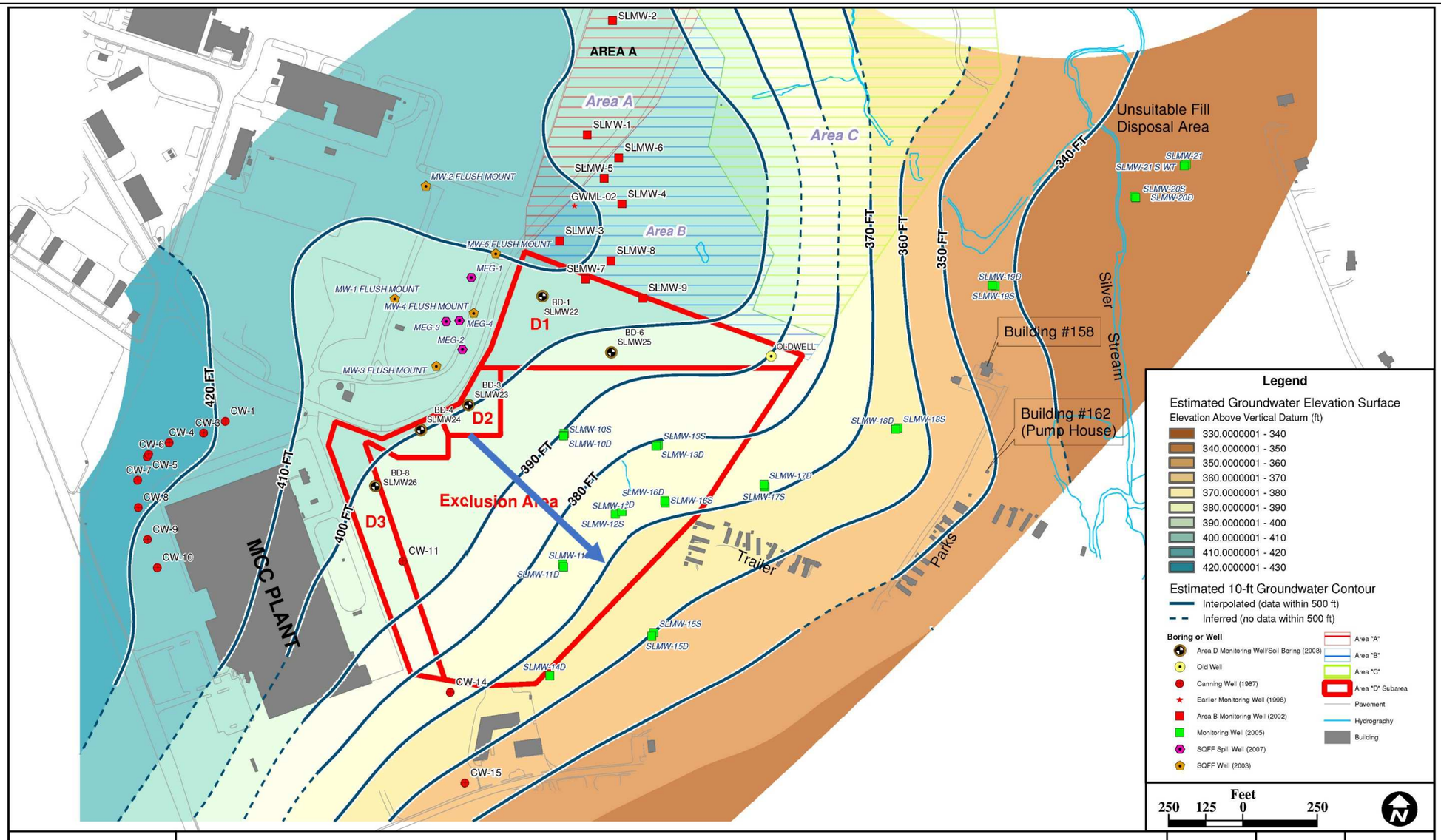
RRI, 2000. Final Report, Photographic Interpretation and Fracture Trace Analysis for the Phase I Environmental Investigation of the Southern Landfill Area at Stewart International Airport (included as Appendix K in the Harza, 2001 report above), February 6.

FIGURE 13

Fracture Trace Analysis (RRI, 2000)

Former Stewart Air Force Base, New York

Nov 2020



HDR	Southern Landfill Area Overburden Groundwater Elevations	Job No.	Date	Figure No.
		147/85198	4/29/09	2-3

\\prl-srv2\projects\201838_CONSULTANT MGMT BUREAU NYS DOT\0038973_NYSDOT 0446505 STEWART CONTINU\GIS\map_docs\mxd\CS_figures\Figure2-3_Rev2.mxd

Figure shown is Figure 2-3 from HDR, 2009a. Stewart International Airport Southern Landfill Area Surface Water & Sediment and Area D Groundwater Investigations Report, Stewart International Airport, Town of New Windsor, Orange County, New York, May.

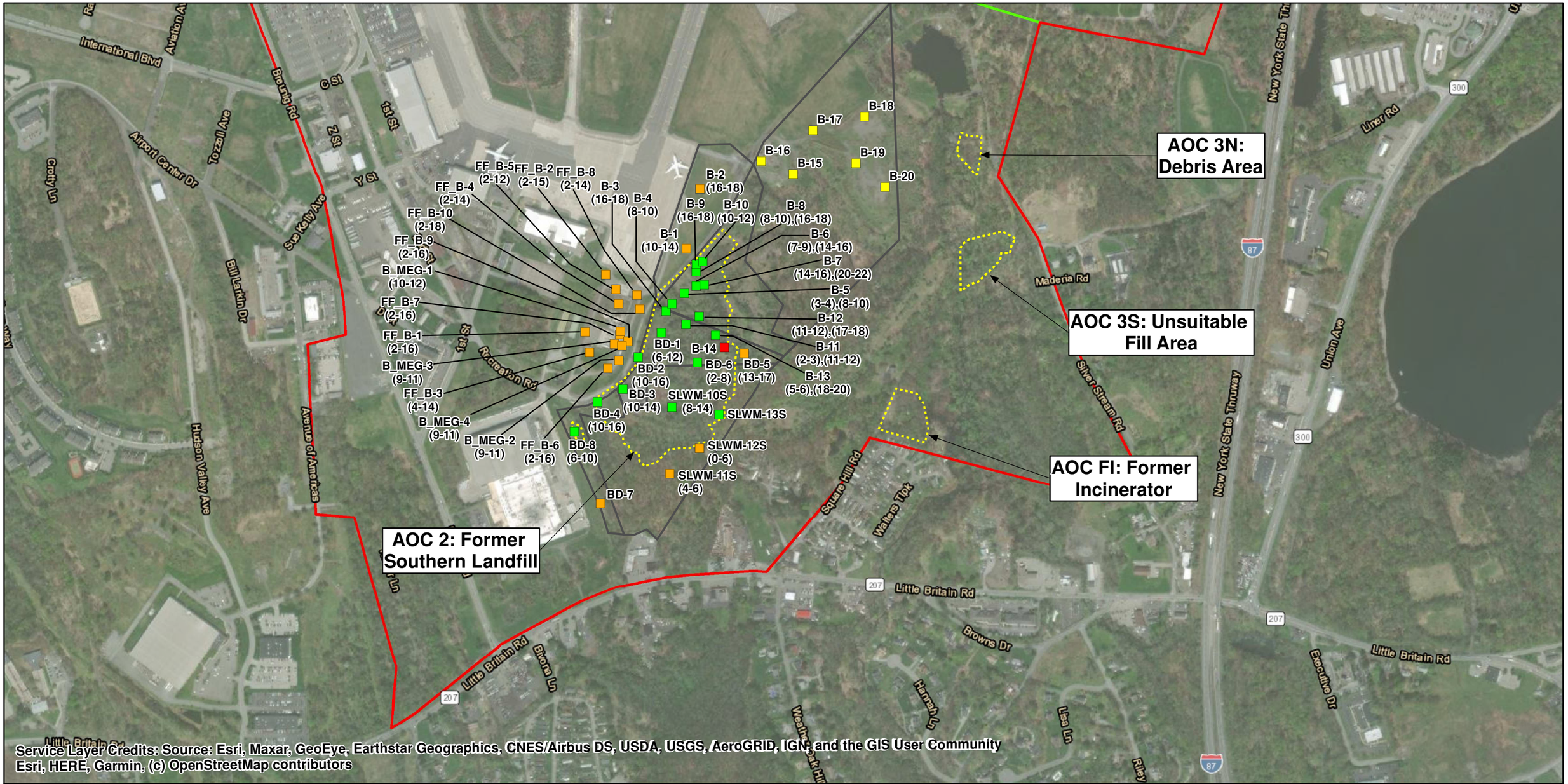
→ Approximate Overburden Groundwater Flow Direction

FIGURE 14

Overburden Groundwater Elevation Contours (HDR, 2009a)

Former Stewart Air Force Base, New York

Aug 2022



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC
- New York Air National Guard (NYANG) Base
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force
- Soil boring in AOC
- Soil boring in nearby vicinity
- Attempted but unsuccessful soil boring in AOC
- Area C soil borings shown for

N W E S

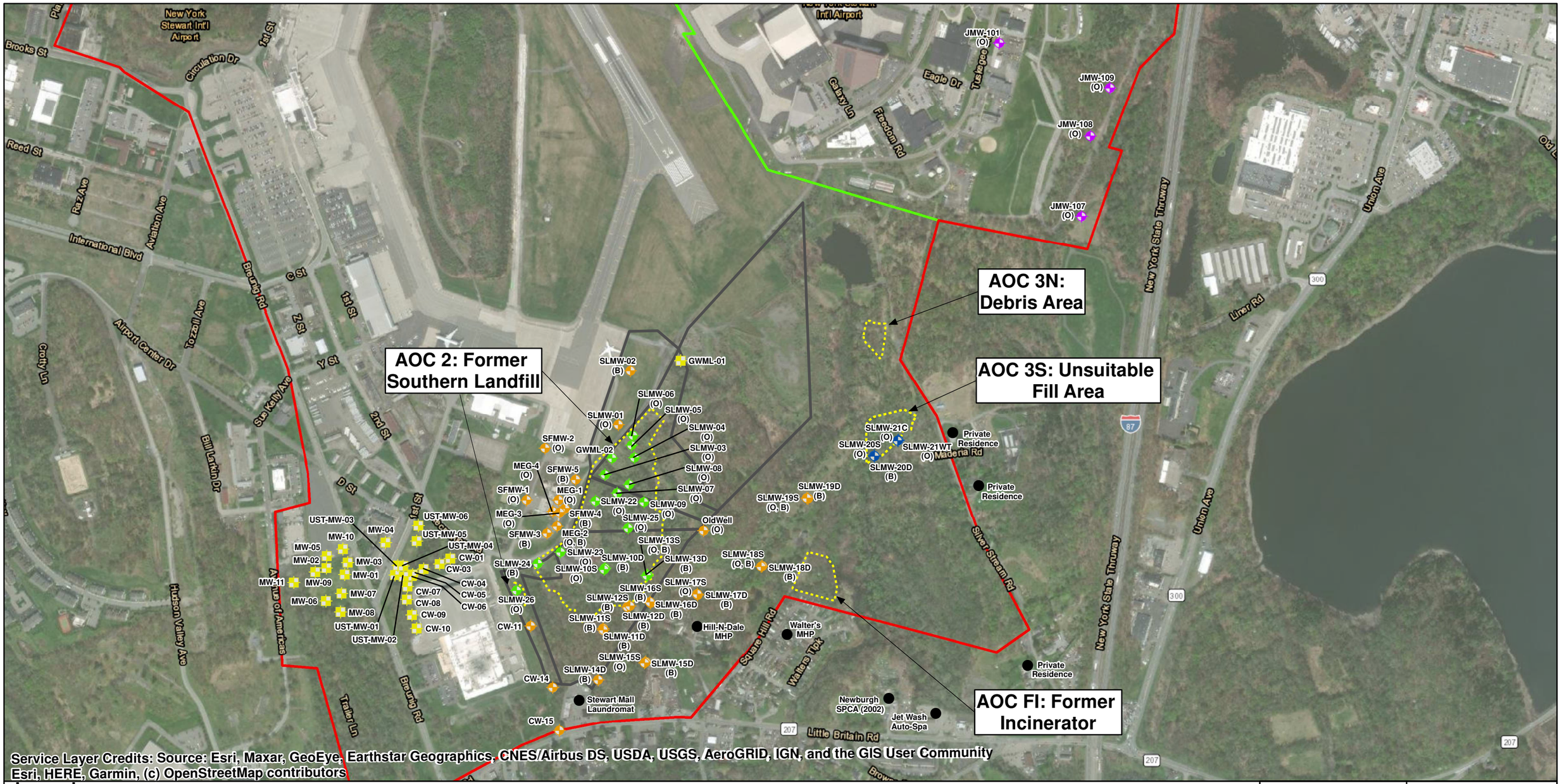
0 425 850 1,275 1,700 Feet

FIGURE 15

Historical Soil Sampling Locations

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- New York Air National Guard (NYANG) Base
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force

- Monitoring wells AOC 2
- Monitoring wells AOC 3
- NYANG wells shown for reference
- Monitoring wells nearby vicinity upgradient or downgradient
- Monitoring wells cross-gradient
- Downgradient Drinking Water Wells

O - Overburden
B - Bedrock

NOTE: This figure shows groundwater monitoring well locations as documented in past reports. The condition of the wells is unknown.

N W E S

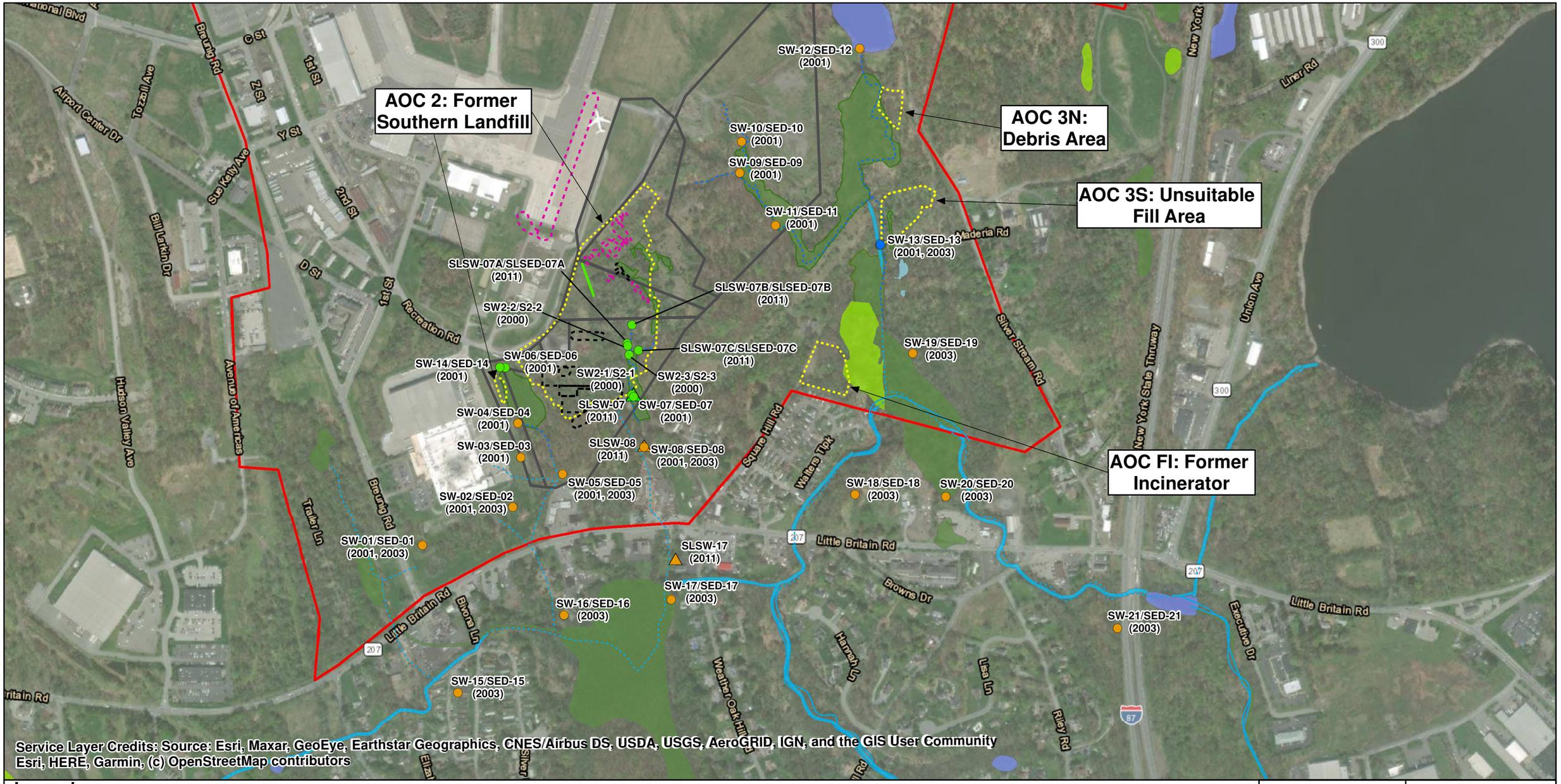
0 480 960 1,440 1,920 Feet

FIGURE 16

Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force Base
- Disposal Trench
- Stained Soil
- Trench from 2021 Geophysical Investigation
- Field Delineated Wetlands
- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riverine
- Vernal Pools
- Surface water and sediment sample locations in AOC 2
- Surface water and sediment sample locations nearby AOC 3
- Surface water and sediment sample locations in vicinity (upstream or downstream)
- Drainage Lines
- Field delineated Streams
- Streams
- Surface Water Only Samples
- Sediment and Surface Water Samples

N W E S

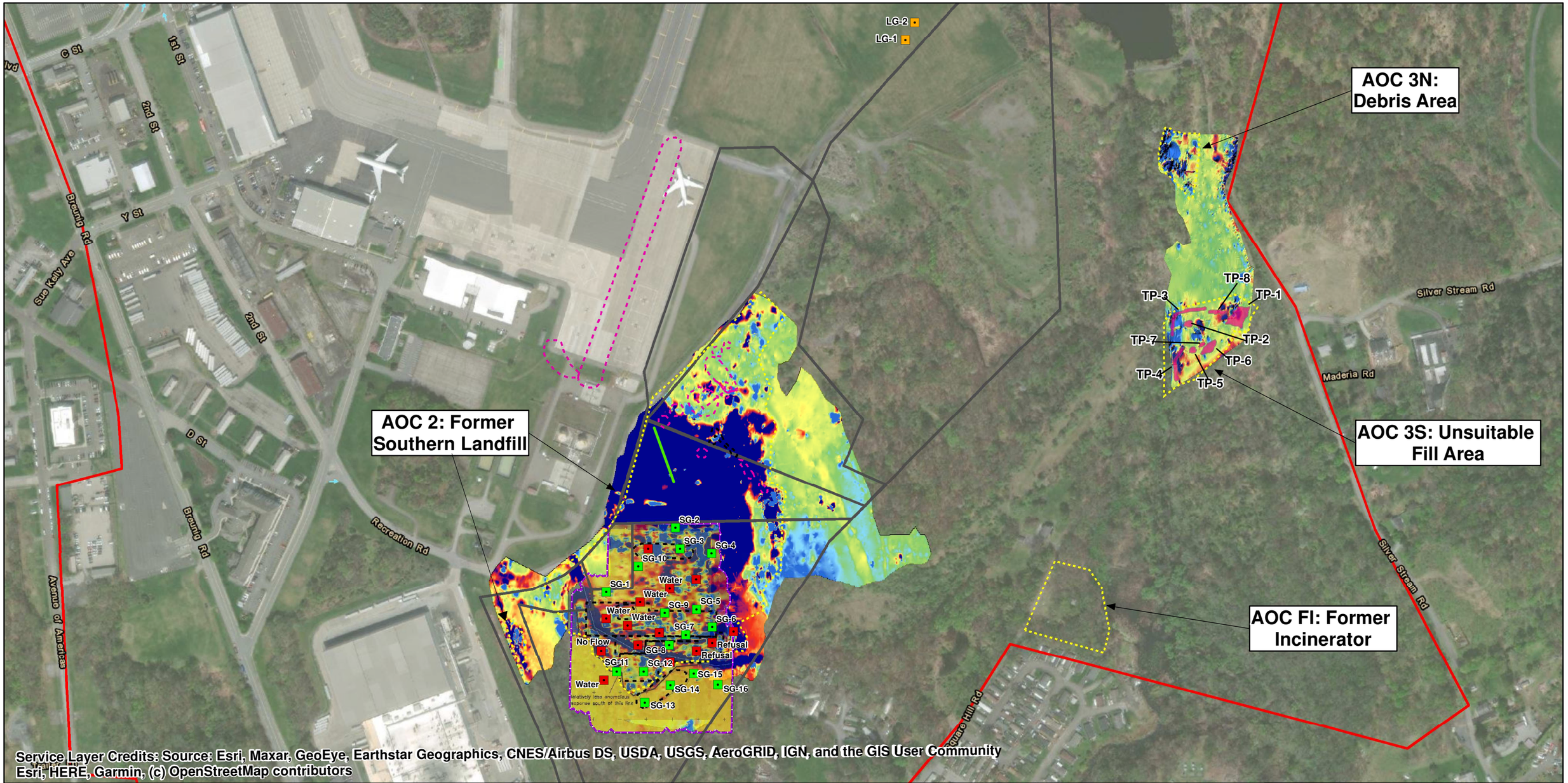
0 420 840 1,260 1,680 Feet

FIGURE 17

Historical Sediment and Surface Water Sampling Locations

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force Base
- Trench from 2021 Geophysical Investigation
- AOC 3 Test Pits from 2001
- 2001 Landfill Gas Boring Locations
- Disposal Trench
- Stained Soil
- 2005 Geophysical Survey Boundary

2007 Soil Gas Sample Locations

- Successful
- Unsuccessful

2005 Geophysical EM Results showing extent of waste fill material

High : 2.7

Low : - 3.3

2021 Geophysical EM Results showing extent of waste fill material

High : 32

Low : - 10

N W E S

0 250 500 750 1,000 Feet

FIGURE 18

Historical Landfill Extent, Contents, and Landfill Gas Sampling Locations

Former Stewart Air Force Base, New York

July 2021

AOC 3N: Debris Area

AOC 3S: Unsuitable Fill Area

AOC 2: Former Southern Landfill

AOC FI: Former Incinerator

Recreation Rd

Madeira Rd

Silver Stream Rd

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Former Stewart Air Force Base
- Older Base Landfill (E.C. Jordan, 1989)
- Trench from 2021 Geophysical Investigation
- Proposed Reference Area
- Disposal Trench
- Stained Soil
- Proposed Surface Soil Samples
- Proposed Subsurface Soil Sample Locations
- Grid Lines
- Field Delineated Wetlands
- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riverine
- Vernal Pools

NOTE:
Topography based on 2014 Orange County LiDAR collection.

N W E S

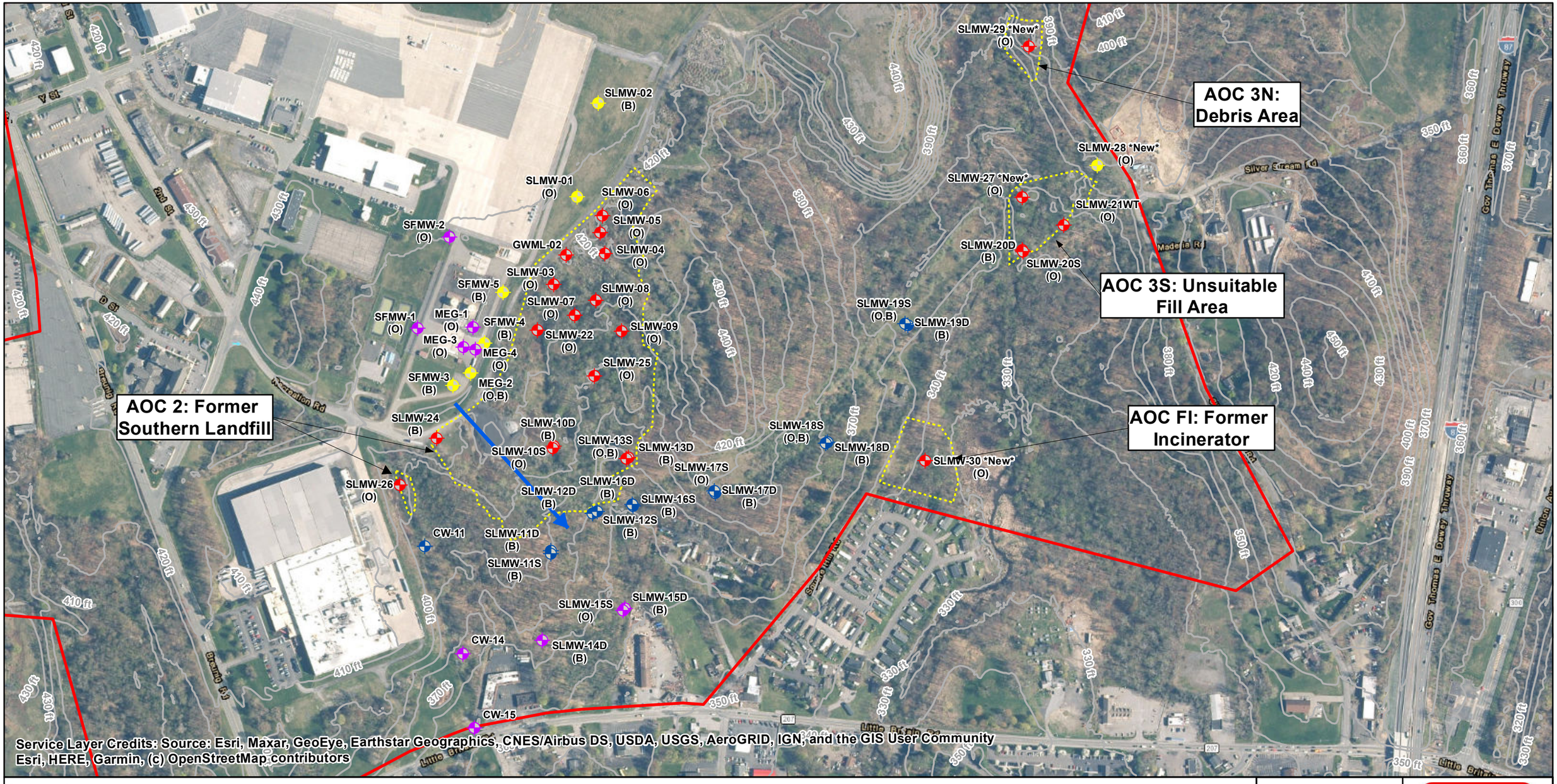
0 190 380 570 760 Feet

FIGURE 19

Proposed Surface and Subsurface Soil Sampling Locations

Former Stewart Air Force Base, New York

Dec 2021



Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Former Stewart Air Force Base
- Approximate Overburden Groundwater Flow Direction

Proposed Groundwater Sampling Locations

Type

- Upgradient
- Site
- Downgradient
- Not proposed for sampling

O - Overburden
B - Bedrock

NOTE:
Topography based on 2014 Orange County LiDAR collection.

N W E S

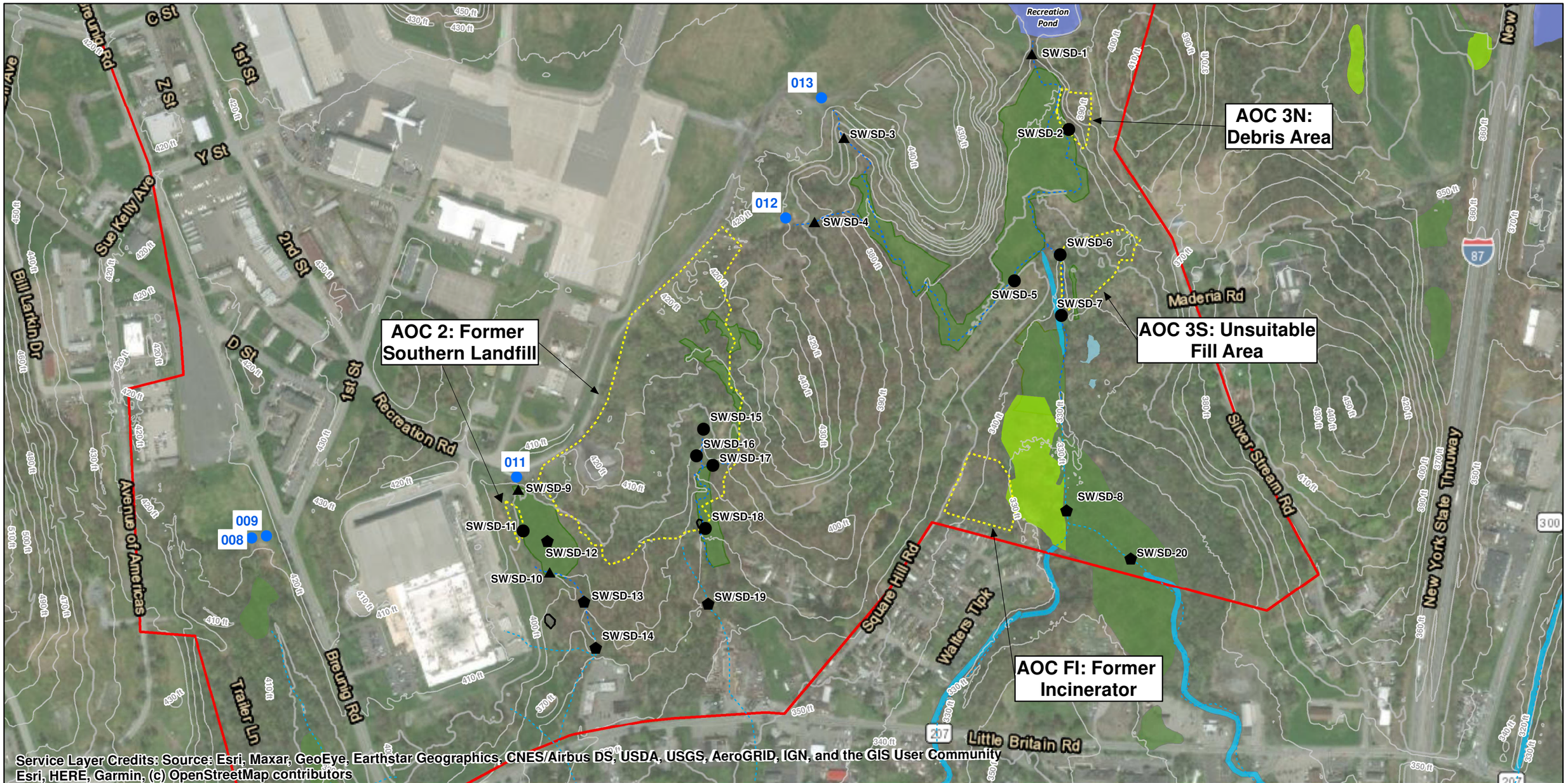
0 260 520 780 1,040 Feet

FIGURE 20

Proposed Groundwater Monitoring Locations

Former Stewart Air Force Base, New York

Aug 2022



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Former Stewart Air Force
- Seep
- Streams
- Drainage Line
- Field delineated Streams
- Field Delineated Wetlands
- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riverine
- Vernal Pools
- SWF Outfall Locations

Approximate Co-Located Sediment and Surface Water Sampling Locations

Type

- Upgradient
- Site Related
- Downgradient

NOTE:
Topography based on 2014 Orange County LiDAR collection.

N W E S

0 290 580 870 1,160 Feet

FIGURE 21

Proposed Sediment and Surface Water Sampling Locations

Former Stewart Air Force Base, New York

Dec 2021

APPENDICES

Appendix A – Human Health Risk Assessment and Screening Level Ecological Risk Assessment Draft Work Plan

Appendix B – National Wetlands Inventory Map for Former Stewart Air Force Base Vicinity and Habitat Explanations and 2021 Wetlands Delineation Memo

Appendix C – Historical Data Evaluation and 2021 Geophysical Survey Report

Appendix D – AOC 3 – Figure 2.6 and Test Pit Logs

Appendix E – Laboratory Certifications

Appendix F – Laboratory Standard Operating Procedures

Appendix G – TI-SDC Standard Operating Procedures

Appendix H – Field Forms

Well Gauging Log Sheet
Well Development/Purge Log
Chain of Custody Form
Drilling Log
Monitoring Well Construction Log
Canister Sampling Field Data Sheet

Appendix I – Site Safety and Health Plan/Accident Prevention Plan

Appendix J – Community Air Monitoring Plan

Appendix K – QC Inspection Checklists and DQCR

Appendix L – Evaluation of Historical Detections of Analytes with Detection Limits Above Project Screening Levels

Appendix M – Analytical Project Limits

APPENDIX A

HUMAN HEALTH RISK ASSESSMENT AND SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT DRAFT WORK PLAN

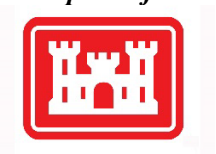
APPENDIX A
HUMAN HEALTH RISK ASSESSMENT AND SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT WORK PLAN FOR REMEDIAL INVESTIGATION ACTIVITIES

AT THE FORMER STEWART AIR FORCE BASE, NEWBURGH AND NEW WINDSOR, NEW YORK

CONTRACT NO. W912WJ-19-D-0006
DELIVERY ORDER NO. W913WJ19F0135

FUDS PROJECT NO. C02NY0704

Prepared for:



U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Prepared by:

TI-SDC JV
3401 Carlins Park Drive, Ste. B
Baltimore, MD 21215-7854

November 2022

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS iv

1.0 RISK ASSESSMENT WORKPLAN 1

2.0 RISK ASSESSMENT METHODOLOGY FOR DATA USE AND EVALUATION .. 2

2.1 INTERPRETING ANALYTICAL RESULTS 2

2.2 UNITS 3

2.3 DATA QUALIFIERS 3

2.4 DUPLICATE SAMPLES AND ANALYSES 3

2.5 CENSORED DATA 3

2.6 SUMMARY STATISTICS 4

3.0 HUMAN HEALTH RISK ASSESSMENT 4

3.1 HAZARD IDENTIFICATION 5

3.1.1 Consideration of Detection Status 5

3.1.2 Essential nutrient status 5

3.1.3 Use of Toxicity Screening Criteria 6

3.1.4 Background and Site-Related COPCs 7

3.2 EXPOSURE ASSESSMENT 8

3.2.1 Exposure Scenarios 9

3.2.2 Exposure Points 11

3.2.3 Exposure Point Concentrations 12

3.2.4 Calculation of Intake 22

3.3 DOSE-RESPONSE ASSESSMENT 25

3.3.1 Dermal Toxicity Values 25

3.3.2 Evaluation of Mutagenic COPCs 25

3.3.3 Evaluation of Lead 26

3.4 RISK CHARACTERIZATION 26

3.4.1 Noncancer Hazards 27

3.4.2 Cancer Risk 27

3.5 UNCERTAINTY ANALYSIS 29

4.0 ECOLOGICAL RISK ASSESSMENT 29

4.1 HABITAT ASSESSMENT 29

4.2 PROBLEM FORMULATION 30

4.2.1 Selection of Study Constituents 30

4.2.2 Exposure Pathways and Potential Receptors 31

4.2.3 Assessment Endpoints 31

4.2.4 Measures of Exposure and Effect 32

4.3 RISK ESTIMATION 32

4.4 RISK CALCULATION 34

4.5 REFINEMENT STEP AND SELECTION OF COPECS 34
4.6 SLERA UNCERTAINTY ANALYSIS 36
4.7 SUMMARY AND CONCLUSIONS 36
5.0 REFERENCES 37

FIGURES

UFP-QAPP main document numbered Figures 6A through 6D and 7 are provided as part of this Appendix.

Figure 6A. Preliminary Human Health Conceptual Site Model for AOC-2 (Former Southern Landfill)
Figure 6B. Preliminary Human Health Conceptual Site Model for AOC-3N (Debris Area)
Figure 6C. Preliminary Human Health Conceptual Site Model for AOC-3S (Unsuitable Fill Area)
Figure 6D. Preliminary Human Health Conceptual Site Model for AOC-FI (Former Incinerator)
Figure 7. Preliminary Ecological CSM

TABLES

Table 1.1, 1.2 Proposed Values Used for Daily Intake Values - Outdoor Maintenance Worker (Soil)
Table 2.1, 2.2 Proposed Values Used for Daily Intake Values - Construction or Utility Worker (Soil)
Table 2.3, 2.4 Proposed Values Used for Daily Intake Values - Construction or Utility Worker (Shallow Groundwater)
Table 3.1, 3.2 Proposed Values Used for Daily Intake Values - Future Off-Site Residences (Potable Groundwater)
Table 3.3, 3.4 Proposed Values Used for Daily Intake Values - Future Off-Site Residences (Indoor Air)
Table 4.1, 4.2 Proposed Values Used for Daily Intake Values - Trespasser (Soil)
Table 4.3, 4.4 Proposed Values Used for Daily Intake Values - Trespasser (Sediment)
Table 4.5, 4.6 Proposed Values Used for Daily Intake Values - Trespasser (Surface Water)
Table 5.1, 5.2 Proposed Values Used for Daily Intake Values - Hunter (Soil)
Table 5.3, 5.4 Proposed Values Used for Daily Intake Values - Hunter (Sediment)
Table 5.5, 5.6 Proposed Values Used for Daily Intake Values - Hunter (Surface Water)
Table 5.7, 5.8 Proposed Values Used for Daily Intake Values - Hunter (Deer Meat)

ACRONYMS AND ABBREVIATIONS

ABSd.....dermal absorption fraction
ABSgi.....gastrointestinal absorption fraction
ADAF.....age-dependent adjustment factor
ADD.....average daily dose
ADE .....average daily exposure
AOC .....Area of Concern
ATSDR .....Agency for Toxic Substance Disease Registry

BERA.....baseline ecological risk assessment
bgs.....below ground surface

CDC .....Center for Disease Control
cm/sec .....centimeter per second
COPC.....chemical of potential concern
COPEC.....chemical of potential ecological concern
CSF .....cancer slope factor
CSM.....conceptual site model
CTE.....central tendency exposure

DAevent.....absorbed dose per event
DQO.....data quality objective

Eco-SSL.....ecological soil screening level
EL-HQ .....effects level hazard quotient

EPC .....exposure point concentration

HHRA .....Human Health Risk Assessment
HI .....Hazard Index
HQ.....Hazard Quotient

IEUBK .....Integrated Exposure Update Biokinetic
ILCR .....incremental lifetime cancer risk

Kp.....permeability coefficient

LADD .....lifetime average daily dose
LADE.....lifetime average daily exposure
LOEL .....lowest observed effect level
LOEC.....lowest observed effect concentration
LOD .....limit of detection

µg/dl.....milligrams per deciliter
mg/kg.....milligrams per kilogram
mg/kg-day.....milligrams per kilogram per day
µg/L .....micrograms per liter
mm.....millimeter

NIH .....National Institute of Health
NYCRR .....New York Codes, Rules and Regulations
NYSDEC .....New York State Department of Environmental Conservation

OSWER .....Office of Solid Waste and Emergency Response

%.....percent
PAH .....polycyclic aromatic hydrocarbon
PCB.....polychlorinated biphenyl
P-COPEC.....preliminary chemical of potential ecological concern
PFAS.....per- and polyfluoroalkyl substances

RAGS .....Risk Assessment Guidance for Superfund
RfC .....reference concentration
RfD .....reference dose
RI .....Remedial Investigation
RME .....Reasonable Maximum Exposure
RSL.....Regional Screening Level

SLERA .....screening level ecological risk assessment
SWF.....Stewart International Airport

TOGS.....Technical and Operational Guidance Series
TRV .....Toxicity Reference Values
TSERAWG.....Tri-Service Environmental Risk Assessment Working Group
UCL .....upper confidence limit
UFP-QAPP .....Uniform Federal Policy for Quality Assurance Project Plan
UR.....unit risk

USACE .....United States Army Corps of Engineers
USEPA.....United States Environmental Protection Agency
VOC .....volatile organic compound

1.0 RISK ASSESSMENT WORKPLAN

This appendix to the Quality Assurance Project Plan (QAPP) presents the human health and ecological risk assessment work plan for the remedial investigation (RI) at four Areas of Concern (AOC) at the Former Stewart Air Force Base (AFB) in Orange County, New York (Site). The purpose of this risk assessment work plan is to define the following:

- The purpose of the risk assessments;
- The use for the data generated in the RI; and
- The methods that will be used in risk assessment.

QAPP Worksheet #10 provided a detailed description of the Site, which contains four separate AOCs. All four areas all have restricted access and usage. AOC 2 is a former landfill, used by the Department of Defense (DoD) from at least 1944 through the early 1970s, and found to contain household waste, demolition debris, ash, spent artillery steel shell casings, hazardous wastes, solvents, pesticides, petroleum waste and other material. Past investigations have estimated the extent of waste to 70 acres, and have identified landfill-related impacts to soil, groundwater, surface water and sediment. More recent estimates have reduced the extent of waste materials in AOC 2 to approximately 17.4 acres. Contaminants detected in various media at AOC 2 included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, and metals.

AOC 3 is a small, bifurcated landfilled area located east/southeast of AOC 2, and consists of two subareas: AOC-3 North (AOC 3N; approximately 0.7 acres) and AOC-3 South (AOC 3S; approximately 1.7 acres). Landfill contents have been observed to consist of residential and demolition debris, scrap metal, tires, motor oil, tar-like material, metal drums, and a variety of other material. No environmental sampling of either AOC 3N or 3S has been conducted to-date; however, a suite of contaminants similar to those at AOC 2 is expected to be present in this area, based on the nature of the waste present in the landfill and the known or suspected site history.

The fourth AOC is the former incinerator area (AOC FI), an approximately 1.7- acre area located in the southeastern portion of Former Stewart AFB, along the southern boundary east of Square Hill Road and north of Walter's Mobile Home Village. There have been no known environmental investigations of the former incinerator area. Suspected contaminants include those related to ash, coke, cinders and clinkers, such as metals, polycyclic aromatic hydrocarbons (PAHs) and other SVOCs, and dioxins.

The QAPP presents a strategy for evaluating the nature and extent of contamination at the Former Stewart AFB, and includes surface soil sampling, subsurface soil sampling, groundwater sampling, surface water sampling, sediment sampling, and soil gas sampling (see QAPP Worksheet #17). A baseline human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA) with Refinement will be performed as part of the RI to evaluate potential risks to both human and ecological receptors associated with potential exposure to contaminants at the Site under existing and prospective future use scenarios. Risk assessment provides risk managers the information needed to understand existing or potential threats by

identifying the nature, extent, and location of the release, the pertinent exposure pathways of contamination migration, the human and/or ecological receptors that may be exposed to the contamination, and the potential risk for adverse effects that receptors may experience as the result of that exposure. The HHRA and SLERA are expected to assess existing and potential risks to human health and ecological receptors in the absence of a response to the releases at the Site and evaluate if response actions are warranted to address the estimated risks.

This risk assessment work plan includes five sections:

- Section 1: introduction and overall risk assessment objectives (this section)
- Section 2: general approach for use of data in the risk assessments,
- Section 3: the human health risk assessment plan
- Section 4: the ecological risk assessment plan, and
- Section 5: references.

Refer to QAPP Worksheet #10 for a detailed description of the AFB history, background information, prior environmental investigations, and conceptual site model, and QAPP Worksheets #11 through 18 for a description of the RI sampling design and proposed sampling plan. The following sections of this appendix present the data use practices for risk assessment and the approach and assumptions for both the HHRA and SLERA.

2.0 RISK ASSESSMENT METHODOLOGY FOR DATA USE AND EVALUATION

RI objectives and DQOs for the RI are described in QAPP Worksheet #11. The HHRA and SLERA will be based on analytical results generated from the RI, as well as relevant historical data determined to be representative of current Site conditions. The proposed treatment of the HHRA and SLERA data is summarized in the following subsections.

2.1 INTERPRETING ANALYTICAL RESULTS

Analytical results used in the HHRA and SLERA will be based on the results reported by the analytical laboratory. There are two types of results that are used in the risk assessment: detected and non-detect (i.e., censored) results. Each result involves a limit of detection (LOD). The LOD is the lowest concentration that can be reliably reported within the specified limits of precision and accuracy during routine laboratory operating conditions and is unique to each sample and compound (SW-846, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods). For chemical data used in the risk assessments, positive chemical results are those results reported at or above the limit of detection (or in some instances, the method detection limit). “Non-detect” results (U-qualified, or censored data) will be reported at the LOD and will be considered in summary statistics.

2.2 UNITS

Analytical results will be presented in units of µg/L for aqueous media (e.g., groundwater, surface water, pore water) and milligrams per kilogram (mg/kg) for solid media (soil, sediment). Solid media results will be expressed on a dry-weight basis.

2.3 DATA QUALIFIERS

Sample results include various levels of data validation. Except for samples qualified as rejected ("R"-flagged), all U- (non-detect) and J- (estimated) qualified data will generally be considered usable for purposes of risk assessment. Data that are qualified as "rejected" during the data validation process will be omitted from the risk assessment data sets. Sample results qualified in any other way (e.g., blank contamination, concentrations outside of instrument calibration range etc.) will be evaluated further to determine their usability prior to inclusion in the risk assessment statistics.

2.4 DUPLICATE SAMPLES AND ANALYSES

Field duplicate samples (or split samples) are two samples, taken from the same medium and sample locations, that are processed and analyzed identically and are used to evaluate sample reproducibility. Where field duplicates are collected, more than one analytical result is reported for a specific sample location and depth. Similarly, multiple results for a sample location may be reported if more than one analytical method is employed for a specific analyte (for example, trichloroethene may be analyzed by both Method 524.2 and 8260 analyses).

Where both a primary and duplicate sample are collected, or where results from multiple analytical methods for the same analyte are presented, the following process will be used to generate a single representative concentration for that sample location:

1. If both primary and duplicate results are detected, then the average of the two detected values will be used;
2. If both a detected result and a non-detect result are reported, then the detected result will be used;
3. If both results are not detected, then the lowest LOD of the two non-detects will be used.

The representative concentration will be used in calculating statistics, such as the arithmetic mean or 95% upper confidence limit (UCL) on the mean.

2.5 CENSORED DATA

Censored[1] data (i.e., results reported as not detected ["U" qualified] at or above the LOD) will be evaluated as part of the HHRA and SLERA. Use of censored results in generating summary statistics is often problematic as the constituent may be present at levels below the LOD or may not be present at all. Sample-specific reporting limits potentially may be elevated relative to typical LOD among other sample results

[1] This terminology relates to left-censored values, where the undetected quantity (below the LOD) is unknown.

and, in some cases, may even be reported as higher than detected results. Consequently, reporting limits of censored results will be evaluated with respect to maximum detected concentrations within a medium as well as the DQOs set forth in QAPP Worksheets #11, 12 and 13. Non-detect results will be evaluated as to their adequacy for use in the risk assessments and may potentially be excluded from the evaluation if it is determined that they will overly bias summary statistics and estimation of exposure point concentrations. Removal of any censored result (that was not already rejected during the formal data validation process) from the risk assessment dataset will be described in the HHRA/SLERA report. Where many elevated LOD are present within a medium, a discussion of this condition will be addressed in the uncertainty analysis.

Censored data used in derivation of summary statistics and estimation of exposure point concentrations will be treated using USEPA-published methods that are included in the latest version of the USEPA Technical Support Center for Monitoring and Site Characterization's ProUCL program Version 5.1.002 (ProUCL; USEPA, 2016). For datasets that include non-detect results, statistical estimation methods (e.g., Kaplan-Meier) that treat non-detections as inequalities will be used to reduce the source of error owing to censored data.

2.6 SUMMARY STATISTICS

Data from each medium sampled (e.g., soil, groundwater, surface water, sediment) will be compiled and statistically summarized. The basic summary statistics to be calculated for each detected constituent include measures of detection frequency (number of detected samples, number of samples analyzed), the arithmetic mean, the range of detected values, the range of censored values, and location of the maximum detected concentration. Statistical analyses will be completed using ProUCL (USEPA, 2016).

Uncertainties associated with the datasets, such as LODs that exceed project action limits, and their implications on the risk assessment conclusions, will be addressed in the Uncertainty Analysis.

3.0 HUMAN HEALTH RISK ASSESSMENT

The HHRA evaluates potential human receptors and exposure pathways and quantitatively evaluates the risk of harm to human health from exposure to site-related impact. The HHRA consists of four main components: hazard identification, exposure assessment, dose-response (toxicity) assessment, and risk characterization. In addition, the HHRA also includes an uncertainty analysis, which identifies the nature, direction and, when possible, the magnitude of the uncertainty associated with the HHRA and potential biases on the conclusions. The HHRA will be conducted in accordance with the USACE risk assessment scope of work (USACE, 2016), USEPA *Risk Assessment Guidance for Superfund* (RAGS)-Parts A through F, and other relevant risk assessment guidance documents and publications from USEPA, USACE, and other agencies. Supporting tables for the HHRA will be provided in accordance with the format specified in RAGS Part D, including those for mutagenic constituents (if needed)[2].

[2] See 12/6/2007 revision, https://www.epa.gov/sites/default/files/2015-11/documents/ragsdtables.pdf

3.1 HAZARD IDENTIFICATION

The hazard identification section summarizes the data collected at the site and presents the approach used in selecting the COPCs that are carried through the risk assessment for each relevant environmental medium. Analytical results collected as part of the RI and past assessments will be used to support the HHRA; a general treatment of the data was discussed in Section 2.

COPCs are those constituents selected from among the analytes detected in each environmental medium and constitute those constituents for which risk is quantitatively evaluated. Selection of the appropriate COPCs is useful in streamlining the risk assessment process to focus on potentially significant risk drivers and for making remedial action decisions. COPC selection should occur through a process that is deliberate, systematic, and based on established selection criteria (USEPA, 1989). This section describes the approach developed to identify and focus the COPCs identified for the risk assessment evaluation.

This process includes many complementary steps and criteria, including an evaluation of potential toxicity through a comparison of concentrations to conservative/default risk-based screening criteria, consideration of detection frequency, presence of common laboratory contaminants and other criteria. The quantitative methods used as part of the statistical analysis provide valuable information for the included analytes and a sound technical basis for eliminating less relevant or relatively inert analytes from the quantitative risk assessment. Each step of this process is discussed in the following subsections.

3.1.1 Consideration of Detection Status

Detected analytes are the focus of COPC refinement. Constituents detected very infrequently or never detected are generally assumed to pose a relatively low exposure and associated health risk relative to more frequently detected constituents. Constituents that are not detected in a medium will not be retained as COPCs. Constituents detected in fewer than 5% of samples, where 20 or more samples are analyzed, will be evaluated further to determine whether they should be retained as COPCs. This additional evaluation, which is consistent with USEPA risk assessment guidance (USEPA, 1989), will consider the spatial distribution and magnitude of concentration relative to human health screening benchmarks or other criteria.

If constituents are not detected, or detected at a low frequency of detection, with elevated reporting limits that do not meet data quality objectives, then these constituents will be excluded from the quantitative HHRA but their exclusion and impacts on the HHRA conclusions will be discussed in the uncertainty analysis.

3.1.2 Essential nutrient status

Certain inorganic constituents commonly detected in environmental samples are considered essential nutrients. These consist of calcium, magnesium, potassium, and sodium. These inorganics therefore will not be included as COPCs. While other inorganics such as iron and manganese may also be considered

essential nutrients, these analytes will not be automatically excluded based on essential nutrient status, given their potential for toxicity at relatively elevated concentrations (particularly in potable water).

3.1.3 Use of Toxicity Screening Criteria

In accordance with USEPA guidance (USEPA, 1989), maximum concentrations of detected analytes that have been retained based on the above COPC process will be compared to various human health screening criteria as a means of emphasizing constituents that are the most toxicologically relevant to human health. Constituents with a maximum concentration exceeding the default, protective screening criteria will be retained as COPCs. Conversely, constituents with maximum concentrations below these conservative benchmarks are assumed to pose relatively negligible risk and will not be evaluated further in the HHRA.

The human health benchmarks that will be used to select COPCs are based on risk-based concentrations, which reflect potential health effects. Risk-based screening values for noncarcinogenic effects will reflect a target hazard quotient (HQ) of 0.1; cancer risk-based screening values will be based on a target one in one million (1×10^{-6}) cancer risk.

Where multiple screening values for a COPC in an individual medium are identified, the lowest value among the various screening values sources will be selected as the final screening concentration. For cases in which a benchmark is not available for a specific constituent, the benchmark for another constituent that is structurally similar to the chemical of interest will be used, as appropriate (USEPA, 1989). If a reasonable surrogate is not available, then the constituent will be excluded as a COPC but will be addressed qualitatively in the uncertainty analysis. Screening criteria to be considered in the COPC selection process are summarized below by environmental matrix.

3.1.3.1 Groundwater Screening Criteria

Groundwater at the Site is not currently used as a potable source of water, although it is classified by NYSDEC as GA, a potable water supply. There are private drinking water wells in the vicinity of the Site. Screening criteria will thus be protective of potential groundwater ingestion and will include the USEPA RSLs for tap water (USEPA, 2021a).

In addition to drinking water, shallow overburden groundwater may also serve as a potential source medium for volatile constituents to migrate into the indoor air of buildings (i.e., vapor intrusion). If volatile constituents are detected in groundwater, then groundwater concentrations will be screened against USEPA groundwater Residential Vapor Intrusion Screening Levels (USEPA, 2021b) to determine whether the vapor intrusion pathway is potentially complete.

3.1.3.2 Soil Gas Screening Criteria

Soil gas analytical results will be compared to USEPA shallow soil gas Residential Vapor Intrusion Screening Levels (USEPA, 2021b) to determine whether the vapor intrusion pathway is potentially complete.

3.1.3.3 Soil (Surface and Subsurface) Screening Criteria

The Site is not used for residential purposes, but the area surrounding the Site is mainly residential. Therefore, screening criteria for soil will be conservatively based on residential use. Screening criteria for soil include the USEPA residential RSLs for soil (USEPA, 2021a)

3.1.3.4 Surface Water Screening Criteria

Surface water at the site consists of freshwater wetland areas and a stream. None of these areas are used as a source of potable water. Recreational users (hunters) or trespassers may occasionally visit these areas. Since USEPA does not provide surface water-specific RSLs, the tapwater RSLs will be conservatively used as COPC screening criteria for surface water.

3.1.3.5 Sediment Screening Criteria

USEPA does not provide default RSLs for sediment, although the RSL Calculator allows for calculation of site and medium-specific RSLs. Therefore, the RSL Calculator will be used to derive human health-based screening criteria for sediment that reflect a recreational wading scenario for a youth trespasser. This scenario is described in Section 3.2.1. The exposure parameters used to derive sediment RSLs will be those used to evaluate the trespasser scenario, as later discussed in Section 3.2.4.1.

As discussed, constituents with maximum concentrations exceeding the screening concentration for each medium will be retained as COPCs.

3.1.4 Background and Site-Related COPCs

Certain constituents, particularly metals, may be present because of local geochemistry and/or regional anthropogenic sources. Where concentrations of detected analytes are determined to be consistent with local background concentrations, background will be used in selecting COPCs in the HHRA, consistent with USACE guidance (Tri-Service Environmental Risk Assessment Working Group [TSERAWG], 2011). Background comparisons may also be used later in the FS process to evaluate remedial alternatives.

The background data sets (see QAPP Worksheets #17 and #18) collected in the RI will be compared to the Site datasets to determine whether Site concentrations of detected contaminants are similar to, lower than, or greater than those of background/reference conditions (referred to herein as ‘background’). This comparison will consist of both qualitative and quantitative methods. Qualitative methods will include generation of box and whisker plots (or similar data distribution plots) to provide visual comparisons of the central tendency and spread of the data.

Quantitative methods will include comparative statistical hypothesis tests to determine whether it can be confidently concluded average site results are greater than average background results. The distribution of the data sets will be evaluated as an initial step in order to determine the appropriate two-sample (Site-Background) tests to perform. The Shapiro-Wilk test, Lilliefors test or other appropriate goodness-of-fit

tests will be performed for each data set to determine if the distribution of the data conforms to a normal distribution or other type of distribution.

If both the background and Site data set approximate a normal distribution, Bartlett's test will be performed to determine equivalence of the variances between the data sets. Bartlett's test is the most appropriate means for testing for homogeneity of variance in cases where the data sets are normally or near-normally distributed. If the variances of the Site data set and the background data set are equal, a standard Student's t-test will be performed to test for differences between the means; otherwise, a Welch's t-test will be performed, which corrects for unequal variances. For both the Student's and Welch's t-test, the null hypothesis will be that there is no significant difference between the mean of the Site data set and the mean of the reference data set. Rejection of the null hypothesis means that the Site mean is higher than the reference mean concentration. A one-sided test will be conducted for all comparisons, and the null hypothesis will be rejected if the calculated p-value is less than 0.05.

If either the background data set or the Site data set is not normally distributed for a given contaminant, the nonparametric Generalized Wilcoxon Test (or similar) will be used to test for differences (using procedures outlined in Helsel (2012). The Generalized Wilcoxon Test is a score test designed to handle data sets that include non-detect results at multiple reporting limits.

Constituents determined to be present at concentrations consistent with or lower than background concentrations will be flagged as "background-related COPCs," and will not be considered further in the quantitative risk assessment, per USACE guidance (USACE, 2011). Background-related COPCs will be discussed qualitatively in the uncertainty analysis.

3.2 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the types and magnitude of potential exposures to COPCs present at or migrating from the Site. The exposure assessment consists of the: 1) development of exposure scenarios, which include the identification of human receptors and relevant exposure routes, as summarized in a site conceptual model; 2) identification of exposure points and calculation of exposure point concentrations; and 3) calculation of COPC intake for each receptor.

Exposure potential at the four AOCs is currently limited (Bluestone, 2019). Each of the AOCs is located within the Stewart International Airport property, which is an active commercial airport and maintenance facility for aircraft and ground vehicles, and public access to AOCs is restricted by locked/gated fencing. Residential areas (e.g., Walter's Mobile Home Village) are located near the airport property. All AOCs are currently undeveloped, consisting largely of dense vegetation, maintained lawn, woodland and/or wetland areas.

Future land use plans for AOC 2 included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. AOCs 3N, 3S and FI remain undeveloped and unmaintained. According to Bluestone (2019), access to these areas is restricted to the public; however, the AFB allows site workers to bow hunt seasonally within these AOCs.

Regarding future activities, there are currently no land use restrictions that would prohibit redevelopment of the Site, so it is assumed that future activities may include redevelopment for commercial/industrial purposes, including excavation into and/or relocation of subsurface soils, at all AOCs. This assumption is likely most relevant for portions of AOC-2 at which aviation-related redevelopment projects such as hangars, office space, fuel farm, and aircraft and vehicle parking are under consideration. It is also assumed that, given the Site's current zoning and use, that residential redevelopment of the Site is unlikely to occur and will be restricted via a deed restriction.

Groundwater at the Site is not used as a source of potable water; the airport is serviced by municipal water. Private potable wells are located downgradient of AOC 2 although past sampling conducted in 2002 suggested that these wells were not impacted at that time by the landfill. However, an updated well survey and groundwater monitoring dataset are needed to determine the presence or absence of other private potable wells near the Site and to verify current contaminant concentrations in groundwater. Groundwater throughout New York State is classified as GA (potable use).

In addition to soil and groundwater, contaminants associated with the landfill have been detected in wetlands and a small tributary adjacent to the landfill. This waterway is a tributary to Silver Stream, which in turn flows into Lake Washington and Moodna Creek, approximately one-half mile downstream of the Site. While Lake Washington was previously used as a potable water supply by the City of Newburgh, this use was suspended in 2016 due to the presence of per- and polyfluoroalkyl substances (PFAS) contamination.

3.2.1 Exposure Scenarios

For each identified human receptor at each exposure point, complete or potentially complete exposure pathways are identified based upon site activities and uses as well as the presence of COPCs in environmental media. A complete exposure pathway consists of the following elements:

- A source and mechanism of chemical release;
- A retention or transport medium;
- A point of potential human contact (exposure point);
- An exposure route (e.g., dermal contact, ingestion, or inhalation).

Human exposure may be direct (i.e., the receptor contacts the COPC in the affected medium such as air, water, or soil) or it may be indirect, involving exposure to chemicals via the food chain (e.g., one may ingest COPCs via consumption of animals (game, fish etc.) that have accumulated contaminants from surface water or sediments).

Based on a review of preliminary analytical results, contaminant migration pathways and impacted media, and current and potential future activities and uses at the Site, the following exposure scenarios are proposed for quantitative analysis in the HHRA.

- **Outdoor maintenance worker (current and future).** Portions of AOC 2 are mowed and outdoor maintenance workers who access this area may potentially be exposed to COPCs via incidental ingestion of and dermal contact with surface and subsurface[3] soil, inhalation of fugitive airborne dust particles and inhalation of VOCs emanating from soil into outdoor air.

- **Trespasser (current and future).** While access to the Site is restricted, there is the potential that trespassers could occasionally visit the Site and come into contact with COPCs in soil. Trespassers could also encounter COPCs in surface water and sediment of the stream and wetlands; it is assumed that this exposure would be limited primarily to wading, rather than swimming, given the dense vegetation, water depth and presence of muck in these waterbodies. Fishing is not anticipated to occur in the wetlands/stream on a routine or frequent basis and is not proposed to be included within the quantitative risk assessment[4]. Potential routes of exposure thus include incidental ingestion of and dermal contact with surface and subsurface soil and sediment, dermal contact with surface water (ingestion of surface water is unlikely to occur during wading), inhalation of fugitive airborne dust particles (from upland soils) and inhalation of VOCs in outdoor air.

- **Hunter (current and future).** Bow hunting of deer is seasonally allowed at the AOCs. A hunter could encounter COPCs in surface/subsurface soil, surface water and sediment while hunting at the Site, and could potentially ingest COPCs (such as certain metals or PCBs) that bioaccumulate into deer from their contact with soil, surface water and vegetation. Potential routes of exposure for the hunter include incidental ingestion of and dermal contact with soil and sediment, dermal contact with surface water, inhalation of fugitive airborne dust particles and inhalation of VOCs in outdoor air, and consumption of meat from deer caught on site (see Section 3.2.3).

- **Future on-site construction/utility worker.** No construction work is currently planned for the Site other than possible future construction of a new airplane hangar facility within a portion of AOC 2. There are no known, active subsurface utility lines within any portion of the AOCs. However, the risk assessment will evaluate risk associated with potential future limited construction and/or utility work at any of the AOCs. Workers may be exposed to COPCs in surface and subsurface soil and in shallow groundwater (less than 10 feet below grade) that pools within an excavation pit or trench. Potential routes of exposure for a construction or utility worker include dermal contact with and incidental ingestion of soil, inhalation of fugitive airborne dust particles and volatile COPCs in ambient air, dermal contact with shallow groundwater in an excavation pit or trench, dermal contact with surface water and sediment in the wetlands/streams, and inhalation of volatiles in ambient air of an excavation pit or

[3] Current soil exposures are assumed to be limited to surface soil, located at 0 to 1-foot bgs. Future soil exposures are assumed to include both surface and subsurface soils up to the water table, or to a 10 feet bgs maximum depth if the water table is deeper. It is assumed that under future conditions, subsurface soils could become exposed (via erosion, excavation, etc.) or be moved to the surface after redevelopment.

[4] It is not anticipated that fish of suitable size exist for recreational fishing to occur on any routine basis in any of the on-site streams given 1) the relatively small size of these streams result in shallow stream depths of only a few inches, 2) the intermittent status of portions of the streams, and 3) the fact that the site is fenced with restricted access.

trench. Incidental ingestion of groundwater or surface water in an excavation scenario is unlikely; it is not reasonable to assume that workers consume groundwater/surface water during typical excavation activities (unlike in a swimming scenario, where minor ingestion of water is highly likely to occur). Additionally, dewatering of excavations is an OSHA requirement, so it is not anticipated that a worker will have routine contact with groundwater or surface water other than while setting up or dismantling dewatering equipment.

- **Off-Site Resident – Groundwater and Soil Gas.** No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Furthermore, it is assumed that future on-site residential use will be prevented through implementation of land use restrictions. Therefore, an on-site resident will not be included as a viable receptor in the HHRA.

However, there are residences located downgradient of the Site. At this time, it is unknown if Site-related COPCs have or could migrate to these residences via groundwater and/or soil gas. Following review of results of the groundwater and soil gas investigation, an off-site resident may be included in the HHRA as a potential receptor. Because all fresh groundwater in New York State is classified as a source of drinking water source (Classification GA under 6CRR-NY 701.15), and there are potable private wells near the Site, and absent any environmental restrictions prohibiting use of groundwater for potable purposes, off-site residential potable use of water will be considered as a potentially complete exposure route. Relevant potential exposure routes for the off-site resident include ingestion of and dermal contact with groundwater, inhalation of VOCs while bathing/showering, and inhalation of VOCs in indoor air (where shallow groundwater and/or soil gas contamination near buildings is identified and a complete vapor intrusion pathway is present). These pathways will be reevaluated for their quantitative inclusion in the HHRA following receipt of the RI groundwater and soil gas data.

As previously discussed, it is assumed that redevelopment at any portion of the Site is possible. Therefore, it is possible that a construction worker could be exposed to subsurface soils in the landfill through future redevelopment, and a facility worker, hunter, or trespasser could be exposed to subsurface soils in the future if surface soils erode or are excavated. While it is acknowledged that these are purely hypothetical scenarios, and there is uncertainty on the relevance of these exposures to actual future site use, it is believed that quantification of risk for these various scenarios will provide good information for supporting risk management decisions.

Figures 6A through 6D of the UFP-QAPP main document, the preliminary human health CSM, summarizes the source media, transport mechanisms, potential human receptors and complete or potentially complete exposure routes for the exposure scenarios described above. Following receipt of the RI data, the CSM will be reviewed and these exposure scenarios will be updated, as needed. Figures 6A through 6D is provided as part of this Appendix as well.

3.2.2 Exposure Points

The exposure point is the area over which exposure is expected to occur. Analytical results will be reviewed in conjunction with physical site conditions as well as the receptor-specific scenarios to determine exposure points. Depending on the exposure scenario and the distribution of analytical results, the individual AOCs may be further divided, given differences in area uses, or may be combined into one "site-wide" exposure point (i.e., AOC 2, AOC 3N, AOC 3S, and AOC FI). Preliminary exposure points are summarized below:

- AOC 2– applicable to the current/future outdoor worker, current/future trespasser, and current/future hunter, future construction worker.
- AOC 3N and 3S – applicable to the current/future trespasser, current/future hunter, future construction worker and future outdoor worker.
- AOC FI - applicable to the current/future trespasser, current/future hunter, future construction worker and future outdoor worker.

Exposure points may be further refined following evaluation of the RI data. Exposure points will also be defined for some environmental media by depth. The following summarizes the applicable depth intervals for each medium of concern:

- Soil: Current soil exposures are assumed to be limited to surface soil, located at 0 to 1-foot bgs. Future soil exposures are assumed to include both surface and subsurface soils up to the water table, or 10 feet bgs maximum depth if the water table is deeper;
- Sediment: Sediment exposures are assumed to be limited to only shallow (0 to 0.5 feet bgs) sediments, consistent with the depth interval specified in QAPP Worksheets #11 and #18;
- Surface water: Surface water exposures will be defined by the water body and depth from which samples are collected (e.g., stream, wetlands); see QAPP Worksheet #18
- Groundwater: The potential for vapor intrusion will be evaluated by data from only shallow (e.g., 0 to 15 feet bgs) wells screened across the groundwater-vadose zone interface, consistent with USEPA guidelines (2015). Shallow water located within 10 feet of the ground surface is also relevant to direct contact exposures for construction/utility workers (consistent with the depth interval specified for soil).
- Soil Gas: The potential for vapor intrusion will be evaluated by data from only shallow (e.g., 0 to 15 feet bgs) soil gas, consistent with USEPA guidelines (2015).

Potable water pathways will be evaluated using data from: 1) existing, active potable wells (where site-related COPCs are identified, each private well will be considered its own distinct exposure point); and 2) monitoring wells across the Site (i.e., AOCs 2, 3N, 3S and FI). Depending on contaminant distribution in groundwater, the monitoring well datasets may be further divided between the shallow and deep aquifers if determined to be necessary.

3.2.3 Exposure Point Concentrations

An exposure point concentration (EPC) is an estimate of the contaminant concentration in the environmental medium of concern (e.g., groundwater) to which a receptor is routinely assumed to be exposed. EPCs are used in conjunction with receptor-specific exposure parameters (later described in Section 3.2.4) to estimate a receptor's average daily intake of a COPC.

EPCs will be calculated for each exposure point and will generally represent the 95th upper confidence limit on the mean concentration (95% UCL). UCLs will be calculated using USEPA ProUCL (USEPA, 2016); this software computes an appropriate UCL of the unknown population mean using a distinct probability distribution (e.g., normal, lognormal, gamma) and/or an appropriate nonparametric method. Because this program calculates multiple parametric/nonparametric UCL values, the program-recommended UCL will be used, unless more than one UCL is recommended. In such instances, the various UCLs will be reviewed, and the most appropriate will be selected as the EPC. In cases where the 95% UCL exceeds the maximum detected concentration of the dataset, the distribution of the data will be reviewed with respect to the 95% UCL; in general, for large datasets, the maximum detected concentration will be selected preferentially over the 95% UCL as the EPC. This approach is consistent with that described in the USEPA Office of Emergency and Remedial Response document Office of Solid Waste and Emergency Response (OSWER) 9285.6 10, Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002a).

The EPC for lead in soil, if selected as a COPC, will be based on the arithmetic mean concentration, in accordance with USEPA guidance document *Estimating the Soil Lead Concentration Term for the Integrated Exposure Uptake Biokinetic (IEUBK) Model* (USEPA, 2007). Evaluation of lead is described further in Section 3.3.3.

Groundwater data from well locations located the AOCs will be used to calculate groundwater EPCs in accordance with USEPA guidance (USEPA, 2014). Data from historical rounds of groundwater results will be reviewed with respect to recent data for their representativeness and inclusion in EPCs.

Samples of certain exposure media (dust, ambient and indoor air, game meat) will not be collected as part of this remedial investigation. In such cases, EPCs for these media will be estimated from soil or groundwater EPCs using USEPA-recommended models. Fugitive dust EPCs, resulting from dust and volatile emissions from soil, will be calculated using soil EPCs and EPA equations as presented in the Soil Screening Guidance (USEPA, 1996):

$$EPC_{air} = EPC_{soil} * (1/VF + 1/PEF)$$

Where:

EPC_{air}	=	air exposure point concentration, including dust and volatiles
EPCsoil	=	soil EPC
VF	=	chemical-specific volatilization factor, obtained from USEPA RSLs (2021), and
PEF	=	particulate emission factor; the USEPA default value of 1.36E+09 m^3/kg

(USEPA, 2021)

Indoor air concentrations (from shallow groundwater and/or soil gas) will be calculated using the USEPA Vapor Intrusion Screening Level calculator (USEPA, 2021b); equations for this model are presented on the USEPA VISL website (https://www.epa.gov/vaporintrusion/visl-equations). Shower air concentrations (from potable groundwater) will be calculated from groundwater EPCs using the Foster & Chrostowski model (Foster & Chrostowski, 1987). Ambient air/trench concentrations resulting from VOC emissions from shallow groundwater (for the construction/utility worker scenario), will be estimated from groundwater EPCs using a combination of a simple box model and an air emissions model. Game meat concentrations will be estimated from soil concentrations. Descriptions of the shower, ambient air, and game meat models are provided in the following subsections. All EPC model equations, assumptions and input parameters will be described and documented in the HHRA.

3.2.3.1 Estimation of Inhalation Exposures to Volatile Organic Compounds in the Shower

The HHRA will use an exposure model developed by Foster and Chrostowski (1987; the "shower model") to estimate average daily shower inhalation exposures to volatile organic compounds (VOCs) that have been identified as COPCs in groundwater at the Site. The model takes into account variable factors that influence the release of VOCs and their subsequent build-up in shower room air. The kinetic shower model estimates the rate that VOCs are released into the air and the rate of decay of the VOCs and quantifies concentrations of VOCs inhaled during and immediately after showering. The model output is an estimated concentration of VOCs in the shower room air and a magnitude of potential exposures for the duration of the event (Foster and Chrostowski, 1987). The Foster and Chrostowski model was validated using experimental data that was presented by Andelman et. al. (1986), who suggested that the model is more sensitive to variations in VOC concentrations in the shower water and to air exchange rate relative to changes in water temperature (Foster and Chrostowski, 1987). The shower model will be used to develop inhalation exposures resulting from bathing in potable water, as represented by Site groundwater EPCs. The shower model estimates the concentration of contaminant in air (in milligrams of compound per cubic meter (mg/m3) of air), which is then used as the average daily exposure in shower room air.

The Foster and Chrostowski shower model incorporates the two-film gas-liquid mass transfer theory adapted by Liss and Slater (1974), which estimates the mass transfer coefficient, KL, for each volatile COPC. The following equation describes the mass transfer rate of a compound at an air-water interface, which is influenced by the Henry's Law Constant, H.

$$K_L = (1/k1 + RT/Hkg)^{-1}$$

where,

K_L	=	Overall mass transfer coefficient (cm/hr)
H	=	Henry's Law Constant (atm-m^3/mol-K)
RT	=	2.4 X 10^{-2} atm-m3/mole = Gas Constant of 8.2 X 10^{-5} atm-m^3/mol-K * absolute temperature of 273 Kelvin (K)
kg	=	Gas-film mass transfer coefficient (cm/hr)
k1	=	Liquid-film mass transfer coefficient (cm/hr)

Chemical-specific values for k1 and kg may be estimated by using measured values for CO2 and H2O (20 cm/hr and 3,000 cm/hr) respectively, according to the following relationship:

$$kg_{(VOC)} = kg(H_2O)(18/MW_{VOC})^{1/2}$$
$$k1_{(VOC)} = k1(CO_2)(44/ MW_{VOC})^{1/2}$$

where,

MW_{VOC}	=	Molecular Weight of the VOC (g/mol)

The equation below yields an adjusted K_L value that accounts for shower water temperature, which affects the oxygen mass transfer rate:

$$K_{aL} = K_L(T_1\mu_S/T_S\mu_1)^{-1/2}$$

where,

K_{aL}	=	Adjusted overall mass transfer coefficient (cm/hr)
T_1	=	Calibration water temperature of KL (K)
T_S	=	Shower water temperature (K)
μ_1	=	Water viscosity at T1 (centiPoise, cp)
μ_S	=	Water viscosity at TS (cp)

The VOC concentration in a shower water droplet, C_{Wd}, may be calculated based upon a mass-balance, integrated rate equation:

$$C_{Wd} = C_{W0}[1 - e(-K_{aL}ts/60d)]$$

where,

C_{Wd}	=	Concentration leaving shower droplet after time tS (µg/L);
C_{W0}	=	Shower water concentration (groundwater EPC, in µg/L)
d	=	Diameter of shower droplet (mm)
t_S	=	Drop time of shower droplet (sec)

The factor K_{aL}/60d relates the rate of transfer and the available interfacial surface area across which volatilization can occur over a spherical shower droplet of diameter multiplied by conversion factors 1 hr/3600 sec and 10 mm/1 cm.

It is important to note that the equation above, and therefore, the overall shower model, assumes that volatilization of COPCs occurs only from shower droplets, starting at the time they are released from the shower head until they reach the shower bottom. The model does not take into account volatilization of COPCs from non-droplet air-water surfaces, which include water running over the showering individual and the shower bottom. Therefore, the actual time over which volatilization can occur may be greater than that estimated by the model, resulting in potential underestimation of VOC concentrations and exposures.

The generation rate of VOCs in the shower room, S, is calculated by the following equation:

$$S = C_{Wd}(FR)/SV$$

where,

S	=	Indoor VOC generation rate ($\mu g/m^3$-min)
FR	=	Shower water flow rate (L/min)
SV	=	Shower room air volume (m^3)

Foster and Chrostowski use a one-box indoor air pollution model to estimate VOC concentrations in the shower room via the differential equation below, which describes the rate of change of VOC concentration with time:

$$dCa/dt = R_{ae}C_a + S$$

where,

C_a	=	Indoor air VOC concentration ($\mu g/m^3$)
R_{ae}	=	air exchange rate (1/min)

The relation above assumes instantaneous mixing of shower room air with no decay of VOCs that have been released, although, in reality, the VOC concentration in the air directly around the individual is likely to be higher relative to the rest of the shower room. The model may, therefore, underestimate inhalation exposures resulting from the assumption of a completely homogenized indoor air environment. Integration of the above equation yields an estimated, time-dependent indoor air concentration as follows:

$$C_a(t) = (S/R_{ae})[1 - e^{(-R_a t)}] \qquad \text{for } t \le D_S, \text{ and}$$

$$C_a(t) = (S/R)[e^{(R_a D_s)} - 1]e^{(-R_a t)} \qquad \text{for } t > D_S$$

where,

$C_a(t)$	=	Indoor air VOC concentration at time t ($\mu g/m^3$)
D_S	=	Shower duration (min)
t	=	Time (min)

The inhalation exposure concentration per shower (event) may then be calculated according to the equation:

$$C_{a\text{-shower}} = \int D_0 t\ C_a(t)dt$$

where,

D_t = Total duration in shower room (min)

The equation above can be solved for the duration of the shower as follows:

$$C_{a\text{-during shower}} = (S/R_{ae}) * D_S - 1/R_{ae} + e^{(-RDs)}/R_{ae}$$

The equation below calculates the estimated inhalation exposure for the duration of the shower plus the duration of time in the shower room after the shower is turned off:

$$C_{A\text{-after shower}} = (S/R_{ae}) * D_S + e^{(-R_{ae}D_t)}/R_{ae} - e^{[(R_{ae}(Ds- Dt)]}/R_{ae}$$

Thus, the following equation is used to calculate a time-weighted shower air concentration, $C_{a\text{-shower}}$, for the duration of total time spent in the shower room:

$$C_{a\text{-shower}} = [(S/R_{ae})((D_S + (e^{(-RaeDt)}/R_{ae}) - (e^{(Rae(Ds- Dt))}/R_{ae}))]/D_t$$

The $C_{a\text{-shower}}$ term is used as the shower air EPC, which is then used in conjunction with the receptor-specific exposure parameters (frequency and duration) and chemical-specific toxicity information (unit cancer risk, or reference concentration) to estimate cancer risk and non-cancer hazard for residential scenarios. The HHRA will document all equations, input assumptions and calculations that will be used to estimate $C_{a\text{-shower}}$.

3.2.3.2 Estimation of Ambient (Trench) Air Concentrations

A conservative screening level model (RTI Model; USEPA, 1990) describing simple mass transfer of volatile constituents from liquid surfaces to air will be used to estimate ambient air concentrations in an excavation pit or trench. The RTI model was originally developed for assessing volatile emissions from aerated and non-aerated lagoons. The model is also applicable to quiescent and turbulent conditions. The model was selected for this analysis due to the similarities between a quiescent lagoon and standing water in the bottom of a trench. The overall mass transfer coefficient is based on an estimation technique presented in Lyman (1982). The compound specific flux rate is then entered into a simple one box mass balance model, which integrates the effects of air movement through a trench and estimates a concentration of contaminant in air (in milligrams of compound per cubic meter (mg/m^3).

Model for Volatile Constituent Mass Emission Rate

The RTI model, which predicts a mass emission rate, is based on the contaminant concentration in the liquid phase (i.e., groundwater seeping into a trench), the area of the liquid surface, the area of the trench, and the overall mass transfer coefficient of each individual volatile constituent.

The RTI Model is summarized as follows:

$$E = K * SA * Cw * CF1 * CF2$$

where,

E = Mass emission rate of contaminant in air phase (g/sec)

K = Overall mass transfer coefficient (m/sec)

SA = Liquid surface area (m^2)

C_w = Concentration of contaminant in liquid phase (mg/L), i.e., groundwater EPC

CF1 = Units conversion factor, 1000 L/m^3

CF2 = Units conversion factor, 1 g / 1000 mg

For the calculation of E, K is converted from units of m/hr to m/sec with a conversion factor of 1 hour per 3,600 seconds.

The overall mass transfer coefficient, K (m/hr), is related to the liquid phase exchange coefficient, kL (m/hr), and the gas-phase exchange coefficient, kG (m/hr), as follows:

$$\frac{1}{K} = \left(\frac{1}{kL} + \frac{R * T}{H * kG}\right) * CF$$

where,

R = Universal gas constant, 8.206 x 10^{-5} (m^3 atm/mol °K)

T = Temperature (298°K)

H = Henry's Law Constant (m^3-atm/mol)

CF = Units conversion factor (3600 sec per hr)

The overall mass transfer coefficient can be determined from experiment or from knowledge of the liquid and gas phase exchange coefficients. Model calculations may also be performed relating these coefficients to physical properties such as the molecular weight and scaling based upon mass transfer coefficients for other compounds. One set of such relationships, presented in Lyman (1982), is given by:

$$kL = 20 * \sqrt{\frac{44}{M}} * CF$$

where,

kL = Liquid phase exchange coefficient (m/hr)

20 = Liquid phase exchange coefficient for carbon dioxide (CO_2) (cm/hr)

44 = Molecular weight of CO_2 (g/mole)

M = Molecular weight of chemical of interest (g/mole)

CF = Units conversion factor (1 m per 100 cm)

and:

$$kG = 3000 * \sqrt{\frac{18}{M}} * CF$$

where,

kG = Gas phase exchange coefficient (m/hr)

3000 = Gas phase exchange coefficient for H_2O (cm/hr)

18 = Molecular weight of H_20 (g/mole)

M = Molecular weight of chemical of interest (g/mole)

CF = Units conversion factor (1 m per 100 cm)

Model for Estimating Air Concentrations

A simple one box mass balance model is next used to estimate the concentration of constituents in the ambient air of an excavation pit or trench. This model assumes that emissions from pooled groundwater in the trench are diluted into air passing through the excavation. The parameters used to calculate the volume of air flowing through the trench and thus the volume into which the emissions are diluted include the following:

- the average regional wind speed, which will be obtained from NRCC, 2020; and
- the width and depth of the excavation. Hypothetical trench dimensions of two meters-wide by 10 meters long will be used for all exposure scenarios. The depth of the trench will be based on the average depth to groundwater at each exposure point.

Concentrations of volatile constituents in trench air are then estimated as follows:

$$[OHM]air = \frac{E}{Q} * \frac{1}{A} * CF$$

where,

$[OHM]_{air}$ = Concentration of contaminant in trench air (mg/m^3)

E = Mass emission rate of contaminants (g/s)

Q = Wind speed of air moving through trench (m/s)

A = Cross sectional area of trench (m^2)

CF = Units conversion factor (1000 mg per g)

The HHRA will present the model equations, assumptions and calculations used in estimation of ambient air EPCs in an excavation trench.

3.2.3.3 Estimation of Game Meat Tissue Concentrations from Soil

Certain types of contaminants such as metals, polychlorinated biphenyls (PCBs) and pesticides have a tendency to accumulate in plants and wildlife. In addition to direct contact with contaminants in soil and other abiotic media, hunters that use the Site for seasonal white-tailed deer hunting may be indirectly exposed to contaminants through consumption of game meat, specifically, deer. Deer tissue concentrations of bioaccumulative contaminants will be estimated from soil using a multicomponent trophic transfer model based on uptake of contaminants into foraging cattle, used as a surrogate for wild deer.

This model is based on the protocol established by USEPA in their guidance document *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (USEPA, September 2005c; EPA530-R-05-006). The first part of the model estimates plant concentrations from soil; the second part of the model estimates cattle (deer) tissue concentrations from the estimated plant concentrations. Each of these components is described further in the following sections.

Soil to Forage:

White-tailed deer are herbivores with a highly varied diet consisting of shoots and leaves of many types of plants, shrubs and trees, legumes, lichens, mushrooms, fruits, acorns and grasses (collectively referred to here as 'forage'). For this model, forage is assumed to consist entirely of above-ground vegetation upon which deer will preferentially browse. Forage concentrations are calculated by multiplying the soil exposure point concentration (EPC) by a soil-to-plant bioconcentration factor ($BCF_{plant\text{-}soil}$), as described by the following equation.

$$C_{plant} = C_{soil} * BCF_{plant\text{-}soil}$$

Where:

C_{plant} = contaminant concentration in plant – calculated value, in units of milligrams per kilogram (mg/kg).

C_{soil} = soil exposure point concentration – calculated value based on Site-specific soil analytical data, in units of mg/kg.

$BCF_{plant\text{-}soil}$ = soil to plant bioconcentration factor – literature value (mg/kg plant / mg/kg soil)

Soil EPCs were discussed earlier in this section and will generally reflect the 95% Upper Confidence Limit of the mean concentration for each exposure unit. $BCF_{plant\text{-}soil}$ values will be obtained from the following literature sources:

- Oak Ridge National Laboratory (ORNL). 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. BJC/OR-133. https://rais.ornl.gov/documents/bjcor-133.pdf
- U.S. EPA. 1992. Technical Support Document for the Land Application of Sewage Sludge. Volumes I and II. EPA 822/R-93-001a. Office of Water. Washington, DC.
- Travis, C.C. and A.D. Arms. 1988. Bioconcentration of Organics in Beef, Milk, and Vegetation. Environmental Science and Technology. 22:271-274. https://pubs.acs.org/doi/abs/10.1021/es00168a005



- Baes, C. F. I., R. D. Sharp, A. L. Sjoreen, and R. W. Shor. 1984. A review and analysis of parameters for assessing transport of environmentally released radionuclides through agriculture. ORNL5786. U. S. Dept. of Energy, Oak Ridge, TN

Preference will be given to values based on median or average BCFs where summary statistics are provided. Alternatively, if forage samples are collected from the Site, then plant analytical results will be used to represent the C_{plant} term.

Forage to meat:

The second component of the model estimates deer tissue concentrations (C_{meat}) from forage concentrations of contaminants, based on information on soil and food ingestion rates, taking into account attributes specific to deer. The first step of this process involves calculating an ingestion rate (IR_{diet}) of each COPC based on soil and forage consumption rates, as shown by the following equation:

$$IR_{COPC} = fHR * [(C_{plant} * IR_{forage} * CF) + (C_{soil} * IR_{soil})]$$

Where:

IR_{COPC} = amount of contaminant consumed in diet (forage and soil) per day – calculated value, in units of milligrams per day (mg/d),

IR_{forage} = daily forage ingestion rate, in units of grams per day (g/d),

IR_{soil} = daily soil ingestion rate (kg/d), and

fHR = fraction home range: ratio of size area to deer home range – calculated value, in units of acre/acre or hectare/hectare.

CF = units conversion factor (1 kg / 1000 g)

The home range of white-tailed deer is variable according to location, time of year and sex. According to Innes (2013), the mean home ranges of deer in New York are 334 acres (135 hectares) in the winter and 556 acres (225 hectares) in the summer. Collectively, the four AOCs comprise approximately 21.5 acres (AOC-2 is 17.4 acres, AOC-3N is 0.7 acres, AOC-3S is 1.7 acres, and AOC FI is 1.7 acres), and there is ample undeveloped forest within the region such that deer will likely move between the Site and other undeveloped locations near the Site. The mean winter home range will be used to calculate a fHR of 5% for AOC-2 (17.4 acres/ 334 acres), 0.7% for AOC-3N/S (combined; 2.4 acres/ 334 acres), and 0.5% for AOC-FI (1.7 acres/ 334 acres).

The forage ingestion rates for deer will be estimated from mean body weight based on the equation for herbivores as presented in the USEPA Wildlife Exposure Factors Handbook (USEPA, 1993), as follows:

$$IR_{forage}\ (g/day) = 0.577\ Body\ Weight\ (in\ grams)^{0.727}$$

Physiological parameters specific to the white-tailed deer include:

- a body weight of 83,000 g, based on the average body weight for adult bucks and does in the Northeastern United States (Innes, 2013).

- a forage ingestion rate of 2,174 g/day (dry weight), estimated from body weight using Equation 4.
- a soil ingestion rate of 2% of the IR_{forage} from Beyer (1994).

While surface water ingestion may also contribute to the overall body burden of a COPC in deer, it is assumed that this contribution is relatively minor compared to that obtained via forage and soil ingestion routes.

IR_{COPC} is then multiplied by a plant-to-meat biotransfer factor to derive the estimated concentration of a COPC in game meat (C_{meat}), as shown in the following equation:

$$C_{meat}\ (mg/kg) = IR_{COPC}\ (mg/d) * BTF\ (mg/kg\ tissue / mg/d)$$

Where:

C_{meat} = contaminant concentration in deer meat – calculated value, in units of mg/kg, and

BTF = plant to meat biotransfer factor, in units of mg/kg tissue per mg/d.

Biotransfer factors for the COPCs will be based on those for cattle and obtained from the following sources.

- Research Triangle Institute (RTI). 2005. Methodology for Predicting Cattle Biotransfer Factors. EPA Contract Number 68-W-03-042 RTI Project Number 08860.002.015. https://archive.epa.gov/epawaste/hazard/tsd/td/web/pdf/btfreportfull05.pdf

- Stevens, J.B. 1992. Disposition of toxic metals in the agricultural food chain. 2. Steady-state bovine tissue biotransfer factors. Environmental Science & Technology 1992 26 (10), 1915-1921.DOI: 10.1021/es00034a006 https://pubs.acs.org/doi/pdf/10.1021/es00034a006, and

- USEPA, 2005c.

The risk assessment will provide complete documentation of all equations, input parameters, assumptions and sources used in the biotransfer model, and will discuss uncertainties associated with use of the model as well as any implications of these uncertainties on the conclusions of the risk assessment.

3.2.4 Calculation of Intake

The quantitative exposure assessment describes a conservative estimate of exposure to a representative individual within a subpopulation (receptor group) based on the defined exposure scenarios. The exposure dose therefore represents the amount of a COPC to which an individual receptor may come into contact. The dose is a function of receptor-specific exposure assumptions and chemical-specific exposure parameters. The material that reaches the receptor's absorption barrier (such as the skin, lung, or gastrointestinal tract) is referred to as the applied dose (for ingestion and inhalation exposures), while the absorbed (or internal) dose is defined as the amount of material that actually crosses the receptor's exchange boundary.

Exposure doses (or intakes) for chemical constituents are calculated as the daily amount of the chemical taken into the body per unit body weight per unit time, in units of milligrams per kilogram per day (mg/kg-day; USEPA, 1989). The general equation used to estimate average daily doses (ADDs; for noncancer effects) and lifetime average daily dose (LADDs; for carcinogenic effects) for ingestion and dermal pathways is as follows:

$$\text{ADD (or LADD)} = \frac{\text{Total amount of COPC contacted/ingested}}{\text{Body weight} * \text{averaging period}}$$

Exposure intakes are normalized to a receptor's averaging period (in days). Note that averaging time for noncarcinogenic compounds is equivalent to the exposure duration, whereas the averaging time for carcinogens is always equivalent to a 70-year (25,550-day) lifetime (USEPA, 1989).

For inhalation exposures, an average daily exposure (ADE; noncancer) and lifetime average daily exposure (LADE; carcinogenic effects) are used instead of intake (USEPA, 2009). Average daily exposures or LADEs are calculated, instead of ADDs or LADDs, to make them compatible with the inhalation dose-response values presented as Reference Concentrations (RfCs) or unit risks (URs) (expressed in units of mg/m^3 and $[mg/m^3]^{-1}$, respectively). Exposures are then estimated by normalizing fugitive dust or vapor EPCs with averaging times as follows:

$$\text{ADE or LADE} = \frac{\text{Time-adjusted exposure concentration for airborne chemicals}}{\text{Averaging time}}$$

Average daily doses, or LADDs for carcinogenic COPCs, will be based on conservative exposure assumptions and factors developed in accordance with USEPA risk assessment guidelines, site-specific information, and other relevant guidance. Exposure doses will be calculated using receptor-specific exposure variables and chemical-specific exposure parameters (e.g., anatomical and physiological parameters, absorption adjustment factors, skin permeability coefficients [Kp]) to calculate the chemical specific doses or exposures for each receptor and pathway.

3.2.4.1 Exposure Parameters

Exposure parameters describe physiological or behavioral aspects, of each target receptor, and will represent a mix of central tendency and upper-bound exposure assumptions and recommendations from USEPA risk assessment guidance (e.g., USEPA; 1989, 2011, 2014b), as well as professional judgment. Per USEPA guidance (1989) and USACE policy (2016b), both central tendency exposure (CTE) and reasonable maximum exposure (RME) scenarios are considered to provide both central and upper-bound estimates of potential health risks.

Proposed intake and exposure equations and parameters for the various scenarios and media are provided in **Tables 1 through 5**. The tables have been constructed in accordance with USEPA Risk Assessment Guidance for Superfund Part D format (RAGS-D Table 4 series). This table series provides all intake equations, input parameters, notes, assumptions and citations for each of the receptors and exposure routes to be evaluated.

3.2.4.2 Dermal and Oral Absorption Factors

The routes of exposure and the exposure matrices upon which toxicological studies and resultant toxicity values are based are often different from the route of exposure and exposure matrix of a chemical at a particular site. This may result in different absorption rates and efficiencies. For soil, a dermal absorption fraction (ABSd), which accounts for these differences in absorption, will be applied to the exposure dose. ABSd values will be obtained from USEPA RAGS-E (USEPA, 2004). Where an ABSd is not available, intake from the dermal route will not be calculated, in accordance with USEPA risk assessment guidance (2004).

For all constituents except arsenic and lead, oral bioavailability in the intake equation is assumed to be equivalent to 100%, and therefore, no adjustment will be made in calculating oral intakes. For arsenic, the USEPA default value for the relative bioavailability of arsenic in soil will be used, in accordance with USEPA (2012b). Lead hazard is assessed in a manner different from that used for other contaminants, as described in Section 3.3.3.

3.2.4.3 Aqueous Dermal Exposures

Dermal absorption from water is a function of the concentration of the COPC, the chemical/physical properties of a COPC, as well as the receptor's exposure time and skin surface area. As an intermediate step in the calculation of dermal groundwater exposures, the absorbed dose per event (DAevent) is first calculated. This value takes into account physical properties of the chemical as well as the exposure time unique to each exposure scenario.

The equations used to calculate DAevent are presented in USEPA, 2004 (Equations 3.2, 3.3, and 3.4). The skin Kp is a key parameter in estimating dermal absorption of chemicals in water. Kp (centimeters/hour) represents the permeability of a chemical from an unspecified (aqueous) vehicle (such as groundwater or surface water) through the skin. Published literature on experimentally measured or estimated values of Kp, as well as other dermal parameters used in the DAevent calculations, will be used for constituents in groundwater (USEPA, 2004).

Some constituents, such as PCBs and other lipophilic organics, have Kp values outside the effective prediction domain of the model used to estimate this parameter. In such instances, USEPA guidance suggests applying a fraction absorbed value to the Kp, which accounts for loss of a constituent due to desquamation of the skin (USEPA, 2004). Where a published fraction absorbed value exists and quantitative assessment is recommended by USEPA (as indicated in Exhibit B-3 of USEPA, 2004), this value will be used to quantify aqueous dermal exposures. USEPA does not recommend quantifying dermal aqueous exposures for various classes of compounds, including PCBs, dioxins, certain pesticides and PAHs (as indicated in Exhibit B-3 of USEPA, 2004). Therefore, dermally absorbed dose will not be estimated for COPCs in water that belong to these classes of chemicals.

3.3 DOSE-RESPONSE ASSESSMENT

The toxicity assessment describes the relationship between the level of exposure and the likelihood and/or severity of an adverse effect. The products of the toxicity assessment are the toxicity values used to predict the likelihood of adverse health effects in identified receptors at site specific exposure levels.

Toxicity values that will be used in the HHRA will be obtained for both carcinogenic (i.e., cancer causing) and/or noncarcinogenic (i.e., systemic) effects, and will be selected according to the following USEPA-recommended hierarchy of references, as recommended by USEPA (OSWER 9285.7 53, "Human Health Toxicity Values in Superfund Risk Assessments"; USEPA, 2003a):

- Tier 1: USEPA Integrated Risk Information System On-Line Database (USEPA, 2021c);
- Tier 2: USEPA Provisional Peer Reviewed Toxicity Values, as provided by the USEPA Superfund Health Risk Technical Support Center (USEPA, 2021d);
- Tier 3: Other sources, including USEPA Health Effects Assessment Summary Tables, FY 1997 Update (USEPA, 1997a); California Environmental Protection Agency; Agency for Toxic Substance Disease Registry (ATSDR); and other USEPA regional and state hazardous waste site programs.

Where toxicity values are not available for a particular COPC, a structurally similar compound will be identified as a surrogate for that COPC, as appropriate, and the surrogate's toxicity values will be used to quantify risks. All surrogates used in the HHRA will be identified and discussed in the report. Where appropriate surrogate compounds are not identified, risks for that particular constituent will not be quantified and will instead be addressed qualitatively in the uncertainty analysis section of the HHRA (see Section 3.5).

3.3.1 Dermal Toxicity Values

Toxicity values provided by Tier 1, 2, and 3 sources are typically based on an administered (e.g., oral) dose. For dermal exposure pathways, the absorbed dose is calculated; however, the use of oral toxicity values without modification in calculating risk from dermal routes of exposure may potentially underestimate the potential risk. Therefore, USEPA recommends that oral toxicity values be adjusted where adequate information is available on gastrointestinal absorption efficiency, so that the dermal toxicity values reflect toxicity related to an absorbed rather than administered dose.

Dermal toxicity values will be derived from oral RfDs and oral cancer slope factors (CSFs) using the gastrointestinal absorption fraction (ABSgi) values and adjustment equations recommended in USEPA, 2004. Where no ABSgi is recommended for a particular COPC, an ABSgi of 100% will be assumed (i.e., no adjustment will be made), and the dermal RfDs and CSFs are assumed to be equivalent to the oral values.

3.3.2 Evaluation of Mutagenic COPCs

USEPA's guidance on cancer risks (USEPA; 2005a, 2005b) specify the use of age-dependent adjustment factors (ADAFs) for carcinogens that act via a mutagenic mode. Carcinogenic PAHs, trichloroethylene and

hexavalent chromium are common examples of constituents that have been determined to act in this manner. If such constituents are identified as COPCs, USEPA guidance recommends using ADAFs combined with age-specific exposure estimates when assessing cancer risks. In the absence of chemical-specific data, the supplemental guidance recommends the following default adjustments, which reflect the fact that cancer risks are generally higher from early-life exposures than from similar exposures later in life:

- For exposures before two years of age (i.e., spanning a two-year interval from the first day of birth until a child's second birthday), a 10-fold adjustment is made.
- For exposures between two and 16 years of age (i.e., spanning a 14-year time interval from a child's second birthday until their sixteenth birthday), a three-fold adjustment is made.
- For exposures after turning 16 years of age, no adjustment is made.

For this risk assessment, ADAFs would apply to only the trespasser and off-site residential scenarios because these scenarios encompass children of ages less than 16 years. ADAF adjustments will be made in accordance with the equations provided in USEPA, 2005b.

3.3.3 Evaluation of Lead

The intake equations and toxicity values discussed in prior sections do not apply to lead exposures. If lead is identified as a COPC, different procedures will be used to evaluate the potential risk of harm from lead. USEPA currently recommends use of two models that estimate blood lead concentrations. For children 0-84 months in a residential setting, the IEUBK model is recommended (USEPA, 1994); for older children and adults, where exposure may occur on an intermittent basis and/or does not reflect the kind of high-intensity, chronic residential exposures evaluated for young children, the Adult Lead Methodology will be used. (USEPA, 1996; USEPA, 2003b).

Since the toxicokinetics (i.e., the absorption, distribution, metabolism, and excretion of toxicants in the body) of lead are well understood, lead is regulated based on blood lead concentration. USEPA and the Centers for Disease Control and Prevention (CDC) have determined that there is no safe blood lead level in children. The USEPA risk reduction goal for contaminated sites is to limit the probability of a child's blood lead concentration exceeding 10 µg/dL (the P10) to 5% or less after cleanup. The CDC more recently has identified that childhood blood lead concentrations at or above 5 micrograms of lead per deciliter of blood (µg/dl) are much higher than most children's levels and may require case management (CDC, 2012). This more recent blood lead level will be used as the target level for both lead models, consistent with USEPA Office of Land and Emergency Management (OLEM) Directive 9200.2-167.

3.4 RISK CHARACTERIZATION

Characterization of risk to human health is the estimation of the incidence and severity of the adverse effects that may potentially occur in a human population due to chemical exposures, expressed as risk estimates. Risk estimates are generated through integration of the exposure assessment and the toxicity assessment and compared to relevant risk management criteria (e.g., USEPA risk limits). The results of the risk

characterization are then used to inform risk management decisions regarding the future need for remedial actions.

3.4.1 Noncancer Hazards

Exposure to contaminants may potentially affect organ systems and developmental, reproductive, neurobehavioral, and other physiological functions. Unlike potential cancer effects, these effects are assumed to have a threshold (or "safe") dose, below which no effects are expected. The potential for noncarcinogenic health effects is characterized by the HQ, which is the ratio of the estimated ADD (or exposure concentration [ADE], for inhalation pathways) and a toxicity value considered to be the level below which adverse health effects would not be observed (i.e., RfD or RfC):

Oral/dermal pathways:

$$HQ = ADD/RfD$$

Inhalation pathways:

$$HQ = ADE/RfC$$

To account for exposures that a receptor may receive from multiple chemicals and exposure routes, the cumulative noncancer hazard, known as the hazard index (HI), is calculated as the sum of the chemical-specific HQs, under the global assumption that effects from individual COPCs are additive. As shown in the following two equations, the cumulative HI for a receptor is calculated by summing the route-specific HIs. Route-specific HIs are calculated as the sum of all chemical-specific HQs:

$$\text{Total } HI_{\text{route-specific}} = \Sigma\, HQ_{\text{chemical-specific}}$$

$$\text{Cumulative } HI_{\text{receptor}} = \Sigma\, HI_{\text{route-specific}}$$

Separate doses/exposures and the resultant HIs are calculated for each receptor age group evaluated (i.e., young child, older child, or adult), since the averaging time over which noncancer effects are assessed is equivalent to the exposure duration, and thus these noncancer hazards are not summed across age groups (USEPA, 1989).

The cumulative HI for each receptor age group evaluated is then compared with a noncancer hazard threshold of unity (1), as per USEPA guidance (USEPA, 1991). If the HI for the RME condition is less than or equal to 1, then it is assumed that chemical concentrations of COPCs do not pose a risk of harm to human health, i.e., there is little concern that potential noncancer health effects will occur as a result of exposure, and that further response actions are not warranted. An HI greater than one indicates the potential for adverse effects. Where the cumulative HI exceeds one, route-specific HIs will be broken down by target organ, by summing the cumulative risks for each target organ or adverse effect.

3.4.2 Cancer Risk

The potential for carcinogenic health effects is characterized as the incremental lifetime cancer risk (ILCR). The ILCR represents the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogenic COPC and is calculated for carcinogenic constituents. For a given constituent, the ILCR is the product of the quantified exposure and the measure of carcinogenic potency (i.e., CSF or UR):

Oral and dermal pathways:

$$ILCR = LADD \times CSF$$

Inhalation pathways:

$$ILCR = LADE \times UR$$

The ILCR, which represents the probability of developing cancer related to potential exposures to carcinogenic COPCs evaluated in the risk assessment (distinct from the "background incidence" of cancer in the general population), is presented in scientific notation. For example, the ILCR of a specific chemical might be expressed as 1×10^{-6} or one in one million, which means that the probability of an individual developing cancer due to lifetime exposure to that potentially carcinogenic COPC is one in one million.

To account for exposures that a receptor may receive from multiple COPCs, the ILCRs for all COPCs are summed to calculate a route-specific ILCR. Analogous to the noncancer hazard index calculation described above, the cumulative ILCR for a receptor is then calculated by summing all of the route-specific ILCRs across relevant environmental media for each type of exposure, as demonstrated by the following equations:

$$\text{Total } ILCR_{\text{route-specific}} = \Sigma\ ILCR_{\text{COPC-specific}}$$

$$\text{Cumulative } ILCR_{\text{receptor}} = \Sigma\ ILCR_{\text{route-specific}}$$

Because cancer risk is expressed as a probability averaged over a lifetime of exposure, the cancer risks for each receptor age group evaluated within a scenario (i.e., child and adult) are added together to calculate a cumulative lifetime cancer risk.

The cumulative ILCR for a receptor is then compared to USEPA's upper bound cumulative receptor cancer risk threshold of 10^{-4} (USEPA, 1991). RME cancer risks that fall below this low-probability risk range are considered to be "*de minimis*" and essentially non-observable relative to the background incidence of being eventually diagnosed with cancer in a population (which for the United States is approximately 38.5% for men and women [National Institute of Health National Cancer Institute, 2018.[5]]). Remedial action is generally not warranted for cumulative cancer risks below 10^{-4} (USEPA, 1991). Cumulative cancer risks exceeding the upper end of the target USEPA ILCR range, however, may require a risk management decision point to determine if remedial action is warranted.

[5] https://seer.cancer.gov/statfacts/html/all.html

3.5 UNCERTAINTY ANALYSIS

As part of the HHRA, information is presented on the uncertainty associated with the risk characterization, including data gaps in toxicological or exposure assessment information and the conservative assumptions or scientific judgments used to bridge these data gaps. A discussion of the uncertainty and conservatism associated with the analytical results, risk assessment assumptions and input parameters will be provided in the HHRA.

4.0 ECOLOGICAL RISK ASSESSMENT

A SLERA will be conducted in accordance with USEPA and USACE guidance. The objective of the SLERA is to identify constituents and media that do *not* warrant further evaluation in a more comprehensive baseline ecological risk assessment (BERA). The effort is designed to eliminate constituents that present insignificant hazards while retaining for further study contaminants with concentrations that may have the potential to present a risk to ecological receptors.

This SLERA will follow both USEPA and USACE ecological risk assessment methodology, as presented in the following guidance documents:

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997b);
- Standard Scopes of Work for Environmental Risk Assessments. Engineer Pamphlet (EP) 200-1-15 (USACE, 2016);
- TSERAWG A Guide to Screening Level Ecological Risk Assessment, TF-090801 (TSERAWG, 2008);
- TSERAWG, no date. Selection of Assessment and Measurement Endpoints for Ecological Risk Assessments, TG-090802.

In accordance with this guidance, the assessment will be comprised of the following sections:

- Habitat Assessment;
- Problem Formulation;
- Risk Estimation;
- Risk Calculation;
- Summary and Conclusions;
- Uncertainty Analysis.

As appropriate, aspects of this assessment may be conducted separately for each of the four AOCs that are the subject of the RI (AOC 2, AOC 3N, AOC 3S and AOC FI). The specific activities associated with each of these sections are described below.

4.1 HABITAT ASSESSMENT

The habitat assessment will include a qualitative description of the location and type of different habitats, vegetation, and fauna observed at the Site. The SLERA will identify and describe the general terrestrial,

wetland and aquatic habitat types present on each of the four AOCs. Information about plants, soils, hydrology and habitat gathered from various field efforts will be used in the habitat assessment.

This section will also include the results of a review of publicly available records for the potential presence at or near the site of state- and federally-protected species as provided by the New York State Biodiversity Mapping system. The understanding of habitat type and quality will be used to identify potential receptors and assessment endpoints in the risk assessment.

4.2 PROBLEM FORMULATION

The purpose of the Problem Formulation is to determine the focus and scope of the SLERA by systematically identifying the stressors, the ecosystems potentially at risk, the potential ecological receptors, and the ecological effects to be evaluated. Components of the Problem Formulation consist of:

- The selection of constituents that will be included in the study;
- A description of complete and potentially complete exposure routes;
- Identification of known or potential ecological receptors;
- An ecological CSM, and, based on this model;
- The selection of specific assessment endpoints and measures of effects.

Methods for each of these are discussed separately in the following subsections.

4.2.1 Selection of Study Constituents

At this Site, stressors are the chemical constituents detected in sampled site media. The data used for the study will consist of the sampling data obtained from the RI and from prior investigations, as previously discussed in Section 2. All detected Site-related compounds will initially be considered as study constituents for evaluation in the SLERA. As described in Section 2, common, naturally-occurring earth metals (potassium, calcium, sodium, and magnesium) will not be included. Undetected compounds will not be quantitatively assessed in the SLERA but may be qualitatively evaluated in the Uncertainty Analysis (Section 4.6) if they are known Site contaminants with a complete migration pathway to the sampled media.

4.2.2 Exposure Pathways and Potential Receptors

Exposure pathways will be documented in the SLERA and will describe the pathways between contaminants and potential receptors at the Site. For soil, the shallow (0 to 1 feet bgs) soils are considered the relevant depth interval for the majority of ecological receptors, since this zone provides a growth medium for plants and invertebrates, and a potential exposure medium for other animals (birds, mammals, reptiles, and amphibians) though ingestion or trophic transfer. Exposure to subsurface soils (1-5 feet bgs) is most relevant to deep-rooted plants and burrowing animals.

Primary potential receptors in on-site waterbodies (stream and wetlands) include aquatic invertebrates and fish. Amphibians and reptiles, because of their reduced exposure to surface water relative to aquatic invertebrates and fish, are considered to be minor receptors. While amphibians and fish will not be quantitatively evaluated in the SLERA, potential risks to these receptors will be qualitatively discussed in the Uncertainty Analysis.

Figure 7 of the UFP-QAPP main document summarizes the preliminary ecological CSM. Once the RI data have been reviewed and the nature and extent of site-related contaminant distribution better understood, this CSM will be re-evaluated and updated, as needed. Figure 7 is provided as part of this Appendix as well.

4.2.3 Assessment Endpoints

Assessment endpoints will be confirmed following the RI, but based on the work to date at the site are expected to consist of the following, by media:

Soils:

- Survival and growth of terrestrial plants;
- Survival and growth of soil invertebrates;
- Survival, growth, and reproduction of birds;
- Survival, growth, and reproduction of mammals.

Surface Water and Sediment:

- Survival and growth of aquatic plants;
- Survival, growth, and reproduction of benthic invertebrates;
- Survival, growth and reproduction of fish.

As discussed, the potential effects on amphibians and reptiles, which have less exposure to the aquatic environment than fish and benthic invertebrates, will be considered as adequately assessed by the evaluation of fully aquatic receptors.

4.2.4 Measures of Exposure and Effect

Measures of exposure will be the measured concentrations of constituents in sampled site media. For the SLERA, the maximum value detected in discrete samples will be used as the exposure point concentration, in accordance with USEPA guidance (1997).

Measures of effect for this SLERA will consist of generic, conservative, and chemical-specific screening benchmarks associated with no or minimal adverse effects. For surface water, these will preferentially consist of promulgated or draft USEPA or New York State freshwater surface water quality criteria, if available. Values for other constituents and media will be obtained from the scientific literature, various state or federal standards or guidance, or from secondary sources where such values are commonly compiled, such as the USEPA Region 2, Region 3, Region 4, or Region 5 ecological screening value tables. USEPA's ecological soil screening levels (Eco-SSLs) will be used as the primary reference for screening constituents in soil. Primary sources will be used where available. Specific sources for each media are identified in Section 4.3. The receptor categories for the ecological screening benchmarks are generic in nature; individual wildlife receptor species and feeding guilds are not typically evaluated separately in this initial screening step. However, note that the protection of all feeding guilds is inherent in the EPA SSLs and other benchmarks that are used as wildlife benchmarks. In the development of those SSLs, EPA (and other agencies) evaluated several different types of receptors and trophic levels and used the lowest calculated screening level from among all receptors as the final benchmark. Thus, these screening benchmarks are considered to be protective of an array of wildlife receptors representing multiple trophic levels.

If necessary, exposure to higher trophic level receptors, such as birds and mammals, may be estimated for bioaccumulative compounds by calculating an ingested dose. For this effort, the representative receptors and exposure parameters used by USEPA in the development of Eco-SSLs may be used, unless other species are considered more representative of the site. Wildlife receptors used in this assessment will be selected following the habitat assessment, to ensure appropriate organisms are used for each trophic level.

4.3 RISK ESTIMATION

This section will present the specific data, methods and values by which exposure and effects will be estimated for each receptor.

Study data will be presented (or referenced, if presented elsewhere) along with summary data consisting of maximum and minimum detected, maximum and minimum reporting limits, frequency of detection, and, if appropriate, average and 95% UCL calculations.

Exposure of birds and mammals to bioaccumulating compounds may be estimated through the calculation of an ingested dose. If so, the equations for conducting this evaluation will be presented in this section, along with the toxicity reference values (TRVs) to which estimated doses will be compared.

Effects will be assessed using ecological benchmarks selected from among the following sources. These may be supplemented with values from other sources, as necessary and appropriate.

Soil Benchmark Sources:

- USEPA, 2003-2008. *Ecological Soil Screening Levels*. Office of Solid Waste and Emergency Response. <https://www.epa.gov/chemical-research/ecological-soil-screening-level> (See constituent-specific documents);
- USEPA Region 4, 2018. *Soil Screening Values*. Ecological Risk Assessment Supplemental Guidance;
- Efroymson, R.A., et al., 1997a. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision*. Oak Ridge National Laboratory, Oak Ridge, TN;
- Efroymson, R.A., et al., 1997b. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*. Oak Ridge National Laboratory, Oak Ridge, TN.

Surface Water Benchmark Sources:

- USEPA, 2021e. *National Recommended Water Quality Criteria* (aquatic life criteria). Office of Water, Washington, D.C.;
- NYSDEC, 1998. *Surface Water Quality Standards (6 New York Codes, Rules and Regulations [NYCRR] Part 703) and Guidance Values (Technical and Operational Guidance Series [TOGS] 1.1.1)*, June;
- USEPA Region 4, 2018. *Region 4 Freshwater Surface Water Screening Values for Hazardous Waste Sites*, March 2018 Update;
- Suter, G.W. and C.L. Tsao, 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*. Oak Ridge National Laboratory;
- USEPA Region 3, 2006. *Freshwater Screening Benchmarks*.

Sediment Benchmark Sources:

- MacDonald, D.D. et al, 2000. *Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems*. Arch. Environ. Contam. Toxicol. 39, 20-31;
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- USEPA Region 4, 2018. *Freshwater Ecological Screening Values*;
- USEPA Region 3, 2006. Freshwater Sediment Screening Benchmarks.

Wildlife Toxicity Reference Value Sources:

- USEPA, 2005-2008. *Ecological Soil Screening Levels*, OSWER Directive 9285.7;
- Sample, B.E. et al., 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. Oak Ridge National Laboratory, ES/ER/TM-86/R3;
- Scientific literature.

4.4 RISK CALCULATION

In this section, the exposure data (maxima of site data or calculated doses) and effects data (benchmarks or TRVs) will be compared to produce an estimate of the potential for risk to the receptors designated as assessment endpoints. Media concentrations relative to a benchmark or TRV will be expressed as a HQ, which is calculated as follows:

$$HQ = \frac{\text{Exposure concentration or Exposure Dose}}{\text{Ecological benchmark or TRV}}$$

A maximum HQ of less than or equal to 1.0 will be interpreted to mean that all concentrations are below the threshold levels for potential adverse effects and that risks are likely to be negligible. These constituents will not be retained for further evaluation. An HQ greater than 1.0 suggests that exposures may potentially be associated with adverse effects and that further evaluation of these constituents is warranted. Constituents with a maximum HQ greater than 1.0 will be retained for further evaluation.

At the end of this section, a table will be presented explicitly identifying which study constituents exceed benchmarks and which are not associated with potential risk. These constituents will be designated as preliminary chemicals of potential ecological concern (P-COPECs). This section will formally conclude the SLERA phase of the assessment, as required by USEPA (1997b).

4.5 REFINEMENT STEP AND SELECTION OF COPECS

The SLERA is an intentionally conservative tool to rule out constituents that pose minimal potential for ecological risk. However, because of this conservatism, it is helpful to refine some exposure and toxicity criteria that were used in the SLERA to include more reasonable or realistic parameters, to better assist in understanding ecological risk potential and focusing future field efforts to those constituents that may actually pose a risk to ecological receptors. The goal of this analysis is to reduce the uncertainty associated with the use of conservative exposure and screening-level toxicity assumptions so that the final risk conclusions are still conservative, but more relevant to site-specific conditions and actual levels of effect. From a practical standpoint, the goal of the refinement is to obtain as complete an understanding of site risks as possible without conducting site-specific ecological tests, such as toxicity, food chain or bioaccumulation studies. This refinement step will therefore be used to further evaluate any constituents that are identified as warranting further assessment under the SLERA, and to select the chemicals of potential ecological concern (COPECs) that would be evaluated in a BERA.

In the refinement, each constituent that exceeded benchmarks in the SLERA will be evaluated further by considering additional toxicity data and site-specific information, including:

- *Magnitude of SLERA benchmark Exceedances*: For many constituents, exceedances of the benchmark by factors of two or three or more may still not reflect a potential risk, because of the conservatism of the assumptions used to develop the benchmark. Magnitude and location of any benchmark exceedances will be evaluated;
- *Comparison to Lowest-Observed-Effect Levels:* In this section, an evaluation will be conducted that compares site data to values associated with the actual onset of effects, or a high probability of effects. These values will include lowest observed effect levels (LOELs) or concentrations (LOECs) as obtained from the literature sources described above or others as necessary. As opposed to the no-effect values used as benchmarks, these low-effect values define a level where effects are more likely or, in toxicological tests, where effects were actually detected. The actual onset of effects occurs somewhere between the no-effect level and the LOEL, so this comparison provides helps to bound the risk estimate and thus provides important information about the actual potential for effect. USEPA guidance (1997) specifies that cleanup levels should be based on low-effect values, rather than screening values. HQs will be generated based on effect-level values, and will be termed EL-HQs;
- *Use of Average Site Data*: For this analysis, the arithmetic average site concentration, rather than the 95% UCL, will be compared to Refined SLERA screening values, particularly for mammals and birds which roam freely across and between the study areas;
- Comparison to Background: Some constituents, such as metals, have multiple potential sources, including naturally occurring or anthropogenic background sources, and may not be present from site operations. Constituents identified as consistent with background conditions (see Section 3.1.4) will be ruled out as COPECs, consistent with the approach used in the HHRA;
- *Comparison to Other Site Media*: Since the goal of corrective measures at this Site is to address contamination resulting from DOD-related activities at the AOCs, constituents will be reviewed for potential associations with source area media or historical operations;
- *Refinement of Wildlife Exposure Models.* Wildlife exposure models will be reevaluated and modified, as warranted, to better reflect Site-specific conditions. The Refinement may include modifications to assumptions of bioavailability of a constituent; area usage factors, food consumption rates and other life history factors; low effects-based toxicity values; and a use of arithmetic mean exposure point concentrations.

  In the Refinement, an EL-HQ of less than 1.0 indicates that the concentration is below that conservatively associated with the onset of adverse effects and will be interpreted to mean that the potential for significant risk, while present, is relatively low. An EL-HQ equal to or in excess of 1.0 will be interpreted to mean that exposures are in the estimated range of potential effects and that further evaluation of these constituents may be warranted.

The results of these evaluations will be considered together to reach a final assessment of the potential for ecological risk and the need for a BERA. Constituents associated with a potential for risk after this step will be designated as COPECs.

4.6 SLERA UNCERTAINTY ANALYSIS

Ecological risk assessments are subject to a wide variety of uncertainties as the result of both the assumptions used to describe site conditions and receptor exposure, as well as the natural variability in receptor behavior and toxicological response. This section will consist of a systematic review of the assumptions and uncertainties associated with the methodology and data used to complete the study. Assumptions or limitations that underlie the conclusions of the SLERA and Refinement steps will be identified, and the direction of the bias associated with each assumption will be described.

4.7 SUMMARY AND CONCLUSIONS

A summary of the SLERA and Refinement findings, and any recommendations for future evaluation, will be presented in this section. The conclusions section will include a statement about which COPECs and pathways will be eliminated from further consideration and which require either more sampling or further toxicological assessment in a BERA. Each AOC will be considered separately, and separate conclusions will be drawn for each evaluated receptor. Any data gaps and additional sampling needs will be identified in general terms, but with sufficient detail to support the development of a subsequent BERA work plan, if necessary.

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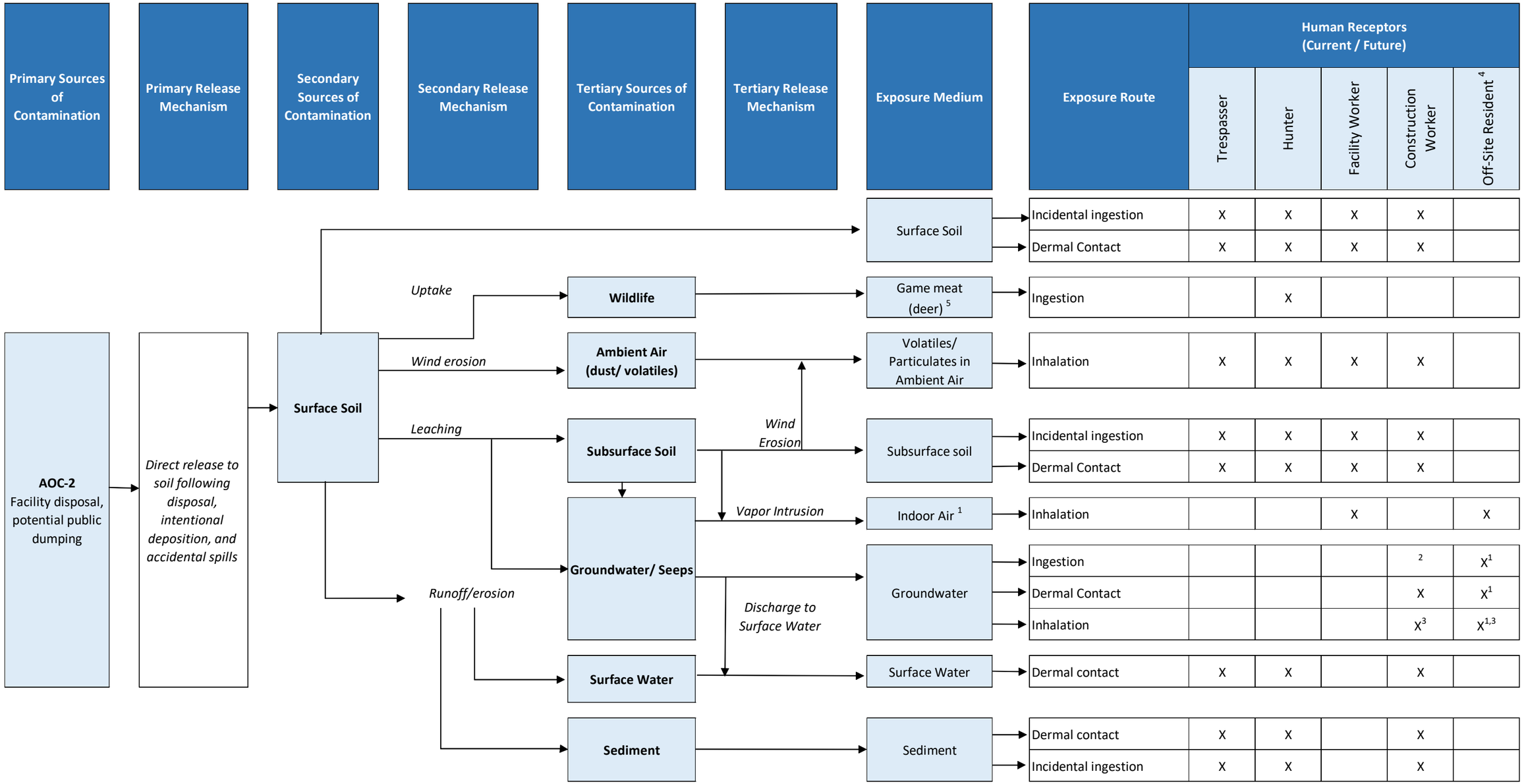
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FIGURES



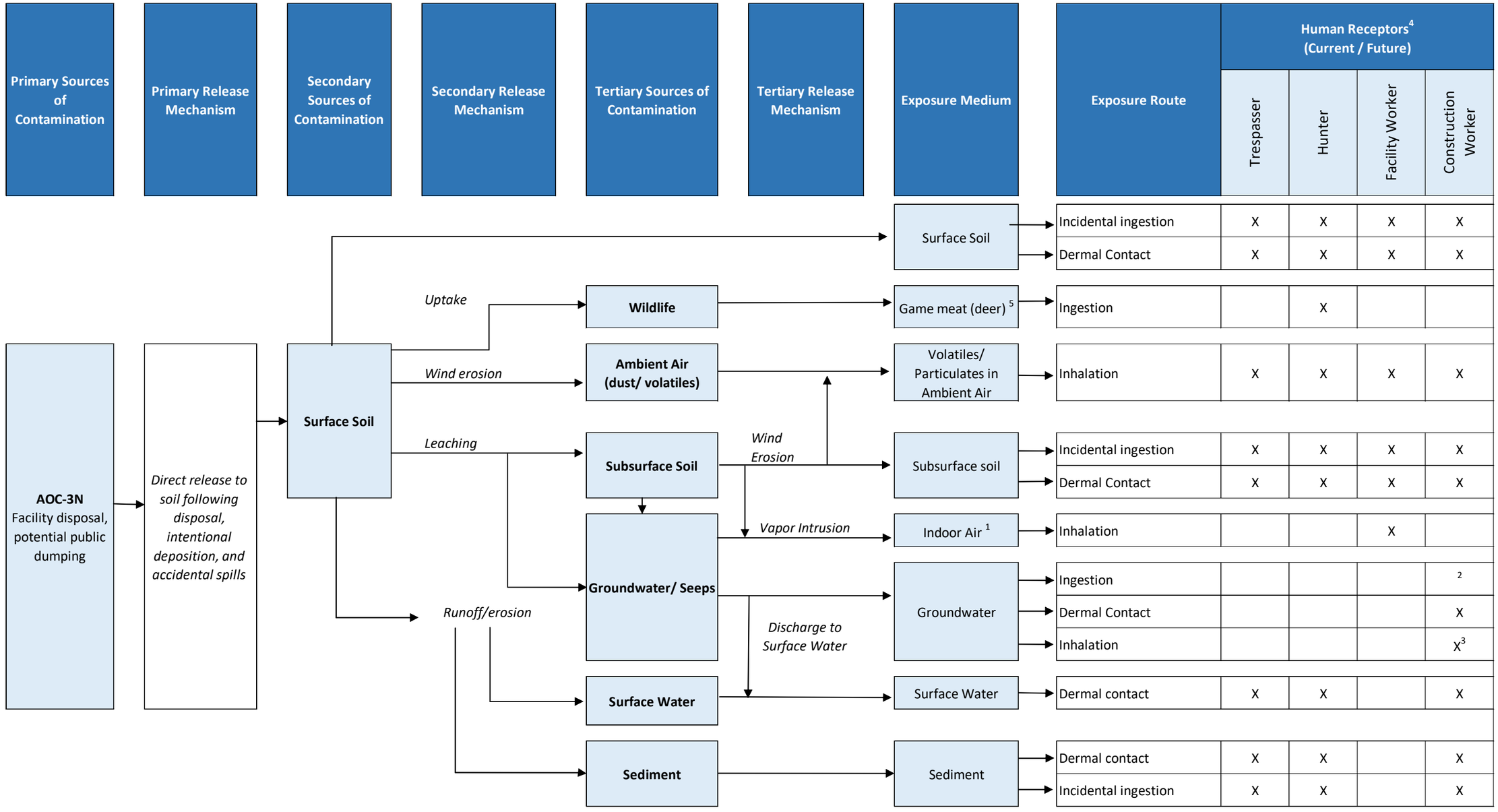
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media.
3. Inhalation routes for groundwater: Construction workers may inhale VOCs from standing water within an excavation pit/trench, whereas off-site residents may inhale VOCs during showering/bathing.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes are considered incomplete at this stage. Complete or potentially complete exposure routes for indoor air and groundwater are applicable to off-site residents.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6A

Preliminary Human Health Conceptual Site Model for AOC-2 (Former Southern Landfill)

Former Stewart Air Force Base, New York

Aug 2022



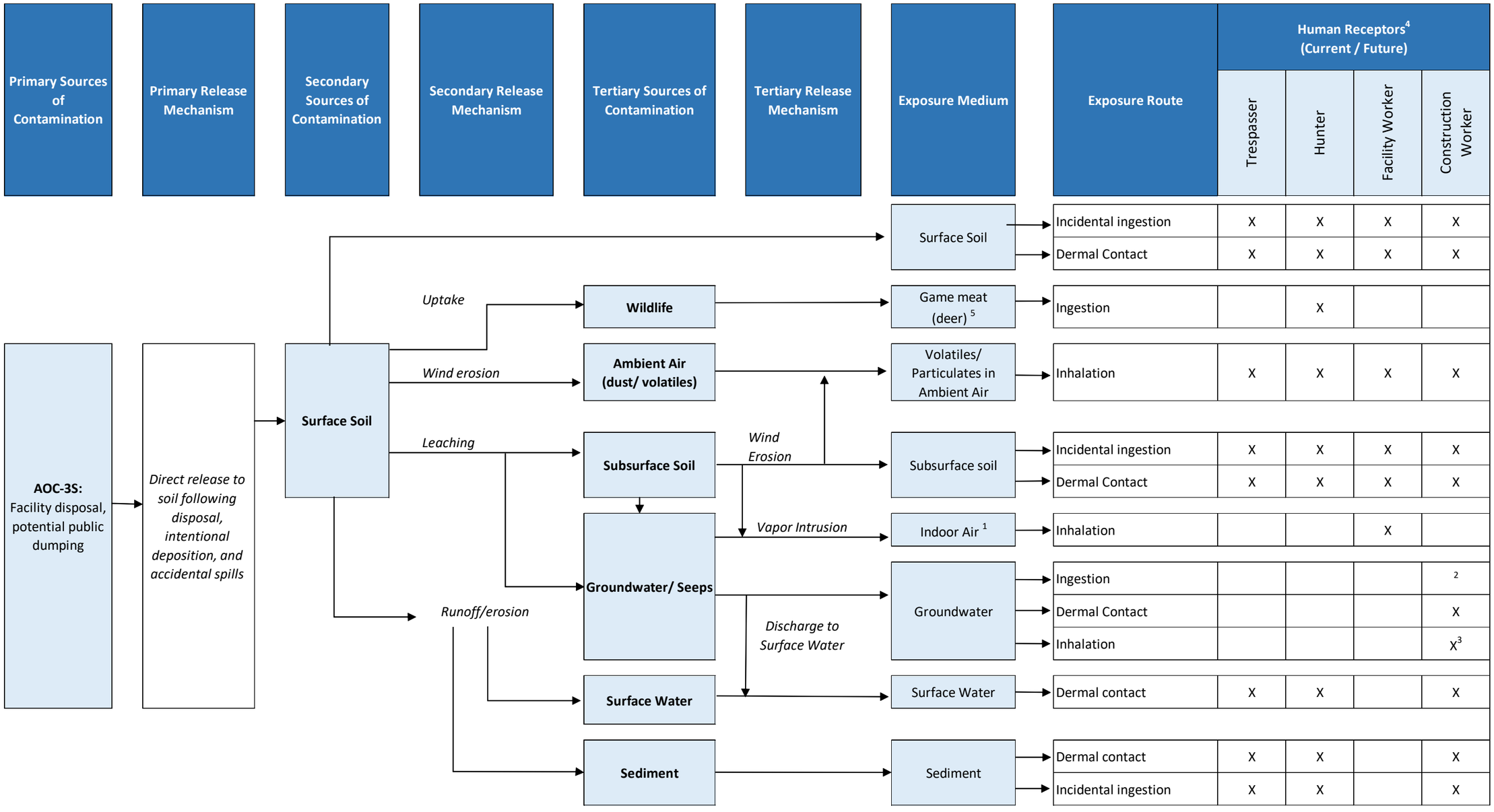
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media .
3. Construction workers may inhale VOCs from standing water within an excavation pit/trench.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes are considered incomplete at this stage.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6B

Preliminary Human Health Conceptual Site Model for AOC-3N (Debris Area)

Former Stewart Air Force Base, New York

Aug 2022



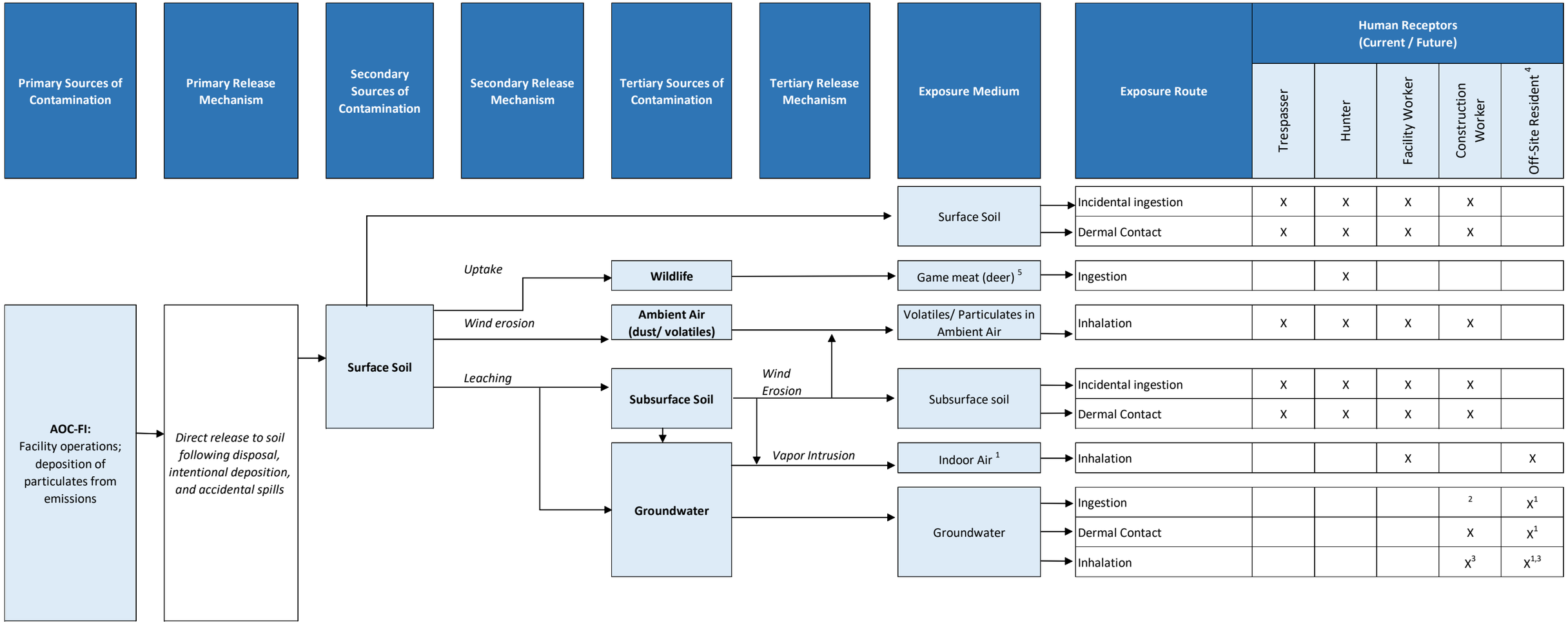
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media.
3. Construction workers may inhale VOCs from standing water within an excavation pit/trench.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes are considered incomplete at this stage.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6C

Preliminary Human Health Conceptual Site Model for AOC-3S (Unsuitable Fill Area)

Former Stewart Air Force Base, New York

Aug 2022



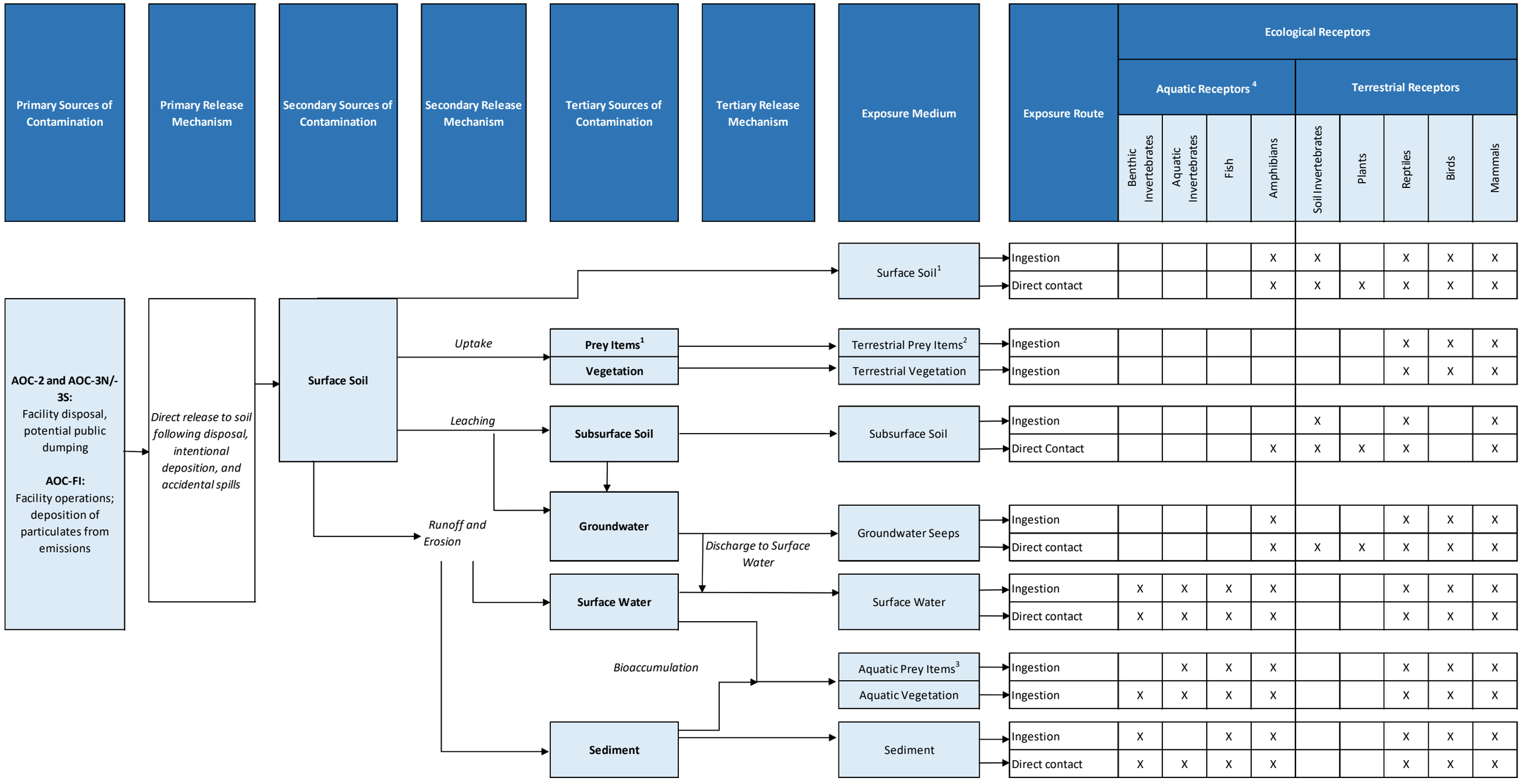
NOTES:
AOC = Area of Concern
X = Assumed to be complete/potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
VOCs = Volatile Organic Compounds
1. Tentative exposure medium and/or exposure route, pending review of groundwater data and private well survey.
2. It is not anticipated that a construction worker would ingest groundwater or surface water during typical excavation/construction activities; therefore, incidental ingestion is not considered a complete exposure pathway for these media .
3. Inhalation routes for groundwater: Construction workers may inhale VOCs from standing water within an excavation pit/trench, whereas off-site residents may inhale VOCs during showering/bathing.
4. No portion of the Site is used for residential purposes, and all future redevelopment included in the master plan for the Stewart International Airport consists of aviation-related projects such as hangars, office space, fuel farm, and aircraft and vehicle parking. Therefore, residential use of the Site is not reasonably anticipated, and soil exposure routes for a resident receptor are considered incomplete at this stage. Complete or potentially complete exposure routes for indoor air and groundwater are applicable to off-site residents.
5. Game meat (obtained via deer hunting) contaminant concentrations will be estimated from soil concentrations using a bioaccumulation model. See Section 3.2.3.3 of Appendix A for further discussion.

FIGURE 6D

Preliminary Human Health Conceptual Site Model for AOC-FI (Former Incinerator)

Former Stewart Air Force Base, New York

Aug 2022



NOTES:
AOC = Area of Concern
X = Assumed to be complete or potentially complete exposure route. Blank cells indicate the exposure route is presumed incomplete at this stage, but may be revised based on remedial investigation results.
1. Includes moist wetland soils
2. Prey items may consist of invertebrates, birds, mammals, fish, amphibians and reptiles
3. Prey items may consist of invertebrates, amphibians, and small fish.
4. Includes invertebrate and amphibian species associated with the vernal pools identified at the Site.

FIGURE 7

Preliminary Ecological Conceptual Site Model

Former Stewart Air Force Base, New York

Apr 2022

TABLES

TABLE 1.1
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust and volatiles	Outdoor Maintenance Worker Adult	AOC-2	IR_{soil}	Ingestion rate of soil	50	mg/day	USEPA, 2017	1
			AF_{soil}	Soil adherence factor	0.12	mg/cm^2	USEPA 2014	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	152	days/yr	Professional judgment	4
			ED	Exposure Duration	25	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	4	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	0.5	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2021	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	Professional judgment	11
			AT_{nc}	Averaging Time - noncancer	25	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 1.1 Notes:

1. Soil ingestion rate (IR) is the general population upper percentile soil ingestion rate for an adult in Table 5-1 of USEPA 2017.
2. The soil adherence factor (AFsoil) is the USEPA default soil adherence factor for an adult worker (USEPA 2014).
3. The skin surface area is the EPA-recommended default SA for the adult worker (USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a outdoor worker would be present 5 days per week for the 7 non-winter months (April - October).
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the default exposure duration for an outdoor worker (USEPA 2014).
6. The exposure time (ET) is the amount of time spent outdoors. An ET of 4 hours per day was selected based on professional judgment.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that an outdoor worker would be exposed to half of the daily dose when at the site.
8. The body weight for the adult is the recommended default body weight in USEPA 2014.
9. PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e. See Table 4.3.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. EPCs will be calculated in accordance with USEPA guidance (USEPA 1989).

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
USEPA 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
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TABLE 1.2
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust and volatiles	Outdoor Maintenance Worker Adult	AOC-2	IR_{soil}	Ingestion rate of soil	10	mg/day	USEPA, 2017	1
			AF_{soil}	Soil adherence factor	0.02	mg/cm^2	USEPA 2004	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	30	days/yr	USEPA 2014	4
			ED	Exposure Duration	7.2	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	2	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	0.25	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2021	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	7.2	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 1.2 Notes:

1. Soil ingestion rate (IR) is the general population central tendency soil ingestion rate for an adult in Table 5-1 of USEPA 2017.
2. The soil adherence factor (AFsoil) is the geometric mean weighted soil AF for a groundskeeper (commercial/industrial adult), presented in Exhibit 3-3 of USEPA 2004.
3. The skin surface area is the EPA-recommended default SA for the adult worker (USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a outdoor worker would be present 1 day per week for the 7 non-winter months (April - October).
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the median tenure for full time employees, all individuals, in Table 16-105 of USEPA 2011.
6. The exposure time (ET) is the amount of time spent outdoors. It was assumed that an outdoor worker would spend 2 hours performing mowing or lawn maintenance activities.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that an outdoor worker would be exposed to a quarter of the full daily dose when at the site.
8. The body weight for the adult is the recommended default body weight in USEPA 2014.
9. PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e. See Table 4.3.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. EPCs will be calculated in accordance with USEPA guidance (USEPA 1989).

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
USEPA 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
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USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

TABLE 2.1
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust and volatiles	Construction/Utility Worker Adult	Area C of AOC-2	IR_{soil}	Ingestion rate of soil	330	mg/day	USEPA 2002	1
			AF_{soil}	Soil adherence factor	0.3	mg/cm^2	USEPA 2002	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	130	days/yr	Professional judgment	4
			ED	Exposure Duration	1	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	8	hours/event	USEPA 2014	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2014	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	1	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 2.1 Notes:

1. Soil ingestion rate (IR) is the EPA recommended soil ingestion rate for a construction worker as cited in Exhibit 5-1 of USEPA, 2002.
2. The soil adherence factor (AF) is the EPA recommended default exposure factor for a construction worker as cited in Exhibit 5-1 of USEPA 2002.
3. The skin surface area (SA) is the EPA recommended default exposure factor for an adult worker (USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a construction/utility worker would be performing activities for 5 days per week for 6 months out of the year.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. It was assumed the construction/utility worker would perform work over a one year period.
6. The exposure time (ET) is the amount of time spent outdoors. The ET is the USEPA recommended default exposure factor for a outdoor worker of 8 hours, from USEPA 2014.
7. Fraction soil contact (FS) is reflective of the daily dose of soil. It was assumed that an adult worker would be exposed to the full daily dose when at the site.
8. The EPA-recommended body weight (BW) for an adult in USEPA 2014.
9. PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be calculated in accordance with USEPA 2019.
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPCs will be calculated in accordance with USEPA guidance (USEPA 1989)

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2012. Recommendations for the Default Value for Relative Bioavailability of Arsenic in Soil. December 2012. OSWER Directive 9200.1-113.
USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Solid Waste and Emergency Response. OSWER 9355.4-24. December.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

TABLE 2.2
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust and volatiles	Construction/Utility Worker Adult	Area C of AOC-2	IR_{soil}	Ingestion rate of soil	330	mg/day	USEPA 2002	1
			AF_{soil}	Soil adherence factor	0.10	mg/cm^2	USEPA 2002	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	20	days/yr	Professional judgment	4
			ED	Exposure Duration	1	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	8	hours/event	USEPA 2014	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2014	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	1	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 2.2 Notes:

1. Soil ingestion rate (IR) is the EPA recommended soil ingestion rate for a construction worker as cited in Exhibit 5-1 of USEPA, 2002.
2. The soil adherence factor (AF) is the median weighted AF for a construction worker as cited in Exhibit 3-3 of USEPA 2004.
3. The skin surface area (SA) is the EPA recommended default exposure factor for an adult worker (USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a construction/utility worker would be performing activities for 5 days per wek for 4 weeks out of the year.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. It was assumed the construction/utility worker would perform work over a one year period.
6. The exposure time (ET) is the amount of time spent outdoors. The ET is the USEPA recommended default exposure factor for a outdoor worker of 8 hours, from USEPA 2014.
7. Fraction soil contact (FS) is reflective of the daily dose of soil. It was assumed that an adult worker would be exposed to the full daily dose when at the site.
8. The EPA-recommended body weight (BW) for an adult in USEPA 2014.
9. PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be calculated in accordance with USEPA 2019.
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPCs will be calculated in accordance with USEPA guidance (USEPA 1989)

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.

USEPA 2012. Recommendations for the Default Value for Relative Bioavailability of Arsenic in Soil. December 2012. OSWER Directive 9200.1-113.

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USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Solid Waste and Emergency Response. OSWER 9355.4-24. December.

USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Table 2.3
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Shallow Groundwater

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact, inhalation of volatiles in ambient air	Construction/Utility Worker Adult	Area C of AOC-2	EPC_{gw}	Exposure Point Concentration - Groundwater	Chemical-specific	mg/L	Calculated	1
			EPC_a	Exposure Point Concentration - Air	Chemical-specific	mg/m^3	Calculated	1
			EF_{gw}	Exposure Frequency - Groundwater	52	days/year	Professional judgment	2
			EF_a	Exposure Frequency - Air	130	days/year	Professional judgment	2
			ET_a	Exposure Time - Air	8	hours/day	USEPA 2014	3
			t_e	Exposure time - Groundwater	0.5	hours/event	Professional judgment	3
			ED	Exposure Duration	1	years	Professional judgment	4
			BW	Body weight	80	kg	USEPA 2014	5
			SA	Skin surface area	3,527	cm^2	USEPA 2014	6
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	7
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	7
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	7
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	7
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	7
			EV	Event Frequency	1	events/day	USEPA 1989	8
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	9
			AT_{nc}	Averaging Time-noncancer	1	years	USEPA 1989	10

Average Daily Intake (ADI) Equations:

ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

$ADI_{inhalation}$ (mg/m^3) = EPC * ET * EF * ED * 1/AT * 1/C1 * 1/C3

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless]}

(short-duration exposures)

and DA_{event} (mg/cm2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) * EPC (mg/L) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3 C3=24 hours/day

Table 2.3 Notes:

1. Groundwater EPCs will be calculated in accordance with USEPA guidance (USEPA 1989)
   Ambient air EPCs will be estimated from groundwater data using an air emissions model (USEPA, 1990)

2. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a construction/utility worker would be exposed to trench air 5 days per week, and exposed to groundwater 2 days per week for 6 months out of one year while setting up and dismantling dewatering equipment.

3. The exposure time (ET) is the amount of time spent outdoors. The ET is the USEPA recommended default exposure factor for a outdoor worker of 8 hours, from USEPA 2014. The exposure time for groundwater was assumed to be 1/2 hour for each event while setting up and dismantling dewatering equipment.

4. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. It was assumed the construction/utility worker would perform work for one year.

5. The EPA-recommended body weight (BW) for an adult in USEPA 2014.

6. The skin surface area (SA) is the EPA recommended default exposure factor for a worker in USEPA 2014.

7. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

8. Event frequency (EV) describes how many "events" occur for each day of exposure. For all receptors, it was assumed that one event would occur on each day of exposure as recommended by USEPA 1989.

9. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.

10. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.

References:

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).
U.S. EPA. 1990. Estimation of Baseline Air Emissions at Superfund Sites. Report ASF 2a. Office of Air Quality. August.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.

Table 2.4
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Shallow Groundwater

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact, inhalation of volatiles in ambient air	Construction/Utility Worker Adult	Area C of AOC-2	EPC_{gw}	Exposure Point Concentration - Groundwater	Chemical-specific	mg/L	Calculated	1
			EPC_a	Exposure Point Concentration - Air	Chemical-specific	mg/m^3	Calculated	1
			EF_{gw}	Exposure Frequency - Groundwater	8	days/year	Professional judgment	2
			EF_a	Exposure Frequency - Air	20	days/year	Professional judgment	2
			ET_a	Exposure Time - Air	8	hours/day	USEPA 2014	3
			t_e	Exposure time - Groundwater	0.5	hours/event	Professional judgment	3
			ED	Exposure Duration	1	years	Professional judgment	4
			BW	Body weight	80	kg	USEPA 2014	5
			SA	Skin surface area	3,527	cm^2	USEPA 2014	6
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	7
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	7
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	7
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	7
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	7
			EV	Event Frequency	1	events/day	USEPA 1989	8
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	9
			AT_{nc}	Averaging Time-noncancer	1	years	USEPA 1989	10

Average Daily Intake (ADI) Equations:

ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

$ADI_{inhalation}$ (mg/m^3) = EPC * ET * EF * ED * 1/AT * 1/C1 * 1/C3

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless]}

(short-duration exposures)

and DA_{event} (mg/cm2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) * EPC (mg/L) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3 C3=24 hours/day

Table 2.4 Notes:

1. Groundwater EPCs will be calculated in accordance with USEPA guidance (USEPA 1989)
   Ambient air EPCs will be estimated from groundwater data using an air emmissions model (USEPA, 1990)

2. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a construction/utility worker would be exposed to trench air 5 days per week, and exposed to groundwater 2 days per week for 4 weeks out of one year while setting up and dismantling dewatering equipment.

3. The exposure time (ET) is the amount of time spent outdoors. The ET is the USEPA recommended default exposure factor for a outdoor worker of 8 hours, from USEPA 2014. The exposure time for groundwater was assumed to be 1/2 hour for each event while setting up and dismantling dewatering equipment.

4. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. It was assumed the construction/utility worker would perform work for one year.

5. The EPA-recommended body weight (BW) for an adult in USEPA 2014.

6. The skin surface area (SA) is the EPA recommended default exposure factor for a worker in USEPA 2014.

7. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

8. Event frequency (EV) describes how many "events" occur for each day of exposure. For all receptors, it was assumed that one event would occur on each day of exposure as recommended by USEPA 1989.

9. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.

10. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.

References:

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).
U.S. EPA. 1990. Estimation of Baseline Air Emissions at Superfund Sites. Report ASF 2a. Office of Air Quality. August.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.

Table 3.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Potable Groundwater

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion of and dermal contact with with potable water and Inhalation of volatiles while showering/bathing	Resident Child (0<6 years)	Current and Future Residences	EPC_{gw}	Exposure Point Concentration - Groundwater	Chemical-specific	mg/L	Calculated	1
			EPC_a	Exposure Point Concentration - Shower Air	Chemical-specific	mg/m^3	Calculated	1
			IR_s	Ingestion rate of drinking water	0.86	L/day	USEPA 2019	2
			EF	Exposure Frequency	350	days/year	USEPA 2014	3
			ED	Exposure Duration	6	years	USEPA 2014	4
			BW	Body weight	15	kg	USEPA 2014	5
			SA	Skin surface area	6365	cm^2	USEPA 2014	6
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	7
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	7
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	7
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	7
			t_e	Event duration	0.54	hours/event	USEPA 2014	8
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	7
			EV	Event Frequency	1	events/day	USEPA 1989	9
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	10
			AT_{nc}	Averaging Time-noncancer	6	years	USEPA 1989	11
			C1	Units Conversion Factor	365	days/year	Constant	
			C2	Units Conversion Factor	0.001	L/cm^3	Constant	

Table 3.1
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Potable Groundwater

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion of and dermal contact with with potable water and Inhalation of volatiles while showering/bathing	Resident Adult	Current and Future Residences	EPC_{gw}	Exposure Point Concentration	Chemical-specific	mg/L	Calculated	1
			EPC_a	Exposure Point Concentration - Shower Air	Chemical-specific	mg/m3	Calculated	1
			IR_s	Ingestion rate of drinking water	3.2	L/day	USEPA 2019	2
			EF	Exposure Frequency	350	days/year	USEPA 2014	3
			ED	Exposure Duration	20	years	USEPA 2014	4
			BW	Body weight	80	kg	USEPA 2014	5
			SA	Skin surface area	19652	cm^2	USEPA 2014	6
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	7
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	7
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	7
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	7
			t_e	Event duration	0.71	hours/event	USEPA 2014	8
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	7
			EV	Event Frequency	1	events/day	USEPA 1989	9
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	10
			AT_{nc}	Averaging Time-noncancer	20	years	USEPA 1989	11

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1

ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

$ADI_{inhalation\text{-}shower}$ (mg/m^3) = EPC * EF * ED * 1/AT * 1/C3

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless])}

(short-duration exposures)

and DA_{event} (mg/cm2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) * EPC (mg/L) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3 C3 = 365 days/year

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion Intake = EPC * IR * EF * ED * ADAF *1/BW * 1/AT * 1/CF1
Dermal Contact Intake = SA * DAe * EV * EF * ED * ADAF *1/BW * 1/AT *1/CF1
Inhalation of Volatiles Intake = EPC * EF * ED * ADAF * 1/AT * 1/C3

Table 3.1 Notes:

1. EPCs will be calculated in accordance with USEPA guidance (USEPA 1989).
   Shower room air concentrations will be estimated from groundwater EPCs using the Foster & Chrostowski Shower Model (1987).

2. Ingestion rates are the age weighted 95th percentile ingestion rates for the child (0-6 years) and the adult (>21 years) in Table 3-1 of USEPA 2019 ("Consumer-Only").

3. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency is the EPA-recommended value for residential scenarios (USEPA, 2014).

4. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. ED values reflect a 26 year residential tenure, which is the current EPA-recommended value for residence time (USEPA 2014).

5. The body weights for the child and adult resident are the recommended default body weights in Attachment 1 of USEPA 2014.

6. SA values are the EPA-recommended SAs for residential water exposures (USEPA 2014).

7. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

8. Event durations are the USEPA-recommended values for adult and child resident water exposure time, as cited in USEPA 2014.

9. Event frequency (EV) describes how many "events" occur for each day of exposure. For all receptors, it was assumed that one event would occur on each day of exposure as recommended by USEPA 1989.

10. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.

11. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.

References:

Foster, S. A., and P. C. Chrostowski, 1987. Inhalation of Volatile Organic Contaminants in the Shower. The Association Dedicated to Air Pollution Control and Hazardous Waste Management (APCA); 20 pp. For presentation at the Annual APCA Meeting, New York, New York, June 21-26.

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USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.

USEPA 2019. Update for Chapter 3 of the Exposure Factors Handbook. Ingestion of Water and Other Select Liquids. Office of Research and Development. February.

Table 3.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current / Future
Medium:	Groundwater
Exposure Medium:	Potable Groundwater

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion of and dermal contact with with potable water and Inhalation of volatiles while showering/bathing	Resident Child (0<6 years)	Current and Future Residences	EPC_{gw}	Exposure Point Concentration - Groundwater	Chemical-specific	mg/L	Calculated	1
			EPC_a	Exposure Point Concentration - Shower Air	Chemical-specific	mg/m^3	Calculated	1
			IR_s	Ingestion rate of drinking water	0.36	L/day	USEPA 2019	2
			EF	Exposure Frequency	350	days/year	USEPA 2014	3
			ED	Exposure Duration	6	years	USEPA 2011	4
			BW	Body weight	15	kg	USEPA 2014	5
			SA	Skin surface area	6365	cm^2	USEPA 2014	6
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	7
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	7
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	7
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	7
			t_e	Event duration	0.54	hours/event	USEPA 2014	8
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	7
			EV	Event Frequency	1	events/day	USEPA 1989	9
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	10
			AT_{nc}	Averaging Time-noncancer	6	years	USEPA 1989	11
			C1	Units Conversion Factor	365	days/year	Constant	
			C2	Units Conversion Factor	0.001	L/cm^3	Constant	

Table 3.2
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current / Future
Medium:	Groundwater
Exposure Medium:	Potable Groundwater

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion of and dermal contact with with potable water and Inhalation of volatiles while showering/bathing	Resident Adult	Current and Future Residences	EPC_{gw}	Exposure Point Concentration	Chemical-specific	mg/L	Calculated	1
			EPC_a	Exposure Point Concentration - Shower Air	Chemical-specific	mg/m^3	Calculated	1
			IR_s	Ingestion rate of drinking water	1.3	L/day	USEPA 2019	2
			EF	Exposure Frequency	350	days/year	USEPA 2014	3
			ED	Exposure Duration	3	years	USEPA 2011	4
			BW	Body weight	80	kg	USEPA 2014	5
			SA	Skin surface area	19652	cm^2	USEPA 2014	6
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	7
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	7
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	7
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	7
			t_e	Event duration	0.71	hours/event	USEPA 2014	8
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	7
			EV	Event Frequency	1	events/day	USEPA 1989	9
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	10
			AT_{nc}	Averaging Time-noncancer	3	years	USEPA 1989	11

Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC * IR * EF * ED * 1/BW * 1/AT * 1/C1

ADI_{dermal} (mg/kg-d) = DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1

$ADI_{inhalation\text{-}shower}$ (mg/m^3) = EPC * EF * ED * 1/AT * 1/C3

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (mg/cm^2-event) = EPC (mg/L) * 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless])}

(short-duration exposures)

and DA_{event} (mg/cm2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) * EPC (mg/L) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3 C3 = 365 days/year

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion Intake = EPC * IR * EF * ED * ADAF *1/BW * 1/AT * 1/CF1
Dermal Contact Intake = SA * DAe * EV * EF * ED * ADAF *1/BW * 1/AT *1/CF1
Inhalation of Volatiles Intake = EPC * EF * ED * ADAF * 1/AT * 1/C3

Table 3.2 Notes:

1. EPCs will be calculated in accordance with USEPA guidance (USEPA 1989).
   Shower room air concentrations will be estimated from groundwater EPCs using the Foster & Chrostowski Shower Model (1987)

2. Ingestion rates are the age weighted 50th percentile ingestion rates for the child (0-6 years) and the adult (>21 years) in Table 3-1 of USEPA 2019

3. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency is the EPA-recommended value for residential scenarios (USEPA, 2014)

4. Exposure duration for residents reflects a total 9 year residential tenure, which is the 50th percentile tenure cited in Table 16-108 for USEPA 2011. The ED for the adult is the total residence time (9 years) minus the child ED (6 years).

5. The body weights for the child and adult resident are the recommended default body weights in Attachment 1 of USEPA 2014

6. SA values are the EPA-recommended SAs for residential water exposures (USEPA 2014).

7. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

8. Event durations are the USEPA-recommended values for adult and child resident water exposure time, as cited in USEPA 2014.

9. Event frequency (EV) describes how many "events" occur for each day of exposure. For all receptors, it was assumed that one event would occur on each day of exposure as recommended by USEPA 198

10. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.

11. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.

References:

Foster, S. A., and P. C. Chrostowski, 1987. Inhalation of Volatile Organic Contaminants in the Shower. The Association Dedicated to Air Pollution Control and Hazardous Waste Management (APCA); 20 pp. For presentation at the Annual APCA Meeting, New York, New York, June 21-26.

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).

USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.

USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.

USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.

Table 3.3
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Source Medium:	Groundwater
Exposure Medium:	Indoor Air

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation of Volatiles via vapor intrusion	Resident Child (0<6 years)	Current and Future Residences	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Calculated	1
			EF	Exposure Frequency	350	days/year	USEPA, 2014	2
			ET	Exposure Time	24	hours/day	USEPA, 2014	3
			ED	Exposure Duration	6	years	USEPA, 2014	3
			AT_c	Averaging Time-cancer	70	years	USEPA, 1989	4
			AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	5
			C1	Units Conversion Factor	365	days/year	Constant	
			C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Volatiles via vapor intrusion	Resident Adult	Current and Future Residences	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Calculated	1
			EF	Exposure Frequency	350	days/year	USEPA, 2014	2
			ET	Exposure Time	24	hours/day	USEPA, 2014	3
			ED	Exposure Duration	20	years	USEPA, 2014	4
			AT_c	Averaging Time-cancer	70	years	USEPA, 1989	5
			AT_{nc}	Averaging Time-noncancer	20	years	USEPA, 1989	6
			C1	Units Conversion Factor	365	days/year	Constant	
			C2	Units Conversion Factor	24	hours/day	Constant	

Average Daily Exposure (ADE) Equation:

$ADI_{inhalation\text{-}shower}$ (mg/m^3) = EPC * EF * ED * 1/AT * 1/C1 * 1/C2

Notes:

1. Indoor air concentrations will be estimated from groundwater EPCs using the EPA VISL Calculator (USEPA 2019).

2. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency is the USEPA-recommended EF for residents (USEPA 2014).

3. The exposure time (ET) describes how long each individual exposure event might last. The ET for the child and adult resident is the the USEPA-recommended ET for residents (USEPA 2014).

4. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. ED values reflect a 26 year residential tenure, which is the current EPA-recommended value for residence time (USEPA 2014).

5. The averaging time for carcinogens (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1989.

6. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration (USEPA 1989).

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Inhalation Intake = EPC * EF * ED * ADAF * 1/AT * 1/C1 * 1/C2

References:

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2019. Vapor Intrusion Screening Level Calculator. May.

Table 3.4
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Future
Source Medium:	Groundwater
Exposure Medium:	Indoor Air

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Inhalation of Volatiles	Resident	Current and Future	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Calculated	1
via vapor intrusion	Child (0<6 years)	Residences	EF	Exposure Frequency	350	days/year	USEPA, 2014	2
			ET	Exposure Time	24	hours/day	USEPA, 2014	3
			ED	Exposure Duration	6	years	USEPA 2011	3
			AT_c	Averaging Time-cancer	70	years	USEPA, 1989	4
			AT_{nc}	Averaging Time-noncancer	6	years	USEPA, 1989	5
			C1	Units Conversion Factor	365	days/year	Constant	
			C2	Units Conversion Factor	24	hours/day	Constant	
Inhalation of Volatiles	Resident	Current and Future	EPC	Exposure Point Concentration	Chemical-specific	mg/m^3	Calculated	1
via vapor intrusion	Adult	Residences	EF	Exposure Frequency	350	days/year	USEPA, 2014	2
			ET	Exposure Time	24	hours/day	USEPA, 2014	3
			ED	Exposure Duration	3	years	USEPA 2011	4
			AT_c	Averaging Time-cancer	70	years	USEPA, 1989	5
			AT_{nc}	Averaging Time-noncancer	3	years	USEPA, 1989	6
			C1	Units Conversion Factor	365	days/year	Constant	
			C2	Units Conversion Factor	24	hours/day	Constant	

Average Daily Exposure (ADE) Equation:

$ADI_{inhalation\text{-}shower}$ (mg/m^3) = EPC * EF * ED * 1/AT * 1/C1 * 1/C2

Notes:

1. Indoor air concentrations will be estimated from groundwater EPCs using the EPA VISL Calculator (USEPA 2019).

2. Exposure Frequency (EF) describes how often the exposure event occurs over a given period of time. The exposure frequency is the USEPA-recommended EF for residents (USEPA 2014).

3. The exposure time (ET) describes how long each individual exposure event might last. The ET for the child and adult resident is the the USEPA-recommended ET for residents (USEPA 2014).

4. Exposure duration for residents reflects a total 9 year residential tenure, which is the 50th percentile tenure cited in Table 16-108 for USEPA 2011. The ED for the adult is the total residence time (9 years) minus the child ED (6 years).

5. The averaging time for carcinogens (AT_c) is set equal to a lifetime (i.e., 70 years) when estimating cancer risk. This is the recommended lifetime in USEPA, 1989.

6. The averaging time for noncancer effects (AT_{nc}) is set equal to the exposure duration (USEPA 1989).

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Inhalation Intake = EPC * EF * ED * ADAF * 1/AT * 1/C1 * 1/C2

References:

USEPA, 1989. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual. (EPA/540/1-89/002).
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2019. Vapor Intrusion Screening Level Calculator. May.

TABLE 4.1
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust	Trespasser Youth 8 to 18	AOC 2 and AOC 3	IR_{soil}	Ingestion rate of soil	66	mg/day	USEPA, 2017	1
			AF_{soil}	Soil adherence factor	0.26	mg/cm^2	USEPA 2004	2
			SA_{soil}	Skin surface area	3,645	cm^2 / day	USEPA 2011	3
			EF	Exposure Frequency	60	days/yr	Professional judgment	4
			ED	Exposure Duration	10	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	2	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	0.5	unitless	Professional judgment	7
			BW	Body Weight	52	kg	USEPA 2011	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2021	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	10	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion: Intake = EPC * IR * EF * ED * CF_1 * SF * ADAF *1/BW * 1/AT *1/CF_2

Dermal Contact: Intake = EPC * SA * AF * ABSd * EF * ED * CF_1 * SF * ADAF *1/BW * 1/AT * 1/CF_2

Inhalation: Intake = EPCair* EF * ET * ED * ADAF * 1/AT * 1/C3 * 1/C2

TABLE 4.1 Notes:

1. Soil ingestion rate is the average age weighted general population upper percentile soil only ingestion rate for a youth 8 to 18 years (USEPA 2017)
2. The soil adherence factor (AFsed) for the youth is an SA-weighted value based on the USEPA (2004) 95th percentile AF values for "Soccer Player #1" (Exhibit C-2).
3. The skin surface area is the age weighted SA for the youth 8 to 18 years (USEPA 2011) and reflect the weighted average of mean values for face, hands, forearms and lower legs. Exhibit C-1 of USEPA 2004 provides ratios for face to head, forarm to arm, and lower leg to leg.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a trespasser would be present 2 days per week for the 7 warm months in the year (April - October).
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED reflects a duration of 10 years for a youth (8 to 18 years).
6. The exposure time (ET) is the amount of time spent outdoors. An ET of 2 hours per day was selected, based on professional judgement.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that a trespasser would be exposed to half the daily dose when at the Site; Therefore, a FS of 0.5 was used, based on professional judgment.
8. The body weight for the trespasser is the age weighted average for a youth in Table 8-1 of USEPA 2011.
9. PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPCS will be calculated in accordance with USEPA guidance (1989).

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
USEPA. 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2012. Recommendations for the Default Value for Relative Bioavailability of Arsenic in Soil. December 2012. OSWER Directive 9200.1-113.
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USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
USEPA 1997. Exposure Factors Handbook, Volume I: General Factors. EPA/600/P-95/002Fa, Office of Research and Development, USEPA, Washington, D.C., August 1997.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Surface Area of Body Parts (m^2)										
		Head	**W-SA**	**Arms**	**W-SA**	**Hands**	**W-SA**	**Legs**	**W-SA**	**Years**
Youth	8-11 years	0.02178	0.06534	0.06795	0.20385	0.051	0.153	0.1244	0.3732	3.00
	11-16 years	0.02409	0.12045	0.10215	0.51075	0.072	0.36	0.1932	0.966	5.00
	16-21 years	0.02508	0.05016	0.12105	0.2421	0.083	0.166	0.2172	0.4344	2.00
	Age-weighted average	0.024		0.096		0.0679		0.177		
Child	Soccer #1 95th% (mg/cm^2)	0.025		0.041		0.33		0.377		

Soil Weighted Adherence Factors	
Youth	0.26

TABLE 4.2
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust	Trespasser Youth 8 to 18	AOC 2 and AOC 3	IR_{soil}	Ingestion rate of soil	18	mg/day	USEPA, 2017	1
			AF_{soil}	Soil adherence factor	0.04	mg/cm^2	USEPA 2004	2
			SA_{soil}	Skin surface area	3,645	cm^2 / day	USEPA 2011	3
			EF	Exposure Frequency	30	days/yr	Professional judgment	4
			ED	Exposure Duration	10	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	1	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	0.25	unitless	Professional judgment	7
			BW	Body Weight	52	kg	USEPA 2011	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2021	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	10	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion Intake = EPC * IR * EF * ED * CF_1 * SF * ADAF *1/BW * 1/AT *1/CF_2

Dermal Contact Intake = EPC * SA * AF * ABSd * EF * ED * CF_1 * SF * ADAF *1/BW * 1/AT * 1/CF_2

Inhalation Intake = EPCair* EF * ET * ED * ADAF * 1/AT * 1/C3 * 1/C2

TABLE 4.2 Notes:

1. Soil ingestion rate is the average age weighted general population central tendency soil only ingestion rate for a youth 8 to 18 years (Table 5-1 of USEPA 2017)
2. The soil adherence factor (AFsed) for the youth is an SA-weighted value based on the USEPA (2004) geometric mean AF values for "Soccer Player #1" (Exhibit C-2).
3. The skin surface area is the age weighted SA for the youth 8 to 18 years (USEPA 2011) and reflect the weighted average of mean values for face, hands, forearms and lower legs. Exhibit C-1 of USEPA 2004 provides ratios for face to head, forarm to arm, and lower leg to leg.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a trespasser would be present 1 day per week for the 7 warm months in the year (April - October).
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED reflects a duration of 10 years for a youth (8 to 18 years).
6. The exposure time (ET) is the amount of time spent outdoors. An ET of 1 hours per day was selected, based on professional judgement.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that a trespasser would be exposed to a quarter of the full daily dose when at the Site; Therefore, a FS of 0.25 was used, based on professional judgment.
8. The body weight for the trespasser is the age weighted average for a youth in Table 8-1 of USEPA 2011.
9. PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPCS will be calculated in accordance with USEPA guidance (1989).

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
USEPA. 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2012. Recommendations for the Default Value for Relative Bioavailability of Arsenic in Soil. December 2012. OSWER Directive 9200.1-113.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
USEPA 1997. Exposure Factors Handbook, Volume I: General Factors. EPA/600/P-95/002Fa, Office of Research and Development, USEPA, Washington, D.C., August 1997.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Surface Area of Body Parts (m^2)										
		Head	**W-SA**	**Arms**	**W-SA**	**Hands**	**W-SA**	**Legs**	**W-SA**	**Years**
Youth	8-11 years	0.02178	0.06534	0.06795	0.20385	0.051	0.153	0.1244	0.3732	3.00
	11-16 years	0.02409	0.12045	0.10215	0.51075	0.072	0.36	0.1932	0.966	5.00
	16-21 years	0.02508	0.05016	0.12105	0.2421	0.083	0.166	0.2172	0.4344	2.00
	Age-weighted average	0.024		0.096		0.0679		0.177		
Child	Soccer #1 Geometric Mean (mg/cm^2)	0.012		0.011		0.11		0.031		

Soil Weighted Adherence Factors	
Youth	0.04

Table 4.3
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact (wading)	Trespasser Youth 8 to 18	AOC 2 and AOC 3	IR_{sed}	Ingestion rate of sediment	66	mg/day	USEPA 2017	1
			AF_{sed}	Sediment adherence factor	0.48	mg/cm^2-ev	USEPA 2011	2
			SA_{sed}	Skin surface area - Wading	3,645	cm^2	USEPA 2011	3
			EV	Event Frequency	1	event/day	USEPA 1989	4
			EF	Exposure Frequency - Wading	30	days/yr	Professional judgment	4
			ED	Exposure Duration	10	years	USEPA 2014	5
			FS	Fraction soil contact at Site	0.5	unitless	Professional judgment	6
			BW	Body Weight	52	kg	USEPA 2011	7
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time - noncancer	10	years	USEPA 1989	9
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	10
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	11
			EPCs	Exposure point concentration	Chemical-specific	mg/kg	Calculated	12

Sediment Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * EF * ED * FS * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * EV * C1* 1/BW * 1/AT * 1/C2

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion Intake = EPC * IR * EF * ED * CF_1 * ADAF *1/BW * 1/AT *1/CF_2

Dermal Contact Intake = EPC * SA * AF * ABSd * EF * ED * EV * CF_1 * ADAF *1/BW * 1/AT * 1/CF_2

Table 4.3 Notes:

1. Sediment ingestion rate is the average age weighted general population upper percentile soil only ingestion rate for a youth 8 to 18 years (USEPA 2017)
2. The soil adherence factor (AFsed) for the youth is an SA-weighted value based on the USEPA (2011) recommended AF for "Children Playing in Sediment".
3. The skin surface area is the age weighted SA for the youth 8 to 18 years (USEPA 2011) and reflect the weighted average of mean values for head, hands, forearms and lower legs. Exhibit C-1 of USEPA 2004 provides ratios for face to head, forarm to arm, and lower leg to leg.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. The event frequency (EV) assumes one event occurs each day. For wading exposures, it was assumed that a trespasser would be present 3 days per week for 10 weeks out of the year.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED reflects a duration of 10 years for a youth (8 to 18 years).
6. Sediment ingestion parameters are reflective of the daily dose of sediment. It was assumed that a trespasser would be exposed to half the daily dose when at the Site; Therefore, a FS of 0.5 was used, based on professional judgment.
7. The body weight for the trespasser is the age weighted average for a youth in Table 8-1 of USEPA 2011.
8. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
9. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
10. ABSd are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://19january2017snapshot.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e_.html.
11. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
12. Sediment EPCS will be calculated in accordance with USEPA guidance (1989).

References:

USEPA. 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2012. Recommendations for the Default Value for Relative Bioavailability of Arsenic in Soil. December 2012. OSWER Directive 9200.1-113.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
USEPA 1997. Exposure Factors Handbook, Volume I: General Factors. EPA/600/P-95/002Fa, Office of Research and Development, USEPA, Washington, D.C., August 1997.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Surface Area of Body Parts (m^2)										
		Head	**W-SA**	**Arms**	**W-SA**	**Hands**	**W-SA**	**Legs**	**W-SA**	**Years**
Youth	8-11 years	0.02178	0.06534	0.06795	0.20385	0.051	0.153	0.1244	0.3732	3.00
	11-16 years	0.02409	0.12045	0.10215	0.51075	0.072	0.36	0.1932	0.966	5.00
	16-21 years	0.02508	0.05016	0.12105	0.2421	0.083	0.166	0.2172	0.4344	2.00
	Age-weighted average	0.024		0.096		0.0679		0.177		
Child	Playing In sediment (mg/cm^2)	0.04		0.17		0.49		0.7		

Sediment Weighted Adherence Factors	
Youth	0.48

1. U.S. EPA. Exposure Factors Handbook 2011 Edition (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, 2011. Table 7.2.
W-SA = Weighted surface area
m = meters
mg = milligrams
cm = centimeters

Table 4.4
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact (wading)	Trespasser Youth 8 to 18	AOC 2 and AOC 3	IR_{sed}	Ingestion rate of sediment	18	mg/day	USEPA 2017	1
			AF_{sed}	Sediment adherence factor	0.48	mg/cm^2-ev	USEPA 2011	2
			SA_{sed}	Skin surface area - Wading	3,645	cm^2	USEPA 2011	3
			EV	Event Frequency	1	event/day	USEPA 1989	4
			EF	Exposure Frequency - Wading	10	days/yr	Professional judgment	4
			ED	Exposure Duration	10	years	USEPA 2014	5
			FS	Fraction soil contact at Site	0.25	unitless	Professional judgment	6
			BW	Body Weight	52	kg	USEPA 2011	6
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	7
			AT_{nc}	Averaging Time - noncancer	10	years	USEPA 1989	8
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	9
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	10
			EPCs	Exposure point concentration	Chemical-specific	mg/kg	Calculated	11

Sediment Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * EF * FS * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * EV * C1* 1/BW * 1/AT * 1/C2

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion Intake = EPC * IR * EF * ED * CF_1 * ADAF *1/BW * 1/AT *1/CF_2

Dermal Contact Intake = EPC * SA * AF * ABSd * EF * ED * EV * CF_1 * ADAF *1/BW * 1/AT * 1/CF_2

Table 4.4 Notes:

1. Sediment ingestion rate is the average age weighted general population central tendency soil only ingestion rate for a youth 8 to 18 years (Table 5-1 of USEPA 2017)

2. The soil adherence factor (AFsed) for the youth is an SA-weighted value based on the USEPA (2011) recommended AF for "Soccer Player #1" (Table 7-20). See tresspasser sediment RME notes for calculation.

3. The skin surface area is the age weighted SA for the youth 8 to 18 years (USEPA 2011) and reflect the weighted average of mean values for head, hands, forearms and lower legs.
   Exhibit C-1 of USEPA 2004 provides ratios for face to head, forarm to arm, and lower leg to leg.

4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. The event frequency (EV) assumes one event occurs each day.
   For wading exposures, it was assumed that a trespasser would be present 1 day per week for 10 weeks out of the year.

5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED reflects a duration of 10 years for a youth (8 to 18 years).

6. Sediment ingestion parameters are reflective of the daily dose of sediment. It was assumed that a trespasser would be exposed to a quarter of the full daily dose when at the Site; Therefore, a FS of 0.25 was used, based on professional judgment.

7. The body weight for the trespasser is the age weighted average for a youth in Table 8-1 of USEPA 2011.

8. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.

9. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.

10. ABSd are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://19january2017snapshot.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e_.html.

11. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).

12. Sediment EPCS will be calculated in accordance with USEPA guidance (1989).

References:

USEPA. 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2012. Recommendations for the Default Value for Relative Bioavailability of Arsenic in Soil. December 2012. OSWER Directive 9200.1-113.
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USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
USEPA 1997. Exposure Factors Handbook, Volume I: General Factors. EPA/600/P-95/002Fa, Office of Research and Development, USEPA, Washington, D.C., August 1997.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Table 4.5
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact with surface water (wading)	Trespasser (General) Youth 8 to 18	AOC 2 and AOC 3	BW	Body weight	52	kg	USEPA 2011	1
			SA_{sw}	Skin surface area - wading	3,645	cm^2	USEPA 2014	2
			EV	Event Frequency	1	events/day	USEPA 1989	4
			EF	Exposure Frequency-wading	30	days/year	Professional Judgment	5
			ED	Exposure Duration	10	years	USEPA 2014	6
			t_e	Event duration - wading	1	hours/event	Professional Judgment	7
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time-noncancer	10	years	USEPA 1989	9
			EPC	Exposure Point Concentration	Chemical-specific	mg/L	Calculated	10
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	11
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	11
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	11
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	11
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	11

Average Daily Intake (ADI) Equations:

ADI_{dermal} (mg/kg-d) = EPC * DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1 (wading)

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (L/cm^2-event) = Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (L/cm^2-event) = 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless]}

(short-duration exposures)

and DA_{event} (L/cm^2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Dermal Contact Intake = EPC * SA * DAe * EV *EF * ED * ADAF *1/BW * 1/AT *1/CF1

Table 4.5 Notes:

1. The body weight for the recreator is the age weighted average for a youth in Table 8-1 of USEPA 2011.
2. The skin surface area is the age weighted SA for the youth 8 to 18 years (USEPA 2011) and reflect the weighted average of mean values for head, hands, forearms and lower legs.
3. Event frequency (EV) describes how many "events" occur for each day of exposure. For all receptors, it was assumed that one event (wading) would occur on each day of exposure as recommended by USEPA 1989.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time.
   For wading exposures, it was assumed that a trespasser would be present 3 days per week for 10 weeks out of the year.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED reflects a duration of 10 years for a youth (8 to 18 years).
6. The event duration (t_e) describes how long each exposure event will occur. It was assumed that a trespasser user may wade for up to 1 hours per exposure event.
7. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.
8. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.
9. Surface water EPCs will be calculated in accordance with USEPA guidnace (USEPA 1989).
10. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

References:

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Table 4.6
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact with surface water (wading)	Trespasser (General) Youth 6 to 18	All areas of Site	BW	Body weight	52	kg	USEPA 2011	1
			SA_{sw}	Skin surface area - wading	3,645	cm^2	USEPA 2014	2
			EV	Event Frequency	1	events/day	USEPA 1989	4
			EF	Exposure Frequency-wading	10	days/year	Professional Judgment	5
			ED	Exposure Duration	10	years	USEPA 2014	6
			t_e	Event duration - wading	0.5	hours/event	Professional Judgment	7
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time-noncancer	10	years	USEPA 1989	9
			EPC	Exposure Point Concentration	Chemical-specific	mg/L	Calculated	10
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	11
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	11
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	11
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	11
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	11

Average Daily Intake (ADI) Equations:

ADI_{dermal} (mg/kg-d) = EPC * DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1 (wading)

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (L/cm^2-event) = Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (L/cm^2-event) = 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless]}

(short-duration exposures)

and DA_{event} (L/cm^2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Dermal Contact Intake = EPC * SA * DAe * EV *EF * ED * ADAF *1/BW * 1/AT *1/CF1

Table 4.6 Notes:

1. The body weight for the recreator is the age weighted average for a youth in Table 8-1 of USEPA 2011.
2. The skin surface area is the age weighted SA for the youth 8 to 18 years (USEPA 2011) and reflect the weighted average of mean values for head, hands, forearms and lower legs.
3. Event frequency (EV) describes how many "events" occur for each day of exposure. For all receptors, it was assumed that one event (wading) would occur on each day of exposure as recommended by USEPA 1989.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time.
   For wading exposures, it was assumed that a trespasser would be present 1 day per week for 10 weeks out of the year.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED reflects a duration of 10 years for a youth (8 to 18 years).
6. The event duration (t_e) describes how long each exposure event will occur. It was assumed that a trespasser user may wade for up to 0.5 hours per exposure event.
7. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.
8. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.
9. Surface water EPCs will be calculated in accordance with USEPA guidnace (USEPA 1989).
10. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

References:

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

TABLE 5.1
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust and volatiles	Adult Hunter	AOC-2 and AOC-3	IR_{soil}	Ingestion rate of soil	50	mg/day	USEPA 2017	1
			AF_{soil}	Soil adherence factor	0.20	mg/cm^2	USEPA 2014	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	10	days/yr	Professional judgment	4
			ED	Exposure Duration	25	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	8	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2021	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	25	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 5.1 Notes:

1. Soil ingestion rate (IR) is the general population upper percentile soil ingestion rate for an adult in Table 5-1 of USEPA 2017.
2. The soil adherence factor (AFsoil) is the 95th percentile weighted soil AF for landscape/rockery activities, presented in Exhibit 3-3 of USEPA 2004.
3. Skin surface area is the EPA recommended SA for an adult worker(USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a hunter would be present one day per weekend during deer bow hunting season (Oct 1 - Nov 15 and Dec 9 - Dec 17). Bow hunting season provided by the New York Department of Environmental Conservation. https://www.dec.ny.gov/outdoor/28605.html.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the USEPA recommended ED for an adult worker, since only airport employees are allowed to hunt at the Site (USEPA 2014).
6. The exposure time (ET) is the amount of time spent outdoors. An ET of 8 hours per day was selected, based on professional judgment.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that a hunter would be exposed to the full daily dose when at the Site; Therefore, a FS of 1.0 was used, based on professional judgment.
8. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
9. Default PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPCs will be calculated in accordance with USEPA guidance (1989).

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
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TABLE 5.2
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust and volatiles	Adult Hunter	AOC-2 and AOC-3	IR_{soil}	Ingestion rate of soil	10	mg/day	USEPA, 2017	1
			AF_{soil}	Soil adherence factor	0.04	mg/cm^2	USEPA 2004	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	3	days/yr	Professional judgment	4
			ED	Exposure Duration	7.2	years	USEPA 2011	5
			ET_{out}	Exposure time outdoors	8	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2021	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2021	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	7.2	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2

Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 5.2 Notes:

1. Soil ingestion rate (IR) is the general population central tendency soil ingestion rate for an adult in Table 5-1 of USEPA 2017.
2. The soil adherence factor (AFsoil) is the geometric mean weighted soil AF for landscape/rockery activities, presented in Exhibit 3-3 of USEPA 2004.
3. The skin surface area (SA) is the EPA-recommended default SA for an adult worker (USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a hunter would be present for one day per weekend, for three weekends during the deer bow hunting season (Oct 1 - Nov 15 and Dec 9 - D Bow hunting season provided by the New York Department of Environmental Conservation. https://www.dec.ny.gov/outdoor/28605.html.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the median tenure for full time employees, all individuals, in Table 16-105 of USEPA 2011.
6. The exposure time (ET) is the amount of time spent outdoors. An ET of 8 hours per day was selected, based on professional judement.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that a hunter would be exposed to the full daily dose when at the Site; Therefore, a FS of 1.0 was used, based on professional judgment.
8. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
9. Default PEF value was obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors will be obtained from the USEPA Regional Screening Level (RSL) table, May 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPCs will be calculated in accordance with USEPA guidance (1989).

References:

USEPA 2021. Regional Screening Levels - Generic Tables. May 2021. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
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USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
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Table 5.3
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact (wading)	Hunter Adult	AOC-2 and AOC-3	IR_{sed}	Ingestion rate of sediment	50	mg/day	USEPA 2017	1
			AF_{sed}	Sediment adherence factor	0.2	mg/cm^2-ev	USEPA 2004	2
			SA_{sed}	Skin surface area - Wading	3,527	cm^2	USEPA 2014	3
			EV	Event Frequency	1	event/day	USEPA 1989	4
			EF	Exposure Frequency - Wading	10	days/yr	Professional judgment	4
			ED	Exposure Duration	25	years	USEPA 2014	5
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	6
			BW	Body Weight	80	kg	USEPA 2011	7
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time - noncancer	25	years	USEPA 1989	9
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	10
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	11
			EPCs	Exposure point concentration	Chemical-specific	mg/kg	Calculated	12

Sediment Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * EF * ED * FS * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * EV * C1* 1/BW * 1/AT * 1/C2

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr

Table 5.3 Notes:

1. Sediment ingestion rate (IR) is the general population upper percentile soil ingestion rate for an adult in Table 5-1 of USEPA 2017.
2. The sediment adherence factor (AF_{sed}) is the weighted geometric SA-weighted value for an adult calmming in USEPA 2011 eflect the weighted average of mean values for head, hands, arms and legs.
3. The skin surface area for the wading scenario is the EPA-recommended default SA for the adult (USEPA 2014)
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a hunter would be present one day per weekend during deer bow hunting season (Oct 1 - Nov 15 and Dec 9 - I Bow hunting season provided by the New York Department of Environmental Conservation. https://www.dec.ny.gov/outdoor/28605.html
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the USEPA recommended ED for an adult worker (USEPA 2014)
6. Sediment ingestion parameters are reflective of the daily dose of sediment. It was assumed that a hunter would be exposed to the full daily dose when at the Site; Therefore, a FS of 1.0 was used, based on professional judgmen
7. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
8. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
9. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
10. ABSd are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://19january2017snapshot.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e_.html.
11. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012)
12. Sediment EPCs will be calculated in accordance with USEPA guidance (1989)

References:

New York Department of Environmental Conservation, 2019. Deer and Bear Hunting Seasons. https://www.dec.ny.gov/outdoor/28605.html
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Surface Area of Body Parts (m^2)									
		Head	**W-SA**	**Arms**	**W-SA**	**Hands**	**W-SA**	**Legs**	**W-SA**
Recreational User Adult	21+ male	0.136		0.314		0.107		0.682	
	21+ female	0.114		0.237		0.089		0.598	
	Average adult	0.125		0.276		0.098		0.64	
Adult	Clamming (mg/cm^2)	0.02		0.12		0.88		0.16	

Sediment Weighted Adherence Factors	
Adult	0.2117

1. U.S. EPA. Exposure Factors Handbook 2011 Edition (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, 2011. Table 7.2
W-SA = Weighted surface area
m = meters
mg = milligrams
cm = centimeters

Table 5.4
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion and dermal contact (wading)	Hunter Adult	AOC-2 and AOC-3	IR_{sed}	Ingestion rate of sediment	10	mg/day	USEPA 2017	1
			AF_{sed}	Sediment adherence factor	0.2	mg/cm^2-ev	USEPA 2011	2
			SA_{sed}	Skin surface area - Wading	3,527	cm^2	USEPA 2014	3
			EV	Event Frequency	1	event/day	USEPA 1989	4
			EF	Exposure Frequency - Wading	3	days/yr	Professional judgment	4
			ED	Exposure Duration	7.2	years	USEPA 2011	5
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	6
			BW	Body Weight	80	kg	USEPA 2011	7
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time - noncancer	7.2	years	USEPA 1989	9
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	10
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	11
			EPCs	Exposure point concentration	Chemical-specific	mg/kg	Calculated	12

Sediment Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * EF * ED * FS * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * EV * C1* 1/BW * 1/AT * 1/C2

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr

Table 5.4 Notes:

1. Sediment ingestion rate (IR) is the general population central tendency soil ingestion rate for an adult in Table 5-1 of USEPA 2017.
2. The sediment adherence factor (AF_{sed}) is the weighted geometric SA-weighted value for an adult calmming in USEPA 2011 eflect the weighted average of mean values for head, hands, arms and legs.
3. The skin surface area for the wading scenario is the EPA-recommended default SA for the adult (USEPA 2014)
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a hunter would be present for one day per weekend, for three weekends during the deer bow hunting season (Oct 1 - Nov 15 and Dec 9 - Dec 17) Bow hunting season provided by the New York Department of Environmental Conservation. https://www.dec.ny.gov/outdoor/28605.html
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the median tenure for full time employees, all individuals, in Table 16-105 of USEPA 2011
6. Sediment ingestion parameters are reflective of the daily dose of sediment. It was assumed that a hunter would be exposed to the full daily dose when at the Site; Therefore, a FS of 1.0 was used, based on professional judgmen
7. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
8. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
9. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
10. ABSd are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://19january2017snapshot.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e_.html.
11. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012)
12. Sediment EPCs will be calculated in accordance with USEPA guidance (1989)

References:

New York Department of Environmental Conservation, 2019. Deer and Bear Hunting Seasons. https://www.dec.ny.gov/outdoor/28605.html
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Table 5.5
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact with surface water (wading)	Adult Hunter	AOC 2 and AOC-3	BW	Body weight	80	kg	USEPA 2014	1
			SA_{sw}	Skin surface area - wading	3,527	cm^2	USEPA 2014	2
			EV	Event Frequency	1	events/day	USEPA 1989	4
			EF	Exposure Frequency-wading	10	days/year	Professional Judgment	5
			ED	Exposure Duration	25	years	USEPA 2014	6
			t_e	Event duration - wading	2	hours/event	Professional Judgment	7
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time-noncancer	25	years	USEPA 1989	9
			EPC	Exposure Point Concentration	Chemical-specific	mg/L	Calculated	10
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	11
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	11
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	11
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	11
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	11

Average Daily Intake (ADI) Equations:

ADI_{dermal} (mg/kg-d) = EPC * DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1 (wading)

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (L/cm^2-event) = Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (L/cm^2-event) = 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless])}

(short-duration exposures)

and DA_{event} (L/cm^2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/(1 + B)^2}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3

Table 5.5 Notes:

1. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
2. The skin surface area for the wading scenario is the EPA-recommended default SA for an adult worker (USEPA 2014).
3. Event frequency (EV) describes how many "events" occur for each day of exposure. For the hunter, it was assumed that one wading event would occur on each day of exposure as recommended by USEPA 1989.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a hunter would be present one day per weekend during deer bow hunting season (Oct 1 - Nov 15 and Dec 9 - Dec 17). Bow hunting season provided by the New York Department of Environmental Conservation. https://www.dec.ny.gov/outdoor/28605.html.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the USEPA recommended ED for an adult worker (USEPA 2014).
6. The event duration (t_e) describes how long each exposure event will occur. It was assumed that a hunter may wade for up to 2 hours per exposure event.
7. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.
8. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.
9. Surface water EPCs will be calculated in accordance with USEPA guidnace (USEPA 1989).
10. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

References:

New York Department of Environmental Conservation, 2019. Deer and Bear Hunting Seasons. https://www.dec.ny.gov/outdoor/28605.html.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
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Table 5.6
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Dermal contact with surface water (wading)	Hunter Adult	AOC 2 and AOC-3	BW	Body weight	80	kg	USEPA 2014	1
			SA_{sw}	Skin surface area - wading	3,527	cm^2	USEPA 2014	2
			EV	Event Frequency	1	events/day	USEPA 1989	4
			EF	Exposure Frequency-wading	3	days/year	Professional Judgment	5
			ED	Exposure Duration	7.2	years	USEPA 2011	6
			t_e	Event duration - wading	1	hours/event	Professional Judgment	7
			AT_c	Averaging Time-cancer	70	years	USEPA 1989	8
			AT_{nc}	Averaging Time-noncancer	7.2	years	USEPA 1989	9
			EPC	Exposure Point Concentration	Chemical-specific	mg/L	Calculated	10
			DA_e	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated	11
			Kp	Permeability coeffiecient	Chemical-specific	cm/h	USEPA 2004	11
			FA	Fraction Absorbed	Chemical-specific	Dimensionless	USEPA 2004	11
			tau_{event}	Lag time per event	Chemical-specific	hours/event	USEPA 2004	11
			B	Ratio of permeability coefficients, stratum corneum to viable epidermis	Chemical-specific	Dimensionless	USEPA 2004	11

Average Daily Intake (ADI) Equations:

ADI_{dermal} (mg/kg-d) = EPC * DA_{event} * EV * EF * ED * SA * 1/BW * 1/AT * 1/C1 (wading)

Where DA_{event} = Dermal absorbed dose per event:

where for inorganics: DA_{event} (L/cm^2-event) = Kp (cm/hr) * t_e (hr/ev) * C2 (L/cm^3)

where for organics: DA_{event} (L/cm^2-event) = 2 FA (unitless) * Kp (cm/hr) * C2 * SQRT{(6 * tau-event [hr/ev] * t_e [hr/ev])/pi [unitless])}

(short-duration exposures)

and DA_{event} (L/cm^2-event) = FA (unitless) * Kp (cm/hr) * C2 (L/cm^3) [(t_e [hr/ev]/1 + B [unitless]) + 2 tau-event (hr/ev) {(1 + 3B + 3 B^2)/$(1 + B)^2$}]

(long-duration exposures)

Unit Conversion Factors: C1 = 365 days/yr C2 = 0.001 L/cm^3

Table 5.6 Notes:

1. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
2. The skin surface area for the wading scenario is the EPA-recommended default SA for an adult worker (USEPA 2014).
3. Event frequency (EV) describes how many "events" occur for each day of exposure. For the hunter, it was assumed that one wading event would occur on each day of exposure as recommended by USEPA 1989.
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. It was assumed that a hunter would be present for one day per weekend, for three weekends during the deer bow hunting season (Oct 1 - Nov 15 and Dec 9 - Dec 17) Bow hunting season provided by the New York Department of Environmental Conservation. https://www.dec.ny.gov/outdoor/28605.html.
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the median tenure for full time employees, all individuals, in Table 16-105 of USEPA 2011.
6. The event duration (t_e) describes how long each exposure event will occur. It was assumed that a hunter may wade for up to 1 hours per exposure event.
7. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended by USEPA 1989.
8. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended by USEPA 1989.
9. Surface water EPCs will be calculated in accordance with USEPA guidnace (USEPA 1989).
10. Chemical-specific dermal absorption coefficients/factors are provided in USEPA, 2004.

References:

New York Department of Environmental Conservation, 2019. Deer and Bear Hunting Seasons. https://www.dec.ny.gov/outdoor/28605.html.
USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA, 2004. US EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) EPA/540/R/99/005, July 2004.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Table 5.7
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Deer
Exposure Medium:	Deer meat

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion	Adult Hunter	AOC 2 and AOC 3	IR_d	Ingestion rate deer meat	190400	mg/day	USEPA 2011	1
			EF	Exposure Frequency	365	days/yr	Professional judgment	2
			ED	Exposure Duration	25	years	USEPA 2014	3
			BW	Body Weight	80	kg	USEPA 2014	4
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	5
			AT_{nc}	Averaging Time - noncancer	25	years	USEPA 1989	6
			FIR	Fraction of Total Ingestion Rate	0.35	unitless	USEPA 2011	7
			EPC_d	Exposure point concentration	Chemical-specific	mg/kg	Calculated	8

Deer meat Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC_d * IR * FIR * EF * ED * C1 * 1/BW * 1/AT * 1/C2

$EPC_d = EPC_{soil}$ * BAF

BAF = Bioaccumulation factor

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr

Table 5.7 Notes:

1. For the hunter, the ingestion rate is the the 90th percentile ingestion rate for home-produced game in Table 13-41 of USEPA 2011 (2.38 g/kg-day * 80 kg * 1000mg/kg).
2. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. The event frequency (EV) assumes one event occurs each day.
3. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the USEPA recommended ED for an adult worker (USEPA 2014).
4. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
5. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
6. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
7. The Fraction of total Ingestion Rate assumes 50 % of the fraction value (73%) for households who hunt game, as indicated in Table 13-68 for (USEPA 2011).
8. Deer meat EPCs will be calculated by multiplying the soil EPC by a bioaccumulation factor (BAF).

References:

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-120.
USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.
USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.
USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.
USEPA 1997. Exposure Factors Handbook, Volume I: General Factors. EPA/600/P-95/002Fa, Office of Research and Development, USEPA, Washington, D.C., August 1997.
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December 1989.

Table 5.8
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Former Stewart Air Force Base
Newburgh and New Windsor, New York

Scenario Timeframe:	Current/Future
Medium:	Deer
Exposure Medium:	Deer meat

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Ingestion	Adult Hunter	AOC 2 and AOC 3	IR_d	Ingestion rate deer meat	60000	mg/day	USEPA 2011	1
			EF	Exposure Frequency	365	days/yr	Professional judgment	2
			ED	Exposure Duration	7.2	years	USEPA 2014	3
			BW	Body Weight	80	kg	USEPA 2014	4
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	5
			AT_{nc}	Averaging Time - noncancer	7.2	years	USEPA 1989	6
			FIR	Fraction of Total Ingestion Rate	17.5	unitless	USEPA 2011	7
			EPC_d	Exposure point concentration	Chemical-specific	mg/kg	Calculated	8

Deer meat Average Daily Intake (ADI) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPC_d * IR * FIR * EF * ED * C1 * 1/BW * 1/AT * 1/C2

$EPC_d = EPC_{soil}$ * BAF

BAF = Bioaccumulation factor

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr

Table 5.8 Notes:

1. For the hunter, the ingestion rate is the the 50th percentile ingestion rate for home-produced game in Table 13-41 of USEPA 2011 (0.75 g/kg-day * 80 kg * 1000mg/kg).
2. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. The event frequency (EV) assumes one event occurs each day
3. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants. The ED is the median tenure for full time employees, all individuals, in Table 16-105 of USEPA 2011.
4. The body weight is the USEPA recommended body weight for an adult (USEPA 2014).
5. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
6. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
7. The Fraction of total Ingestion Rate assumes 25 % of the fraction value (73%) for households who hunt game, as indicated in Table 13-68 for (USEPA 2011).
8. Deer meat EPCs will be calculated by multiplying the soil EPC by a bioaccumulation factor (BAF).

References:

USEPA 2014. Memorandum: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014. Office of Solid Waste and Emergency Response. OSWER Directive 9200.1-1

USEPA 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-090/052F, September 2011. Office of Research and Development, USEPA, Washington, D.C.

USEPA 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum. USEPA, Washington, D.C.

USEPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, OSWER Directive 9285.7-02EP. EPA/540/R/99/005, USEPA, Washington D.C., July 2004.

USEPA 1997. Exposure Factors Handbook, Volume I: General Factors. EPA/600/P-95/002Fa, Office of Research and Development, USEPA, Washington, D.C., August 1997.

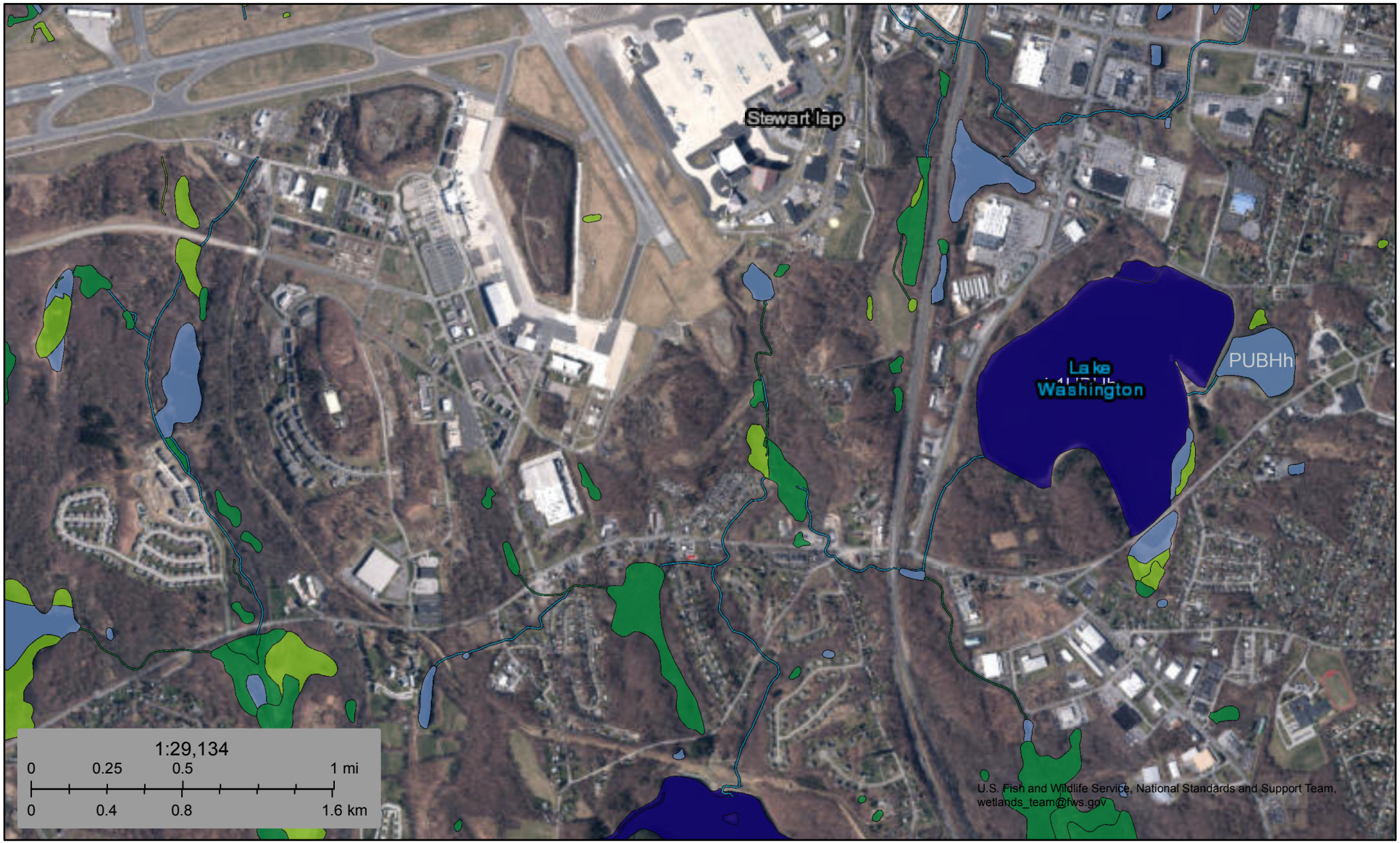
USEPA 1989. Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part A, Interim Final, OSWER Directive 9285.701A. Office of Solid Waste and Emergency Response, USEPA, Washington D.C., December

APPENDIX B

NATIONAL WETLANDS INVENTORY MAP FOR FORMER STEWART AIR FORCE BASE VICINITY

U.S. Fish and Wildlife Service
National Wetlands Inventory

Wetland Map for Former Stewart AFB



April 29, 2020

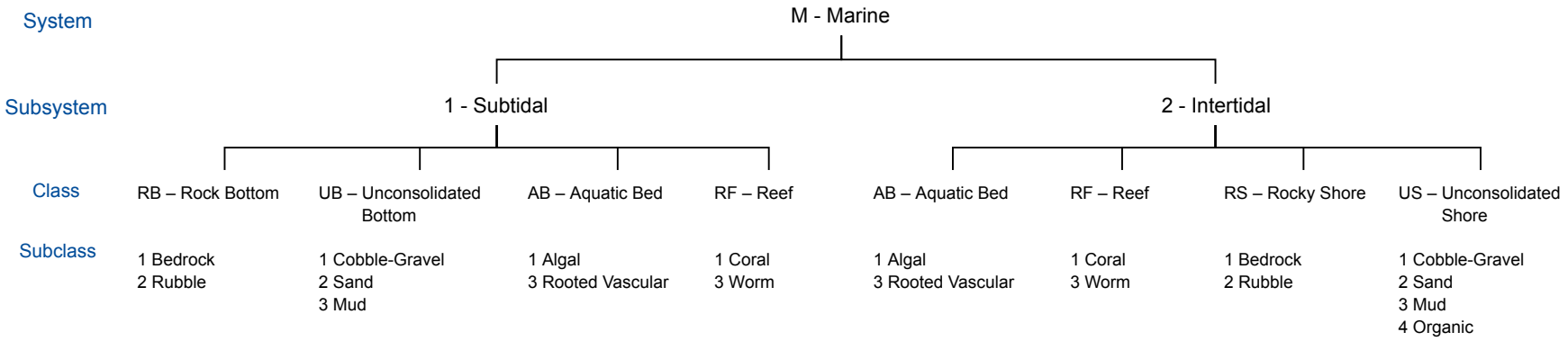
Wetlands

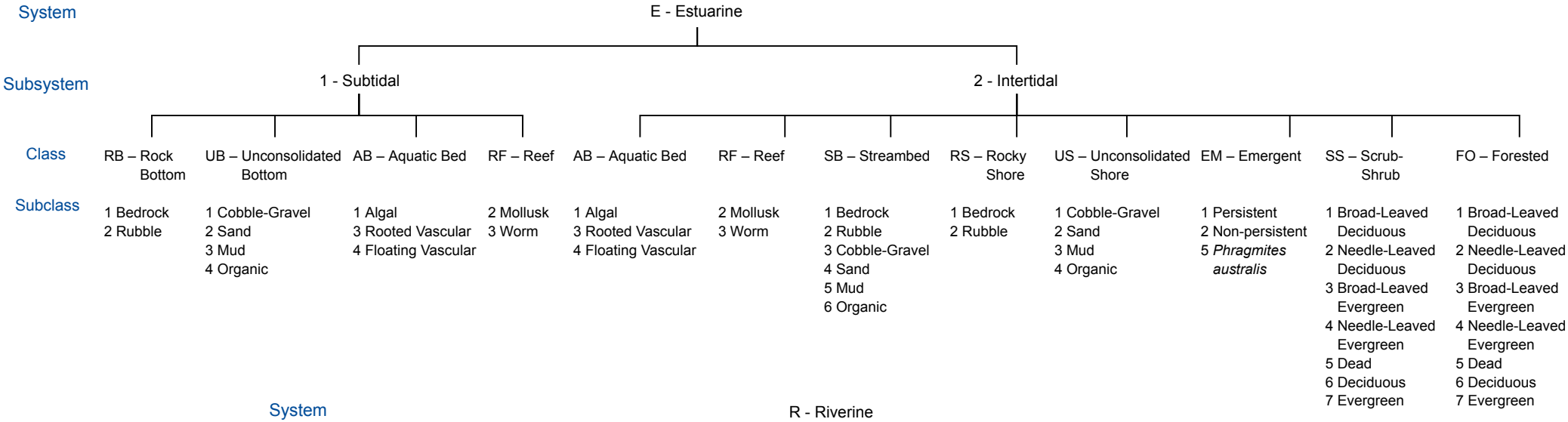
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

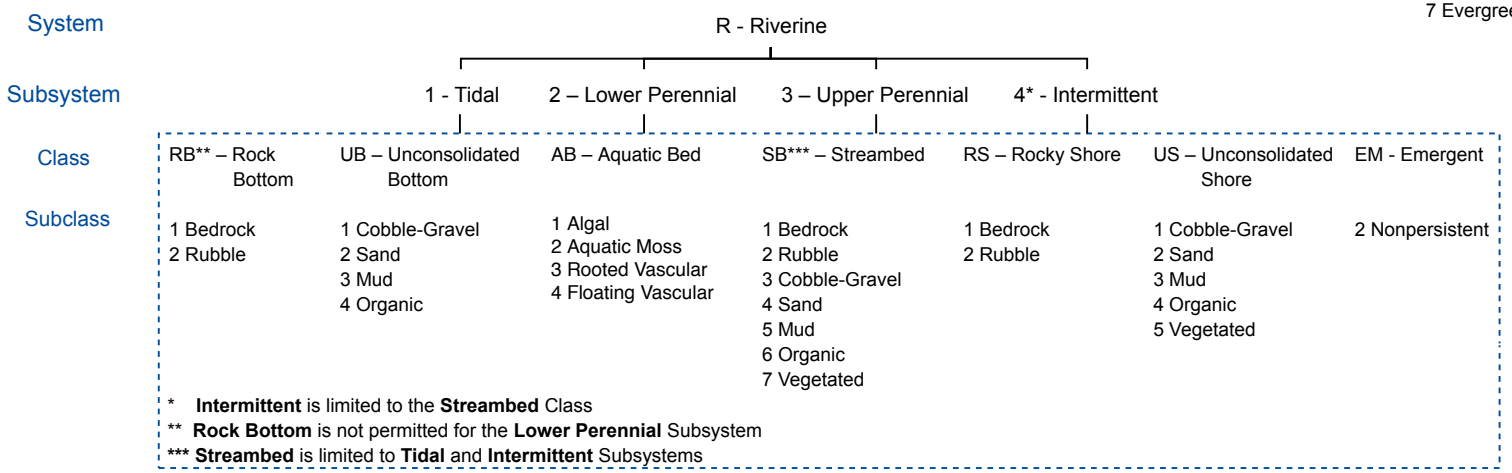
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

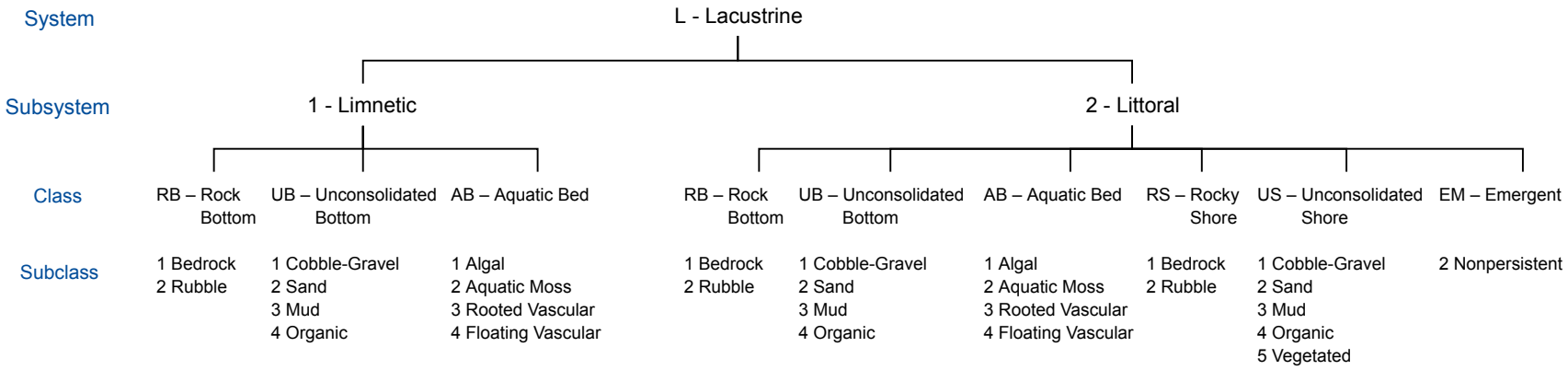


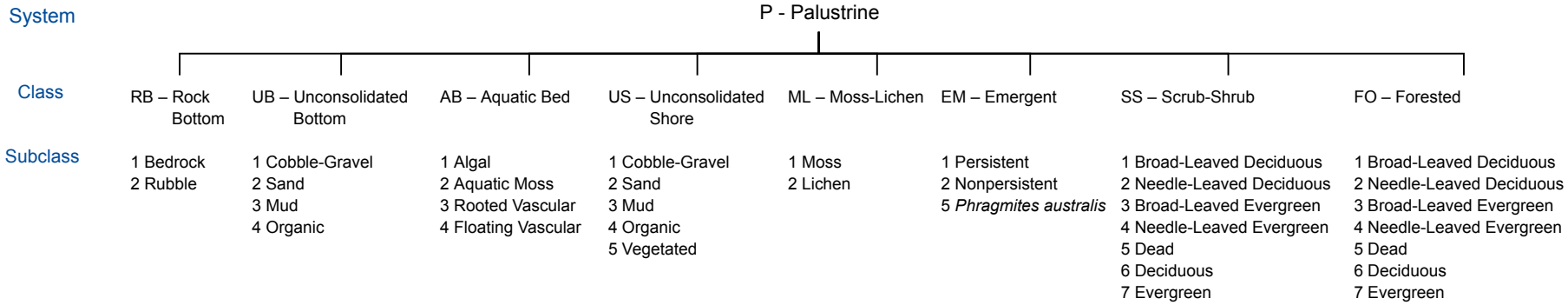




Federal Geographic Data Committee, 2013. Classification of Wetlands and Deepwater Habitats of the United States.

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION





MODIFIERS

In order to more adequately describe the wetland and deepwater habitats, one each of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy.

Water Regime			Special Modifiers	Water Chemistry		Soil
Nontidal	**Saltwater Tidal**	**Freshwater Tidal**		**Halinity/Salinity**	**pH Modifiers for Fresh Water**	
A Temporarily Flooded	L Subtidal	Q Regularly Flooded-Fresh Tidal	b Beaver	1 Hyperhaline / Hypersaline	a Acid	g Organic
B Seasonally Saturated	M Irregularly Exposed	R Seasonally Flooded-Fresh Tidal	d Partly Drained/Ditched	2 Euhaline / Eusaline	t Circumneutral	n Mineral
C Seasonally Flooded	N Regularly Flooded	S Temporarily Flooded- Fresh Tidal	f Farmed	3 Mixohaline / M ixosaline (Brackish)	i Alkaline	
D Continuously Saturated	P Irregularly Flooded	T Semipermanently Flooded-Fresh Tidal	m Managed	4 Polyhaline		
E Seasonally Flooded / Saturated		V Permanently Flooded-Fresh Tidal	h Diked/Impounded	5 Mesohaline		
F Semipermanently Flooded			r Artificial Substrate	6 Oligohaline		
G Intermittently Exposed			s Spoil	0 Fresh		
H Permanently Flooded			x Excavated			
J Intermittently Flooded						
K Artificially Flooded						

Federal Geographic Data Committee, 2013. Classification of Wetlands and Deepwater Habitats of the United States.

COMMITMENT & INTEGRITY
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MEMORANDUM

TO: Keith Fields, Tidewater Inc.

CC: Lisa McIntosh, Woodard & Curran

FROM: Kyle Apigian and Matthew Smith, Woodard & Curran

DATE: July 29, 2021

RE: Former Stewart Air Force Base – Wetland Delineation and Vernal Pool Survey

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Woodard & Curran is pleased to submit this Wetland Delineation and Vernal Pool Survey memorandum of findings for the Former Stewart Air Force Base located in the Town of New Windsor, Orange County, New York (Figure 1). The study area included an approximately 191-acre undeveloped area located to the southeast of the former air force base, west of Silver Stream Road, and north of Little Britain Road (Figure 2). The following paragraphs provide a summary of findings from our April 2021 field investigation of federal Waters of the United States (WOTUS) and vernal pool survey of the study area.

Project Description and Study Area

Woodard & Curran wetland scientists conducted field surveys at the study area to delineate potential Waters of the United States (WOTUS) and evaluate the presence of potential vernal pool habitat between April 26, 2021 and April 28, 2021. The approximately 191-acre study area formerly supported operations of Stewart Air Force Base, but is currently undeveloped. The topography of the study area is undulating and comprised of debris and waste piles, wetlands, uplands, seeps, vernal pools, and stream features. Most of the study area is forested but also contains scrub/shrub and emergent habitats. Ongoing environmental investigations of three Areas of Concern (AOCs) within the study area – specifically the Former Southern Landfill, Former Half Acre Landfill and Fill Area – necessitated delineation of WOTUS and evaluation of vernal pool habitat survey. These ecological field surveys were performed on the entire 191-acre study area. Attachment A - Figure 1 presents the location of the study area on the Cornwall-on-Hudson 7.5-minute USGS Topographic Map. Attachment A - Figure 2 presents the approximate boundary of the study area and AOCs on aerial imagery, which depicts conditions in 2019.

Waters of the US Assessment

Waters of the United States (WOTUS), including streams and wetlands, are defined by 33 CFR Part 328.3(b) and are protected by Section 404 of the Clean Water Act (33 USC 1344), which is administered and enforced in vicinity of the study area by the US Army Corps of Engineers (USACE), New York District. The approximate extents of waters and wetlands were determined using in-house research based on evaluation and data synthesis of the following documents:

- USGS 7.5-minute quadrangle topographic maps
- USDA-NRCS Web Soil Survey for Orange County, New York
- U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps
- Aerial photography, as provided by ESRI World Imagery base maps
- Field maps and notes taken by Woodard & Curran personnel

Wetland boundary locations were determined using the methodology described in the *Regional Supplement to the 1987 Corps of Engineers Wetlands Delineation Manual: Northcentral and Northeast Region Version 2.0* (USACE 2012). The technique presented in the regional supplement uses a multi-parameter approach that requires positive evidence of three wetland criteria:

1. Hydrophytic vegetation
2. Hydric soils
3. Wetland hydrology

Areas within the project study area were classified as wetlands and flagged in the field if they exhibited evidence of all three of the above wetland parameters. Wetlands were defined as palustrine forested (PFO), palustrine emergent (PEM), or palustrine shrub-scrub (PSS). USACE Wetland Determination Data Forms (provided in Attachment B) were filled out in the field to document the field data collected as part of the assessment of the three criteria presented above.

Areas were classified as stream channels and flagged in the field if they exhibited a defined bed and bank, discernible ordinary high-water mark (OHWM), substrate differentiation, and evidence of groundwater contribution and base flow at times other than storm events. Streams were defined as either perennial or intermittent based on whether they appeared on USGS mapping, had evidence of continuous, uninterrupted flow or were apparent to only convey water during seasonal elevated water table presence. Open waters determinations were based upon the presence of an OHWM. Waterbody Delineation Forms (with embedded photos) are provided in Attachment C.

Field studies identified the presence of eight wetlands, seven streams, and no open waters within the study area. Table 1 (below) provides a list of these waters and wetlands, and refer to Attachment A - Figure 3 for a map of the delineated waters and wetlands. A photo log of the wetlands features is provided in Attachment D.

Table 1: Delineated Waters of the US

Resource ID	Classification	Drainage Association	8-Digit HUC	Amount of Resource in Project Study Area
W1	PFO	Silver Stream	02020008	2.740 acres
W2	PFO	Silver Stream	02020008	1.309 acres
W3	PSS	Silver Stream	02020008	0.841 acres
W4	PFO	Silver Stream	02020008	12.931 acres
W5	PEM	Silver Stream	02020008	0.457 acres
W5B	PFO	Silver Stream	02020008	0.149 acres
W6	PFO	Silver Stream	02020008	0.182 acres
W7	PFO	Silver Stream	02020008	3.116 acres
S1	Intermittent	Silver Stream	02020008	541 linear feet
S2	Intermittent	Silver Stream	02020008	227 linear feet

Resource ID	Classification	Drainage Association	8-Digit HUC	Amount of Resource in Project Study Area
S3	Perennial	Silver Stream	02020008	783 linear feet
S4	Intermittent	Silver Stream	02020008	259 linear feet
S5	Perennial	Silver Stream	02020008	2,396 linear feet
S5B	Perennial	Silver Stream	02020008	980 linear feet
S6	Perennial	Silver Stream	02020008	2,897 linear feet

PFO = Palustrine Forested Wetland
PSS = Palustrine Scrub-Shrub Wetland
PEM = Palustrine Emergent Wetland
HUC = Hydrologic Unit Code

Section 10 Regulated Waters

No USACE Section 10 regulated (i.e., navigable) waters were identified during the field survey.

Open Waters

No open waters were identified during the field survey.

Tidal Wetlands

No tidal wetlands were identified during the field survey.

Non-Jurisdictional Features

No non-jurisdictional features – that is, wetlands that are not regulated under the Clean Water Act such as artificial ponds or drainage ditches – were identified during the field survey.

Vernal Pools

Vernal pools are aquatic resources that form in localized topographical depressions and fill with water from winter rains, spring snowmelt and elevated water tables, but only during a portion of the year. During much of the year these ecosystems are dry. These areas are typically inundated in winter, slowly draining in spring, and devoid of water in summer. When filled, vernal pools are critical breeding grounds for a variety of aquatic amphibian and invertebrate species.

Potential vernal pools were identified by walking the study area and examining any observed isolated inundated areas. Pools that were visually identified in the field were assessed using the USACE – New England District DRAFT Vernal Pool Characterization Form. Characteristics evaluated included aspects of the landscape including setting, landscape use, geology, hydrology, canopy cover and size. Biological features of the pools were investigated by completing a thorough visual investigation of the entirety of the pool to determine the fauna present within or utilizing the pool for breeding. In particular, the pool was searched for vernal pool indicator species[1], which are obligate species that exclusively use vernal pools

[1] Per the Vernal Pool Characterization Form, these species include wood frogs, spotted salamanders, blue-spotted salamanders, Jefferson's salamanders, marbled salamanders, and fairy shrimp.

for breeding. Facultative species[1] – those that use vernal pools for foraging or breeding, but not exclusively – were also recorded. Nets were used to capture and more closely examine fauna observed within the pool. A list of common plant species observed within and around the pools was recorded.

Two vernal pools were identified during survey of the Former Stewart Air Force Base. One pool was located within the southwestern portion of the Former Half Acre Landfill area, on the eastern side of Silver Stream. This pool ("Vernal Pool 1" or "VP1") was first observed on May 19, 2020 and was examined again on April 26, 2021. During the April 2021 survey, a second pool ("Vernal Pool 2" or "VP2"), was observed approximately 100 feet to the south of Vernal Pool 1. The perimeters of the pools (edge of water) were delineated in the field using flagging tape hung on adjacent vegetation. A map showing the vernal pool areas is presented in Attachment A - Figure 3. The U.S. Army Corp of Engineers (USACE) Vernal Pool Characterization Forms (with embedded photos) are provided in Attachment E.

Vernal Pool 1

Vernal Pool 1 was observed to be approximately 180 feet by 78 feet at its widest points, with a total area of approximately 10,000 square feet – similar to the dimensions observed in 2020. The vernal pool was surrounded entirely by forest (upland and wetland) within the 100-foot vernal pool envelope. The wider landscape (within 750 feet of the pool) was primarily forested, although open areas and developed areas (residential development) account for a total of approximately 20% of the area within this wider envelope. Tree cover was approximately 80-90% in the area immediately around the pool. The northern end of the pool appeared to be disturbed by a temporary road (truck or ATV traffic).

The primary substrate of the pool was mucky organics from loose glacial till parent material. The water of the pool was clear, approximately 12 inches deep at its deepest point, and the bottom was visible throughout most of its reach.

A temporary outlet was observed at the southwestern corner of the pool. Based on field observations it appears that during high water the pool may overflow, and water may run downslope towards Silver Stream to the west. No inlets were observed. The hydroperiod of the pool was assumed based on the vegetation present. The observed plant species were most consistent with the example indicator species for a pool that dries between March and July, as shown in Section 8 of the Vernal Pool Characterization Form. Species indicative of a longer hydroperiod are generally tolerant of much wetter or inundated conditions and were not observed in or around the pool.

No vernal pool indicator species – or evidence of such species – were observed. The most commonly observed fauna in the pool were mosquito larvae and tadpoles, the latter of which were tentatively identified as spring peepers (*Pseudacris crucifer*). Spring peeper tadpoles are similar to wood frogs (*Lithobates sylvaticus*); however, the tadpoles were observed closely with a hand lens in the field and lacked characteristic features of wood frogs – such as dorsal eyes, a clear (as opposed to mottled) tail, and a pale head stripe[2]. Furthermore, spring peepers were heard calling in the vicinity of the pool. No predator species (fish, bullfrogs, green frogs) were observed in the pool.

[1] These species include spring peepers, gray tree frogs, American toads, spadefoot toads, Fowler's toads, caddisflies, and fingernail clams.

[2] Hoverman, J., Z. Olson, S. LaGrange, J. Grant, and R. Williams. 2015. A Guide to Larval Amphibian Identification in the Field and Laboratory. Purdue University Extension; Frog-TadpolesTipForMay.pdf (gomaywood.org)

Vernal Pool 2

Vernal Pool 2 was observed to be approximately 65 feet by 40 feet with a total area of approximately 1,900 square feet. The surrounding habitat was the same as that identified for Vernal Pool 1. Tree cover was approximately 20% in the area immediately around the pool. The pool itself did not appear disturbed; however partially buried debris was exposed around the edges of the pool and in the vicinity, indicating historical disturbance around the pool. The substrate and depth of the pool were similar to Vernal Pool 1. The water of the pool was clear and the bottom visible throughout. No inlets or outlets were observed around the pool perimeter.

A thorough visual investigation of the entirety of the pool was completed to determine the fauna present within or utilizing the pool for breeding. No vernal pool indicator species – or evidence of such species – were observed. The most commonly observed fauna in the pool were mosquito larvae and tadpoles which were tentatively identified as spring peepers (*Pseudacris crucifer*). Presumptive recently hatched spring peeper egg masses (consisting of gelatinous masses and algae) were observed at the northern end of the pool. No predator species (fish, bullfrogs, green frogs) were observed in the pool.

Vernal Pool Scores

USACE field forms and guidance[1] utilize a scoring system to provide a relative valuation of quality of the vernal pool habitat. The scores are not associated with a particular regulatory requirement but rather are intended to be used in conjunction with other site data and observations when assessing the need for compensatory mitigation. The observed pools were scored for a variety of vernal pool characteristics, including habitat/landscape setting, substrate type, pool size, hydrology and the presence or absence of flora and fauna unique to vernal pools. Certain characteristics are assigned a scoring point; the maximum number of scoring points is 32, where a higher cumulative score suggests a vernal pool that is more ecologically valuable or functional than lower-scored vernal pools. These characteristics and scoring points are presented in detail on the forms included in Attachment E.

Vernal Pool 1 scored a total of 18 out of 28 for vernal pool characteristics and a total of 29.2 out of 32 for pool envelope and critical terrestrial habitat area characteristics. Vernal Pool 2 scored a total of 16 out of 28 for vernal pool characteristics and a total of 29.2 out of 32 for pool envelope and critical terrestrial habitat area characteristics. As discussed, no indicator species were observed in either pool. A detailed breakdown of the scores is presented on the forms, but overall, these scores suggest that while the pool has a moderate to high *potential* as habitat, vernal pool indicator species were not observed in the pool at the time of survey. This may be due to local disturbance, water quality, timing, or other circumstances that were not investigated as part of this evaluation.

Protected Species Habitat Assessment

Under provisions of the Endangered Species Act (ESA) of 1973 (as amended), federal law requires that any action likely to adversely affect a species classified as federally threatened or endangered be subject to review by the USFWS. A preliminary list of threatened and endangered species for the study area was obtained from the USFWS Information Planning and Conservation (IPaC) System online database. Two bats (Indiana bat [*Myotis sodalis*] and northern long-eared bat [*Myotis septentrionalis*]) and one plant

[1] United States Army Corps of Engineers – New England District. 2013. Vernal Pool Assessment (Draft).

(small whorled pogonia [*Isotria medeoloides*]) were identified as having *potential* to occur within the study area. IPaC did not identify any Critical Habitat for any of any species within the same area. The small whorled pogonia is an upland plant species typically found in older hardwood forests with open understories. While portions of the study area may be consistent with this habitat, in general, the shrub and herbaceous understory layers in the study area have moderately dense cover and are early- to mid-successional due to historical disturbance and clearing. With regard to habitat for the northern long-eared bat, singular dead trees (snags) in the study area with loose bark could potentially serve as roosting areas for the bat species, but specific potential roost trees were not observed or noted.

None of the species preliminarily identified by IPaC were observed within the study area; however, the field survey was not completed at a time when bats would typically be active (dusk), and the time of year for this survey (April) would be early to observe small whorled pogonia in flower. The observations made during this evaluation are not intended to substitute for a comprehensive threatened or endangered species survey.

Closing

We appreciate the opportunity to perform this important work for Tidewater, Inc. If you have questions concerning this document, please contact Kyle Apigian at (781) 613-0576 or Matthew Smith at (609) 402-2542.

ATTACHMENTS

Attachment A: Figures (USGS, Aerial and Natural Resource Maps)
Attachment B: USACE Wetland Determination Data Forms
Attachment C: Waterbody Delineation Forms
Attachment D: Wetland Photo Log
Attachment E: USACE Vernal Pool Field Forms

ATTACHMENT A
Figures

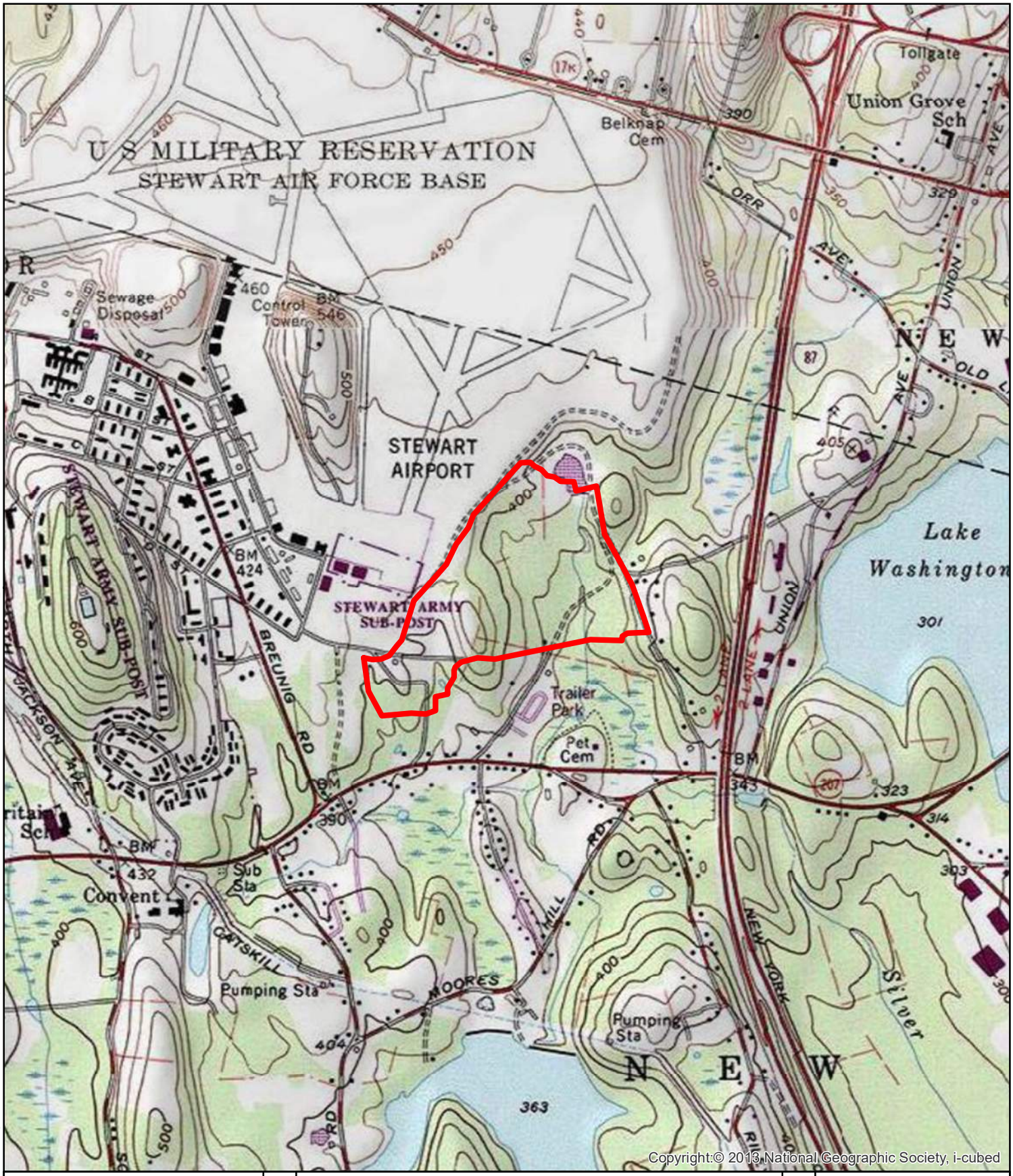


Figure 1
USGS Location Map

Vernal Pool and Wetland Delineation
Former Stewart Air Force Base
New Windsor, NY

Legend

Study Area

1 inch = 2,000 feet

0 650 1,300 2,600 Feet

N

WOODARD &CURRAN

Project #: 0232473
Map Created: July 2021

Figure Exported: 7/29/2021 By: mdsmith Using: \\woodardcurran.net\shared\Projects\0232473.00 Tidewater Inc Stewart AFB Risk Assessment NY\wip\GIS\Project Files\2021.05.18_USGS.mxd

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources:**



Figure 2
Aerial Location Map

Vernal Pool and Wetland Delineation
Former Stewart Air Force Base
New Windsor, NY

Legend

- Former Southern Landfill
- Former Half Acre Landfill
- Fill Area
- Study Area

1 in = 1,500 ft

0 370 740 1,480 Feet

N

WOODARD &CURRAN

Project #: 0232473
Map Created: July 2021

Figure Exported: 7/29/2021 By: mdsmith Using: \\woodardcurran.net\shared\Projects\0232473.00 Tidewater Inc Stewart AFB Risk Assessment NY\wip\GIS\Project Files\2021.05.18_Aerial.mxd

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources:**

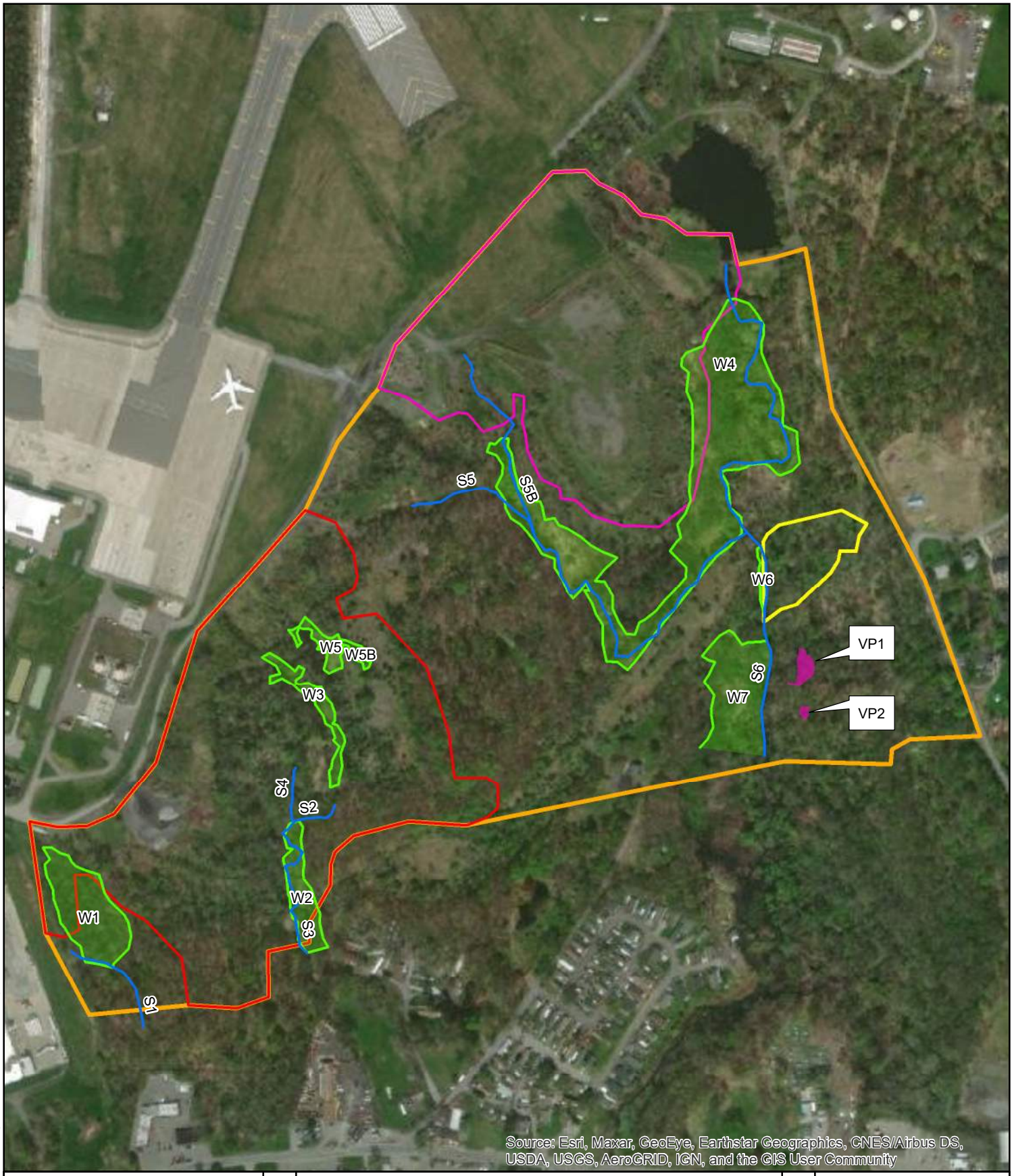


Figure 3
Natural Resource Map

Vernal Pool and Wetland Delineation
Former Stewart Air Force Base

New Windsor, NY

Legend

- Vernal Pools (VP1, VP2)
- Streams (S1, S2, S3, S4, S5, S5B, S6)
- Wetlands (W1, W2, W3, W4, W5, W5B, W6, W7)
- Former Southern Landfill
- Former Half Acre Landfill
- Fill Area
- Study Area

0 200 400 800 Feet

N

WOODARD &CURRAN

Project #: 0232473
Map Created: July 2021

Figure Exported: 7/29/2021 By: mdsmith Using: \\woodardcurran.net\shared\Projects\0232473.00 Tidewater Inc Stewart AFB Risk Assessment NY\wip\GIS\Project Files\2020.05.18_VernalPoolStudyArea.mxd

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources:**

ATTACHMENT B
USACE Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/26/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W1-WET

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 3-8

Subregion (LRR or MLRA): MLRA 144A Lat: Long: Datum:

Soil Map Unit Name: MdB-Mardin gravelly silt loam NWI classification: PFO1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation ____, Soil X, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area within a Wetland?** **Yes** X **No**
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☑ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☑ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No Depth (inches): 0-3

Water Table Present? Yes X No Depth (inches): 0

Saturation Present? (includes capillary fringe) Yes X No Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W1-WET

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	15	N	FAC
2. Ulmus americana	55	Y	FACW
3.			
4.			
5.			
6.			
7.			
	70 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15)			
1. Betula papyrifera	5	N	FACU
2. Betula populifolia	15	Y	FAC
3.			
4.			
5.			
6.			
7.			
	20 = Total Cover		
Herb Stratum (Plot size: 5)			
1. Juncus effusus	10	N	OBL
2. Symplocarpus foetidus	80	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W1-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-2								Organics
3-6	10YR 2/1	100					Silty Loam	
6-10	10YR 3/1	100					Silty Loam	
10+	10YR 2/1	100					Silty Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/26/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W1-UPL

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 3-8

Subregion (LRR or MLRA): MLRA 144A Lat: Long: Datum:

Soil Map Unit Name: MdB-Mardin gravelly silt loam NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes No x	**Is the Sampled Area within a Wetland?** **Yes** **No** x
Hydric Soil Present? Yes No x	
Wetland Hydrology Present? Yes No x	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes No x Depth (inches):

Water Table Present? Yes No x Depth (inches):

Saturation Present? (includes capillary fringe) Yes No x Depth (inches):

Wetland Hydrology Present? **Yes** **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W1-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	25	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	25 = Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Herb Stratum (Plot size: 5)			
1. Alliaria petiolata	50	Y	FACU
2. Solidago canadensis	15	N	FACU
3. Taraxacum officinale	15	N	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _____ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W1-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-8	10YR 5/2	100					Sandy Loam	Gravelly fill
8+								Cobbles, boulders

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Stone (cobbles, boulders)

Depth (inches): 8

Hydric Soil Present? **Yes** ____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/26/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W2-WET

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present? Yes X No _____	
Wetland Hydrology Present? Yes X No _____	If yes, optional Wetland Site ID: _____

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☑ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☑ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☑ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No x Depth (inches): _____

Water Table Present? Yes x No _____ Depth (inches): 3

Saturation Present? (includes capillary fringe) Yes x No _____ Depth (inches): 2

Wetland Hydrology Present? **Yes** x **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W2-WET

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15)			
1. Salix nigra	30	Y	OBL
2.			
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		

Herb Stratum (Plot size: 5)			
1. Alliaria petiolata	10	N	FACU
2. Symplocarpus foetidus	75	Y	OBL
3. Phragmites australis	50	Y	FACW
4. Euthamia gramnifolia	10	N	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	145 = Total Cover		

Woody Vine Stratum (Plot size: 30)			
1. Vitis labrusca	10	Y	FACU
2.			
3.			
4.			
	10 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W2-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-2								Organics
2-8	10YR 4/3	90	10YR 4/6	10	C	M	Loamy clay	
8+	Gley1 3/10Y	100					Loamy sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☑ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/26/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W2-UPL

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes _____ No x	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** x
Hydric Soil Present? Yes _____ No x	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present? Yes _____ No x	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No x Depth (inches): _____

Water Table Present? Yes _____ No x Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No x Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W2-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Carya ovata	15	N	FACU
2. Acer rubrum	30	Y	FAC
3. Quercus rubra	35	Y	FACU
4.			
5.			
6.			
7.			
	75	= Total Cover	

Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Herb Stratum (Plot size: 5)			
1. Alliaria petiolata	40	Y	FACU
2. Berberis thunbergii	10	N	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	50	= Total Cover	

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ____ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W2-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-2								Organics
2+	10YR 4/4	100					Sandy Clay Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/27/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W3-WET

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present? Yes X No _____	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present? Yes X No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☑ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☑ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No x Depth (inches): _____

Water Table Present? Yes x No _____ Depth (inches): 10

Saturation Present? (includes capillary fringe) Yes x No _____ Depth (inches): 8

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W3-WET

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15)			
1. Betula populifolia	15	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	15 = Total Cover		

Herb Stratum (Plot size: 5)			
1. Apocynum androsaemifolium	10	N	UPL
2. Frangula alnus	15	N	FAC
3. Phragmites australis	60	Y	FACW
4. Euthamia gramnifolia	5	N	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No**

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W3-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2								Organics
2-6	10YR 3/1	100					Sandy clay loam	
6+	10YR 4/3	70	10YR 4/6	30	C	M	Sandy clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/27/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W3-UPL

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): Convex Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes _____ No x	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** x
Hydric Soil Present? Yes _____ No x	
Wetland Hydrology Present? Yes _____ No x	If yes, optional Wetland Site ID: _____

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No x Depth (inches): _____

Water Table Present? Yes _____ No x Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No x Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W3-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus deltoides	15	Y	FAC
2. Betula papyrifera	15	Y	FACU
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15)			
1. Betula populifolia	15	Y	FAC
2. Vaccinum angustifolium	15	Y	FACU
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		
Herb Stratum (Plot size: 5)			
1. Euthamia graminifolia	35	Y	FAC
2. Frangula alnus	10	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	45 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species 4	x 3 = 12
FACU species 2	x 4 = 8
UPL species _____	x 5 = _____
Column Totals: 6 (A)	20 (B)

Prevalence Index = B/A = 3.33

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _____ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W3-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1								Organics
1-4	10YR 4/2	100					Clay Loam	
4+	10YR 6/2	90	10YR 6/6	10				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W4-9-WET
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name: MdB—Mardin gravelly silt loam NWI Classification: (none)
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	"wetland 4"

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes		No	X	Depth (inches):	
Water table present?	Yes		No	X	Depth (inches):	
Saturation present? (includes capillary fringe)	Yes	X	No		Depth (inches):	0

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W4-9-WET

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Phragmites australis*	100	Y	FACW
2	*Alliaria petiolata*	4	N	FACU
3	*Impatiens capensis*	1	N	FACW
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		105	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	21	53
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 1 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	101	x 2 =	202
FAC species	0	x 3 =	0
FACU species	4	x 4 =	16
UPL species	0	x 5 =	0
Column totals	105 (A)		218 (B)

Prevalence Index = B/A = 2.08

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W4-9-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-3		100		0			sandy/clayey	no redox C
3-12	Gley 2.5/10GY	100		0			sandy	gleyed; no redox C

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Suface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- X Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? Y

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W4-9-UPL
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name: MdB—Mardin gravelly silt loam NWI Classification: none
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	____	No	X	Depth (inches): ____
Saturation present? (includes capillary fringe)	Yes	____	No	X	Depth (inches): ____

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W4-9-UPL

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Quercus rubra*	40	Y	FACU
2	*Acer rubrum*	20	Y	FAC
3	*Carya ovata*	10	N	FACU
4	*Pyrus calleryana*	10	N	
5				
6				
7				
8				
9				
10				
		80	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Viburnum prunifolium*	15	Y	
2				
3				
4				
5				
6				
7				
8				
9				
10				
		15	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Alliaria petiolata*	10	Y	FACU
2	*Rosa multiflora*	5	Y	FACU
3	*Prunus serotina*	2	N	FACU
4	*Berberis thunbergii*	1	N	FACU
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		18	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	16	40
Sapling/Shrub Stratum	3	8
Herb Stratum	4	9
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 5 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 20.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	20	x 3 =	60
FACU species	68	x 4 =	272
UPL species	0	x 5 =	0
Column totals	88 (A)		332 (B)

Prevalence Index = B/A = 3.77

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W4-9-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-6	10YR 3/2	100		0			Loamy/clayey	No redox concentrations
6-12	10YR 3/3	100		0			Loamy/clayey	No redox concentrations

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? N

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W4-33-WET
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name MdC—Mardin gravelly silt loam NWI Classification: (none)
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- X Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- X Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	X	No	____	Depth (inches):	1
Water table present?	Yes	X	No	____	Depth (inches):	surface
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches):	surface

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Disturbed area

VEGETATION - Use scientific names of plants

Sampling Point: W4-33-WET

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Salix nigra*	15	Y	OBL
2	*Platanus occidentalis*	15	Y	FACW
3				
4				
5				
6				
7				
8				
9				
10				
		30	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Phragmites australis*	100	Y	FACW
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		100	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	6	15
Sapling/Shrub Stratum	0	0
Herb Stratum	20	50
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across all Strata: 3 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	15	x 1 =	15
FACW species	115	x 2 =	230
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column totals	130 (A)		245 (B)

Prevalence Index = B/A = 1.88

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

Infestation by mugwort due to disturbed conditions

SOIL **Sampling Point:** W4-33-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-8.5	10YR 3/1	100		0			clay	
8.5-14	2.5/N - Gley	100		0			clay	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- _X_ Depleted Below Dark Suface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___Y___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W4-33-UPL
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name MdC—Mardin gravelly silt loam NWI Classification: none
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	____	No	X	Depth (inches): ____
Saturation present? (includes capillary fringe)	Yes	____	No	X	Depth (inches): ____

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W4-33-UPL

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Betula papyrifera*	15	Y	FACU
2	*Salix nigra*	10	Y	OBL
3				
4				
5				
6				
7				
8				
9				
10				
		25	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Elaeagnus angustifolia*	10	Y	FACU
2				
3				
4				
5				
6				
7				
8				
9				
10				
		10	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Solidago sp.*	60	Y	
2	*Artemisia vulgaris*	30	Y	
3	*Rosa multiflora*	10	N	FACU
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		100	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	5	13
Sapling/Shrub Stratum	2	5
Herb Stratum	20	50
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 5 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 20.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	10	x 1 =	10	
FACW species	0	x 2 =	0	
FAC species	0	x 3 =	0	
FACU species	35	x 4 =	140	
UPL species	0	x 5 =	0	
Column totals	45	(A)	150	(B)

Prevalence Index = B/A = 3.33

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation

___ Dominance test is >50%

___ Prevalence index is ≤3.0*

___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)

___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W4-33-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-2	10YR 3/2	100		0			Loamy/clayey	topsoil; no redox concentratio
2-14	10YR 4/3	100		0			Loamy/clayey	no redox concentrations

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? N

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W4-55-WET
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name MdC—Mardin gravelly silt loam NWI Classification: (none)
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- X Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- X Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	____	No	X	Depth (inches): ____
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 12

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Disturbed area

VEGETATION - Use scientific names of plants

Sampling Point: W4-55-WET

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Salix nigra*	15	Y	OBL
2	*Platanus occidentalis*	15	Y	FACW
3				
4				
5				
6				
7				
8				
9				
10				
		30	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Berberis thunbergii*	5	Y	FACU
2				
3				
4				
5				
6				
7				
8				
9				
10				
		5	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Artemisia vulgaris*	80	Y	
2	*Symplocarpus foetidus*	20	N	OBL
3	*rosa multiflora*	5	N	FACU
4	*Phragmites australis*	5	N	FACW
5	*Veratrum viride*	5	N	FACW
6	*Alliaria petiolata*	1	N	FACU
7				
8				
9				
10				
11				
12				
13				
14				
15				
		116	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	6	15
Sapling/Shrub Stratum	1	3
Herb Stratum	23	58
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across all Strata: 4 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 50.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	35	x 1 =	35
FACW species	25	x 2 =	50
FAC species	0	x 3 =	0
FACU species	11	x 4 =	44
UPL species	0	x 5 =	0
Column totals	71 (A)		129 (B)

Prevalence Index = B/A = 1.82

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- ___ Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

Infestation by mugwort due to disturbed conditions

SOIL **Sampling Point:** W4-55-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-2.5	10YR 2/2	100		0			topsoil	
3-12	10YR 3/2	100		0			silty	sandy/silty
12-14	10YR 3/3	100		0			sandy	mottling

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
_X_ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? Y

Remarks:
Disturbed soils.
Fill over hydric soils.





WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W4-55-UPL
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name MdC—Mardin gravelly silt loam NWI Classification: none
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	____	No	X	Depth (inches): ____
Saturation present? (includes capillary fringe)	Yes	____	No	X	Depth (inches): ____

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W4-55-UPL

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Prunus serotina*	10	Y	FACU
2	*Carya ovata*	10	Y	FACU
3	*Betula papyrifera*	10	Y	FACU
4	*Populus sp.*	10	Y	
5	*Acer rubrum*	10	Y	FAC
6	*Ostrya virginiana*	5	N	FACU
7				
8				
9				
10				
		55	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Artemisia vulgaris*	15	Y	
2	*Rosa multiflora*	15	Y	FACU
3	*unk grass*	10	Y	
4	*Rubus sp.*	5	N	
5	*Alliaria petiolata*	5	N	FACU
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		50	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	11	28
Sapling/Shrub Stratum	0	0
Herb Stratum	10	25
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 8 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 12.50% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	55	x 4 =	220
UPL species	0	x 5 =	0
Column totals	65 (A)		250 (B)

Prevalence Index = B/A = 3.85

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W4-55-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-11	7.5YR 3/4	100		0			loamy/clayey	No redox concentrations
11-18	10 YR 4/6	100		0			loamy/clayey	No redox concentrations

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? N

Remarks:





WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/27/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W5-WET

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 3-8

Subregion (LRR or MLRA): MLRA 144A Lat: Long: Datum:

Soil Map Unit Name: MdB-Mardin gravelly silt loam, 3 to 8 % slopes; Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No	**Is the Sampled Area within a Wetland?** **Yes** X **No**
Hydric Soil Present? Yes X No	If yes, optional Wetland Site ID:
Wetland Hydrology Present? Yes X No	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes No x Depth (inches):

Water Table Present? Yes x No Depth (inches): 6

Saturation Present? (includes capillary fringe) Yes x No Depth (inches): 4

Wetland Hydrology Present? **Yes** X **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W5-WET

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Herb Stratum (Plot size: 5)			
1. Galium obtusum	10	N	FACW
2. Euthamia gramnifolia	5	N	FAC
3. Phragmites australis	65	Y	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No**

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W5-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-1								Organics
1-8	10YR 4/2	100					Sandy clay loam	
8+	10YR 4/2	65	10YR 4/6	35	C	M	Sandy clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/27/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W5-UPL

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes _____ No x	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** x
Hydric Soil Present? Yes _____ No x	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present? Yes _____ No x	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No x Depth (inches): _____

Water Table Present? Yes _____ No x Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No x Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W5-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Juniperus virginiana	15	Y	FACU
2. Populus deltoides	15	Y	FAU
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15)			
1. Elaeagnus commutata	35	Y	UPL
2. Juniperus virginiana	20	Y	FACU
3.			
4.			
5.			
6.			
7.			
	55 = Total Cover		
Herb Stratum (Plot size: 5)			
1. Euthamia graminifolia	15	N	FAC
2. Festuca altaica	65	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 20 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _____ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W5-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-2								Organics
2+	10YR 5/4	100					Clay Loam	Gravelly fill

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/27/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W5B-WET

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes x No _____	**Is the Sampled Area within a Wetland?** **Yes** x **No** _____
Hydric Soil Present? Yes x No _____	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present? Yes x No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes x No _____ Depth (inches): 0

Water Table Present? Yes x No _____ Depth (inches): 0

Saturation Present? (includes capillary fringe) Yes x No _____ Depth (inches): 0

Wetland Hydrology Present? **Yes** x **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W5B-WET

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix nigra	65	Y	OBL
2. Betula papyrifera	10	N	FACU
3. Populus deltoides	25	Y	FAC
4.			
5.			
6.			
7.			
	100	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15)			
1. Elaeagnus angustifolia	35	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	35	= Total Cover	

Herb Stratum (Plot size: 5)			
1. Alliaria petiolata	5	N	FACU
2. Juncus effusus	10	N	OBL
3. Phragmites australis	75	Y	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90	= Total Cover	

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** _____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W5B-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-1								Organics
1-3	10YR 3/1	100					Sandy clay loam	
3-15	10YR 4/1	60	10YR 4/6	40	C	M	Clay loam	
15+	10YR 4/1	60	10YR 4/6	40	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: Orange County Sampling Date: 4/27/21

Applicant/Owner: US Army Corps of Engineers State: NY Sampling Point: W5B-UPL

Investigator(s): Matthew Smith, Matthew Gehringer Section, Township, Range: Town of New Windsor

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): _____

Subregion (LRR or MLRA): MLRA 144A Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pg-Pits, gravel NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation x, Soil X, or Hydrology x significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes _____ No x	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** x
Hydric Soil Present? Yes _____ No x	
Wetland Hydrology Present? Yes _____ No x	If yes, optional Wetland Site ID: _____

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No x Depth (inches): _____

Water Table Present? Yes _____ No x Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No x Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: W5B-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. Juniperus virginiana	15	Y	FACU
2. Populus deltoides	15	Y	FAU
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15)			
1. Elaeagnus commutata	35	Y	UPL
2. Juniperus virginiana	20	Y	FACU
3.			
4.			
5.			
6.			
7.			
	55 = Total Cover		
Herb Stratum (Plot size: 5)			
1. Euthamia graminifolia	15	N	FAC
2. Festuca altaica	65	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 20 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- [✔] 1 - Rapid Test for Hydrophytic Vegetation
- [✔] 2 - Dominance Test is >50%
- [✔] 3 - Prevalence Index is ≤3.0[1]
- [✔] 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [✔] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _____ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W5B-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-2								Organics
2+	10YR 5/4	100					Clay Loam	Gravelly fill

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W6-7-WET
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name: ESB—Erie extremely stony soils, gently sloping NWI Classification: PFO1E
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- X Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes		No	X	Depth (inches):
Water table present?	Yes		No	X	Depth (inches):
Saturation present? (includes capillary fringe)	Yes	X	No		Depth (inches): 3

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W6-7-WET

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1 *Salix nigra*		50	Y	OBL
2				
3				
4				
5				
6				
7				
8				
9				
10				
		50	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1 *Symplocarpus foetidus*		40	Y	OBL
2 *Artemesia vulgaris*		15	N	
3 *Solidago sp.*		10	N	
4 *Berberis thunbergii*		10	N	FACU
5 *Viburnum dentatum*		1	N	FAC
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		76	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	10	25
Sapling/Shrub Stratum	0	0
Herb Stratum	15	38
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across all Strata: 2 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	90	x 1 =	90
FACW species	0	x 2 =	0
FAC species	1	x 3 =	3
FACU species	10	x 4 =	40
UPL species	0	x 5 =	0
Column totals	101 (A)		133 (B)

Prevalence Index = B/A = 1.32

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W6-7-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-7	10YR 2/2	100		0			Sandy Loam, roots	no redox C
7-16	7.5YR 6/1	90	7.5YR 5/6	10	C	PL/M	sandy	contrasting mottles

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- _X_ Depleted Below Dark Suface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- _X_ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? _Y_

Remarks:





WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W6-7-UPL
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name: ESB—Erie extremely stony soils, gently sloping NWI Classification:
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches):	____
Water table present?	Yes	____	No	X	Depth (inches):	____
Saturation present? (includes capillary fringe)	Yes	____	No	X	Depth (inches):	____

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W6-7-UPL

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Liriodendron tulipifera*	20	Y	FACU
2	*Populus deltoides*	10	Y	FAC
3				
4				
5				
6				
7				
8				
9				
10				
		30	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Lonicera sempervirens*	5	Y	
2				
3				
4				
5				
6				
7				
8				
9				
10				
		5	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Rosa multiflora*	15	Y	FACU
2	*Alliaria petiolata*	10	Y	FACU
3	*Solidago sp.*	10	Y	
4	*Artemesia vulgaris*	5	N	
5	*Rubus sp.*	5	N	
6	*Erythronium americanum*	1	N	
7				
8				
9				
10				
11				
12				
13				
14				
15				
		46	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	6	15
Sapling/Shrub Stratum	1	3
Herb Stratum	9	23
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 6 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 16.67% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	45	x 4 =	180
UPL species	0	x 5 =	0
Column totals	55 (A)		210 (B)

Prevalence Index = B/A = 3.82

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation

___ Dominance test is >50%

___ Prevalence index is ≤3.0*

___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)

___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W6-7-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-1	10YR 4/4	100		0			loamy/clayey	topsoil
1-6	10YR 4/4	100		0			gravel	gravel mixed with organics
6-12	10YR 4/4	100		0			sandy clay	no redox C

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? N

Remarks:



WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W7-16-WET
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name: ESB—Erie extremely stony soils, gently sloping NWI Classification: PEM1/SS1E
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes		No	X	Depth (inches):	
Water table present?	Yes	X	No		Depth (inches):	3
Saturation present? (includes capillary fringe)	Yes	X	No		Depth (inches):	surface

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W7-16-WET

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1 *Salix nigra*		10	Y	OBL
2				
3				
4				
5				
6				
7				
8				
9				
10				
		10	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1 *Rosa multiflora*		10	Y	FACU
2				
3				
4				
5				
6				
7				
8				
9				
10				
		10	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1 *Phragmites australis*		50	Y	FACW
2 *Rosa multiflora*		10	N	FACU
3 *Cornus sp.*		1	N	
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		61	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	2	5
Sapling/Shrub Stratum	2	5
Herb Stratum	12	31
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across all Strata: 3 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 66.67% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	10	x 1 =	10	
FACW species	50	x 2 =	100	
FAC species	0	x 3 =	0	
FACU species	20	x 4 =	80	
UPL species	0	x 5 =	0	
Column totals	80	(A)	190	(B)

Prevalence Index = B/A = 2.38

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W7-16-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-2	7.5YR 3/2	100					organic,peat/muck	saturated
2-6	7.5YR 3/1	100					organic, peat/muck	saturated

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- _X_ Depleted Below Dark Suface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- _X_ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? Y

Remarks:



WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: Stewart AFB City/County: New Windsor Sampling Date: 4/27/2021
Applicant/Owner: State: NY Sampling Point: W7-16-UPL
Investigator(s): Kyle Apigian, Stephanie Rogacki Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave
Slope (%): -- Lat.: Long.: Datum:
Soil Map Unit Name: ESB—Erie extremely stony soils, gently sloping NWI Classification:
Are climatic/hydrologic conditions of the site typical for this time of the year? Y (If no, explain in remarks)
Are vegetation ____, soil X, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	____	No	X	Depth (inches): ____
Saturation present? (includes capillary fringe)	Yes	____	No	X	Depth (inches): ____

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: W7-16-UPL

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Populus grandidentata*	50	Y	FACU
2	*Acer platanoides*	35	Y	
3				
4				
5				
6				
7				
8				
9				
10				
		85	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Berberis thunbergii*	30	Y	FACU
2	*Lonicera sempervirens*	10	Y	
3				
4				
5				
6				
7				
8				
9				
10				
		40	= Total Cover	

Herb Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1	*Rosa multiflora*	30	Y	FACU
2	*Alliaria petiolata*	7	N	FACU
3	*Cornus sp.*	1	N	
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		38	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	17	43
Sapling/Shrub Stratum	8	20
Herb Stratum	8	19
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across all Strata: 5 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 0.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	117	x 4 =	468
UPL species	0	x 5 =	0
Column totals	117 (A)		468 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation

___ Dominance test is >50%

___ Prevalence index is ≤3.0*

___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)

___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** W7-16-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-2	10 YR 3/1	100		0			topsoil	no redox C
2-12	10YR 4/4	100		0			clayey/loamy	large gravel/soil, no redox C

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? N

Remarks:



ATTACHMENT C
Waterbody Delineation Forms

WATERBODY DELINEATION FORM

Waterbody Name: Stream 1 **Waterbody ID No.:** S1

Associated Wetland No.:

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 023473	Weather: 60 F; Clear
Investigators: MS/MG - Woodard & Curran	State/County/Municipality: New Windsor, NY	Quad Name:

PHYSICAL ATTRIBUTES

Waterbody Characteristic Photo

Facing: SE Direction of Flow: South



Waterbody Type	Lake	Pond	Borrow Pit	River	(Stream)	Ag. Ditch	Other:		
Stream Flow	Fast		Moderate		(Slow)		Very Slow		None
Flow type	Perennial		(Intermittent)		Ephemeral				
Stream Depth (in.)	(0-3)	3-6	6-12	12-18	18-24	24-36	36-48	48-60	60+
Stream Width (ft.)	Top of Bank: 6				Water Surface: 5				
OHWM _____(ft.)									
Bank Height (ft.) (looking downstream else give direction you are facing here:_____)	Left	(0-2)	2-4		4-6		6-8		8+
	Right	(0-2)	2-4		4-6		6-8		8+
Bank Slope (°) (looking downstream else give direction you are facing here:_____)	Left	(0-20)	20-40		40-60		60-80		80+
	Right	(0-20)	20-40		40-60		60-80		80+

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 0232473	Investigators: MS/MG

QUALITATIVE ATTRIBUTES

Water Appearance	Clear	(Slightly Turbid)	Turbid	Very Turbid	Color:
	Floating algal mats	Obvious surface scum	Sheen on surface	Greenish color	Other:
Stream Substrate %	Bedrock____	Gravel 25%	Sand 25%	Silt/Clay 25%	Organic 25%
Aquatic Habitats	Sand Bar	(Gravel Bar)	Mud Bar	Gravel Riffles	Deep Pools
Undercut Banks	(Overhanging trees/shrubs)	(In-stream emergent plants)	In-stream submerged plants	(Bank root systems)	Fringing Wetlands
Aquatic Organisms Observed	Waterfowl	Fish (adult)	Fish (juvenile)	Frogs	Turtles
	Snakes	Other:			
	Invertebrates:	Intolerant	Facultative	Tolerant	None
Riparian Zone	Width of natural vegetation zone from edge of active channel out onto flood plan: (wetlands adjacent) (ft)				
	Circle vegetative layers: (trees) (shrubs) (herbs)				
	❑ Significant bare areas within riparian zone				
	❑ Evidence of non-buffered concentrated flows				
Channel Condition	(Channelization/Braiding)	Unnatural straitening	Downcutting	Dikes/Berms	Excessive bank erosion
Disturbances	❑ Livestock access to riparian zone		❑ Manure in stream or on banks		
	❑ Waste discharge pipes present		☒ Other: Terrain was observed to be disturbed.		

Comments

STREAM QUALITY (indicate)	❑ High	☒ Moderate	❑ Low

High Quality: Natural channel (no structures or dikes; no evidence of downcutting or excessive lateral cutting); evidence of past channel alteration with significant recovery; any dikes/levies are set back to provide access to adequate flood plain; natural vegetation extends at least one or two active channel widths on each side; banks stable and protected by roots that extend to the base-flow elevation; water clear to tea-colored; no barriers to fish movement (seasonal water withdrawals prevent movement); many fish cover types available; diverse and stable aquatic habitat; no disturbance by livestock or man; intolerant microinvertebrates present.

Moderate Quality: Altered channel evidenced by rip rap and/or channelization; dikes/levees restrict flood plain width; natural vegetation extends 1/3-1/2 of the active channel width on each side; filtering function of riparian vegetation only moderately compromised; banks moderately unstable (outside bends actively eroding with few fallen trees); considerable water cloudiness, submerged objects covered with green film; moderate odor; minor barriers to fish movement; 4-3 fish cover types available; fair aquatic habitat; minimum disturbance by livestock or man; Facultative microinvertebrates present.

Low Quality: Channel is actively downcutting or widening; rip rap and channilization excessive; flood plain restricted by dikes/levees; natural vegetation less than 1/3 of the active channel width on each side; lack of regeneration; filtering function severely compromised; Banks unstable (inside and outside bends actively eroding with numerous fallen trees); water very turbid to muddy; obvious pollutants (algal mats, surface scum, surface sheen); heavy odor; green color to water; severe barriers to fish movement; 2-0 fish cover types available; little to no aquatic habitat; severe disturbance by livestock or man; tolerant or no microinvertebrates present.

WATERBODY DELINEATION FORM

Waterbody Name: Stream 2 **Waterbody ID No.:** S2

Associated Wetland No.:

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 023473	Weather: 60 F; Clear
Investigators: MS/MG - Woodard & Curran	State/County/Municipality: New Windsor, NY	Quad Name:

PHYSICAL ATTRIBUTES

Waterbody Characteristic Photo

Facing: West Direction of Flow: West



Waterbody Type	Lake	Pond	Borrow Pit	River	(Stream)	Ag. Ditch	Other:		
Stream Flow	Fast		Moderate		Slow		(Very Slow)		None
Flow type	Perennial		(Intermittent)		Ephemeral				
Stream Depth (in.)	(0-3)	3-6	6-12	12-18	18-24	24-36	36-48	48-60	60+
Stream Width (ft.)	Top of Bank: 6				Water Surface: 2				
OHWM _____(ft.)									
Bank Height (ft.) (looking downstream else give direction you are facing here:_____)	Left	(0-2)	2-4		4-6		6-8		8+
	Right	(0-2)	2-4		4-6		6-8		8+
Bank Slope (°) (looking downstream else give direction you are facing here:_____)	Left	(0-20)	20-40		40-60		60-80		80+
	Right	(0-20)	20-40		40-60		60-80		80+

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 0232473	Investigators: MS/MG

QUALITATIVE ATTRIBUTES

Water Appearance	Clear	Slightly Turbid	Turbid	Very Turbid	Color:
	Floating algal mats	Obvious surface scum	Sheen on surface	Greenish color	Other:
Stream Substrate %	Bedrock____	Gravel 10%	Sand 20%	Silt/Clay 40%	Organic 30%
Aquatic Habitats	Sand Bar	Gravel Bar	Mud Bar	Gravel Riffles	Deep Pools
Undercut Banks	Overhanging trees/shrubs	In-stream emergent plants	In-stream submerged plants	Bank root systems	Fringing Wetlands
Aquatic Organisms Observed	Waterfowl	Fish (adult)	Fish (juvenile)	Frogs	Turtles
	Snakes	Other:			
	Invertebrates:	Intolerant	Facultative	Tolerant	None
Riparian Zone	Width of natural vegetation zone from edge of active channel out onto flood plan: (wetlands adjacent) (ft)				
	Circle vegetative layers: trees shrubs herbs				
	❑ Significant bare areas within riparian zone				
	❑ Evidence of non-buffered concentrated flows				
Channel Condition	Channelization/Braiding	Unnatural straitening	Downcutting	Dikes/Berms	Excessive bank erosion
Disturbances	❑ Livestock access to riparian zone		❑ Manure in stream or on banks		
	❑ Waste discharge pipes present		☒ Other: Terrain was observed to be disturbed.		

Comments

STREAM QUALITY (indicate)	❑ High	☒ Moderate	❑ Low

High Quality: Natural channel (no structures or dikes; no evidence of downcutting or excessive lateral cutting); evidence of past channel alteration with significant recovery; any dikes/levies are set back to provide access to adequate flood plain; natural vegetation extends at least one or two active channel widths on each side; banks stable and protected by roots that extend to the base-flow elevation; water clear to tea-colored; no barriers to fish movement (seasonal water withdrawals prevent movement); many fish cover types available; diverse and stable aquatic habitat; no disturbance by livestock or man; intolerant microinvertebrates present.

Moderate Quality: Altered channel evidenced by rip rap and/or channelization; dikes/levees restrict flood plain width; natural vegetation extends 1/3-1/2 of the active channel width on each side; filtering function of riparian vegetation only moderately compromised; banks moderately unstable (outside bends actively eroding with few fallen trees); considerable water cloudiness, submerged objects covered with green film; moderate odor; minor barriers to fish movement; 4-3 fish cover types available; fair aquatic habitat; minimum disturbance by livestock or man; Facultative microinvertebrates present.

Low Quality: Channel is actively downcutting or widening; rip rap and channilization excessive; flood plain restricted by dikes/levees; natural vegetation less than 1/3 of the active channel width on each side; lack of regeneration; filtering function severely compromised; Banks unstable (inside and outside bends actively eroding with numerous fallen trees); water very turbid to muddy; obvious pollutants (algal mats, surface scum, surface sheen); heavy odor; green color to water; severe barriers to fish movement; 2-0 fish cover types available; little to no aquatic habitat; severe disturbance by livestock or man; tolerant or no microinvertebrates present.

WATERBODY DELINEATION FORM

Waterbody Name: Stream 3 **Waterbody ID No.:** S3

Associated Wetland No.:

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 023473	Weather: 60 F; Clear
Investigators: MS/MG - Woodard & Curran	State/County/Municipality: New Windsor, NY	Quad Name:

PHYSICAL ATTRIBUTES

Waterbody Characteristic Photo

Facing: North Direction of Flow: South



Waterbody Type	Lake	Pond	Borrow Pit	River	(Stream)	Ag. Ditch	Other:		
Stream Flow	Fast		Moderate		(Slow)		Very Slow		None
Flow type	(Perennial)		Intermittent		Ephemeral				
Stream Depth (in.)	0-3	(3-6)	6-12	12-18	18-24	24-36	36-48	48-60	60+
Stream Width (ft.)	Top of Bank: 7				Water Surface: 6				
OHWM _____(ft.)									
Bank Height (ft.) (looking downstream else give direction you are facing here:_____)	Left	(0-2)	2-4		4-6		6-8		8+
	Right	(0-2)	2-4		4-6		6-8		8+
Bank Slope (°) (looking downstream else give direction you are facing here:_____)	Left	(0-20)	20-40		40-60		60-80		80+
	Right	(0-20)	20-40		40-60		60-80		80+

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 0232473	Investigators: MS/MG

QUALITATIVE ATTRIBUTES

Water Appearance	(Clear)	Slightly Turbid	Turbid	Very Turbid	Color:
	Floating algal mats	Obvious surface scum	Sheen on surface	Greenish color	Other:
Stream Substrate %	Bedrock_____	Gravel 10%	Sand 20%	Silt/Clay 40%	Organic 30%
Aquatic Habitats	Sand Bar	Gravel Bar	Mud Bar	Gravel Riffles	Deep Pools
Undercut Banks	(Overhanging trees/shrubs)	(In-stream emergent plants)	In-stream submerged plants	Bank root systems	(Fringing Wetlands)
Aquatic Organisms Observed	Waterfowl	Fish (adult)	Fish (juvenile)	Frogs	Turtles
	Snakes	Other:			
	Invertebrates:	Intolerant	Facultative	Tolerant	None
Riparian Zone	Width of natural vegetation zone from edge of active channel out onto flood plan: (wetlands adjacent) (ft)				
	Circle vegetative layers: (trees) (shrubs) (herbs)				
	❑ Significant bare areas within riparian zone				
	❑ Evidence of non-buffered concentrated flows				
Channel Condition	(Channelization/Braiding)	Unnatural straitening	Downcutting	Dikes/Berms	Excessive bank erosion
Disturbances	❑ Livestock access to riparian zone		❑ Manure in stream or on banks		
	❑ Waste discharge pipes present		☒ Other: Terrain was observed to be disturbed.		

Comments

STREAM QUALITY (indicate)	❑ High	☒ Moderate	❑ Low

High Quality: Natural channel (no structures or dikes; no evidence of downcutting or excessive lateral cutting); evidence of past channel alteration with significant recovery; any dikes/levies are set back to provide access to adequate flood plain; natural vegetation extends at least one or two active channel widths on each side; banks stable and protected by roots that extend to the base-flow elevation; water clear to tea-colored; no barriers to fish movement (seasonal water withdrawals prevent movement); many fish cover types available; diverse and stable aquatic habitat; no disturbance by livestock or man; intolerant microinvertebrates present.

Moderate Quality: Altered channel evidenced by rip rap and/or channelization; dikes/levees restrict flood plain width; natural vegetation extends 1/3-1/2 of the active channel width on each side; filtering function of riparian vegetation only moderately compromised; banks moderately unstable (outside bends actively eroding with few fallen trees); considerable water cloudiness, submerged objects covered with green film; moderate odor; minor barriers to fish movement; 4-3 fish cover types available; fair aquatic habitat; minimum disturbance by livestock or man; Facultative microinvertebrates present.

Low Quality: Channel is actively downcutting or widening; rip rap and channilization excessive; flood plain restricted by dikes/levees; natural vegetation less than 1/3 of the active channel width on each side; lack of regeneration; filtering function severely compromised; Banks unstable (inside and outside bends actively eroding with numerous fallen trees); water very turbid to muddy; obvious pollutants (algal mats, surface scum, surface sheen); heavy odor; green color to water; severe barriers to fish movement; 2-0 fish cover types available; little to no aquatic habitat; severe disturbance by livestock or man; tolerant or no microinvertebrates present.

WATERBODY DELINEATION FORM

Waterbody Name: Stream 4 **Waterbody ID No.:** S4

Associated Wetland No.:

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 023473	Weather: 60 F; Clear
Investigators: MS/MG - Woodard & Curran	State/County/Municipality: New Windsor, NY	Quad Name:

PHYSICAL ATTRIBUTES

Waterbody Characteristic Photo

Facing: South Direction of Flow: South



Waterbody Type	Lake	Pond	Borrow Pit	River	(Stream)	Ag. Ditch	Other:		
Stream Flow	Fast		Moderate		(Slow)		Very Slow		None
Flow type	Perennial		(Intermittent)		Ephemeral				
Stream Depth (in.)	(0-3)	3-6	6-12	12-18	18-24	24-36	36-48	48-60	60+
Stream Width (ft.)	Top of Bank: 4				Water Surface: 4				
OHWM _____(ft.)									

Bank Height (ft.) (looking downstream else give direction you are facing here:_____)	Left	(0-2)	2-4	4-6	6-8	8+
	Right	(0-2)	2-4	4-6	6-8	8+
Bank Slope (°) (looking downstream else give direction you are facing here:_____)	Left	(0-20)	20-40	40-60	60-80	80+
	Right	(0-20)	20-40	40-60	60-80	80+

Date: April 26, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 0232473	Investigators: MS/MG

QUALITATIVE ATTRIBUTES

Water Appearance	Clear	Slightly Turbid	Turbid	Very Turbid	Color:
	Floating algal mats	Obvious surface scum	Sheen on surface	Greenish color	Other:
Stream Substrate %	Bedrock____	Gravel 10%	Sand 20%	Silt/Clay 40%	Organic 30%
Aquatic Habitats	Sand Bar	Gravel Bar	Mud Bar	Gravel Riffles	Deep Pools
Undercut Banks	Overhanging trees/shrubs	In-stream emergent plants	In-stream submerged plants	Bank root systems	Fringing Wetlands
Aquatic Organisms Observed	Waterfowl	Fish (adult)	Fish (juvenile)	Frogs	Turtles
	Snakes	Other:			
	Invertebrates:	Intolerant	Facultative	Tolerant	None
Riparian Zone	Width of natural vegetation zone from edge of active channel out onto flood plan: 15 (ft) Circle vegetative layers: trees shrubs herbs ❑ Significant bare areas within riparian zone ❑ Evidence of non-buffered concentrated flows				
Channel Condition	Channelization/Braiding	Unnatural straitening	Downcutting	Dikes/Berms	Excessive bank erosion
Disturbances	❑ Livestock access to riparian zone		❑ Manure in stream or on banks		
	❑ Waste discharge pipes present		☒ Other: Terrain was observed to be disturbed.		

Comments

STREAM QUALITY (indicate)	❑ High	☒ Moderate	❑ Low

High Quality: Natural channel (no structures or dikes; no evidence of downcutting or excessive lateral cutting); evidence of past channel alteration with significant recovery; any dikes/levies are set back to provide access to adequate flood plain; natural vegetation extends at least one or two active channel widths on each side; banks stable and protected by roots that extend to the base-flow elevation; water clear to tea-colored; no barriers to fish movement (seasonal water withdrawals prevent movement); many fish cover types available; diverse and stable aquatic habitat; no disturbance by livestock or man; intolerant microinvertebrates present.

Moderate Quality: Altered channel evidenced by rip rap and/or channelization; dikes/levees restrict flood plain width; natural vegetation extends 1/3-1/2 of the active channel width on each side; filtering function of riparian vegetation only moderately compromised; banks moderately unstable (outside bends actively eroding with few fallen trees); considerable water cloudiness, submerged objects covered with green film; moderate odor; minor barriers to fish movement; 4-3 fish cover types available; fair aquatic habitat; minimum disturbance by livestock or man; Facultative microinvertebrates present.

Low Quality: Channel is actively downcutting or widening; rip rap and channilization excessive; flood plain restricted by dikes/levees; natural vegetation less than 1/3 of the active channel width on each side; lack of regeneration; filtering function severely compromised; Banks unstable (inside and outside bends actively eroding with numerous fallen trees); water very turbid to muddy; obvious pollutants (algal mats, surface scum, surface sheen); heavy odor; green color to water; severe barriers to fish movement; 2-0 fish cover types available; little to no aquatic habitat; severe disturbance by livestock or man; tolerant or no microinvertebrates present.

WATERBODY DELINEATION FORM

Waterbody Name: Stream 5/Stream 5B **Waterbody ID No.:** S5/S5B

Associated Wetland No.:

Date: April 27, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 023473	Weather: 60 F; Clear
Investigators: SR/KA - Woodard & Curran	State/County/Municipality: New Windsor, NY	Quad Name:

PHYSICAL ATTRIBUTES

Waterbody Characteristic Photo

Facing: NNW Direction of Flow: SSW



Waterbody Type	Lake	Pond	Borrow Pit	River	(Stream)	Ag. Ditch	Other:		
Stream Flow	Fast		(Moderate)		Slow		Very Slow		None
Flow type	(Perennial)		Intermittent		Ephemeral				
Stream Depth (in.)	0-3	3-6	6-12	12-18	(18-24)	24-36	36-48	48-60	60+
Stream Width (ft.) **OHWM _____(ft.)**	Top of Bank: most commonly 18 feet; stream varied in quadrants				Water Surface: most commonly 12 feet; stream varied in quadrants				

Bank Height (ft.) (looking downstream else give direction you are facing here:_____)	Left	0-2	2-4	4-6	6-8	(8+)
	Right	0-2	2-4	4-6	6-8	(8+)
Bank Slope (°) (looking downstream else give direction you are facing here:_____)	Left	0-20	20-40	40-60	60-80	(80+)
	Right	0-20	20-40	40-60	60-80	(80+)

Date: April 27, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 0232473	Investigators: SR/KA - Woodard & Curran

QUALITATIVE ATTRIBUTES

Water Appearance	(Clear)	Slightly Turbid	Turbid	Very Turbid	Color:
	Floating algal mats	Obvious surface scum	Sheen on surface	Greenish color	Other:
Stream Substrate %	Bedrock 100%	Gravel_____	Sand_____	Silt/Clay_____	Organic_____
Aquatic Habitats	Sand Bar	Gravel Bar	Mud Bar	(Gravel Riffles)	(Deep Pools)
Undercut Banks	Overhanging trees/shrubs	(In-stream emergent plants)	In-stream submerged plants	(Bank root systems)	Fringing Wetlands
Aquatic Organisms Observed	Waterfowl	Fish (adult)	Fish (juvenile)	Frogs	Turtles
	Snakes	Other:			
	Invertebrates:	Intolerant	Facultative	Tolerant	None
Riparian Zone	Width of natural vegetation zone from edge of active channel out onto flood plan: >5 (ft)				
	Circle vegetative layers: (trees) (shrubs) (herbs)				
	❑ Significant bare areas within riparian zone				
	❑ Evidence of non-buffered concentrated flows				
Channel Condition	(Channelization/Braiding)	Unnatural straitening	Downcutting	Dikes/Berms	Excessive bank erosion
Disturbances	❑ Livestock access to riparian zone		❑ Manure in stream or on banks		
	❑ Waste discharge pipes present		☒ Other: Terrain was observed to be disturbed.		

Comments

Stream 6 meets Stream 5 at quadrant S6-1 point. Quadrant S6-38 and S6-39 is receiving leaching groundwater with depositional iron observed along the stream bank.

STREAM QUALITY (indicate)	❑ High	☒ Moderate	❑ Low

High Quality: Natural channel (no structures or dikes; no evidence of downcutting or excessive lateral cutting); evidence of past channel alteration with significant recovery; any dikes/levies are set back to provide access to adequate flood plain; natural vegetation extends at least one or two active channel widths on each side; banks stable and protected by roots that extend to the base-flow elevation; water clear to tea-colored; no barriers to fish movement (seasonal water withdrawals prevent movement); many fish cover types available; diverse and stable aquatic habitat; no disturbance by livestock or man; intolerant microinvertebrates present.

Moderate Quality: Altered channel evidenced by rip rap and/or channelization; dikes/levees restrict flood plain width; natural vegetation extends 1/3-1/2 of the active channel width on each side; filtering function of riparian vegetation only moderately compromised; banks moderately unstable (outside bends actively eroding with few fallen trees); considerable water cloudiness, submerged objects covered with green film; moderate odor; minor barriers to fish movement; 4-3 fish cover types available; fair aquatic habitat; minimum disturbance by livestock or man; Facultative microinvertebrates present.

Low Quality: Channel is actively downcutting or widening; rip rap and channilization excessive; flood plain restricted by dikes/levees; natural vegetation less than 1/3 of the active channel width on each side; lack of regeneration; filtering function severely compromised; Banks unstable (inside and outside bends actively eroding with numerous fallen trees); water very turbid to muddy; obvious pollutants (algal mats, surface scum, surface sheen); heavy odor; green color to water; severe barriers to fish movement; 2-0 fish cover types available; little to no aquatic habitat; severe disturbance by livestock or man; tolerant or no microinvertebrates present.

WATERBODY DELINEATION FORM

Waterbody Name: Stream 5 **Waterbody ID No.:** 4

Associated Wetland No.:

Date: April 27, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 023473	Weather: 60 F; Clear
Investigators: SR/KA - Woodard & Curran	State/County/Municipality: New Windsor, NY	Quad Name:

PHYSICAL ATTRIBUTES

Waterbody Characteristic Photo

Facing: ESE Direction of Flow: SSE



Waterbody Type	Lake	Pond	Borrow Pit	River	(Stream)	Ag. Ditch	Other:		
Stream Flow	Fast		(Moderate)		Slow		Very Slow		None
Flow type	Perennial		(Intermittent)		Ephemeral				
Stream Depth (in.)	0-3	3-6	(6-12)	12-18	18-24	24-36	36-48	48-60	60+
Stream Width (ft.)	Top of Bank: 5.83 ft				Water Surface: 5.42 ft				
OHWM _____(ft.)									

Bank Height (ft.) (looking downstream else give direction you are facing here:_____)	Left	0-2	2-4	(4-6)	6-8	8+
	Right	(0-2)	2-4	4-6	6-8	8+
Bank Slope (°) (looking downstream else give direction you are facing here:_____)	Left	(0-20)	20-40	(40-60)	60-80	80+
	Right	(0-20)	20-40	40-60	60-80	80+

Date: April 27, 2021	Client/Project Name & No.: USACE/Stewart Intl Airport; 0232473	Investigators: SR/KA - Woodard & Curran

QUALITATIVE ATTRIBUTES

Water Appearance	(Clear)	Slightly Turbid	Turbid	Very Turbid	Color:
	Floating algal mats	(Obvious surface scum)	Sheen on surface	Greenish color	Other:
Stream Substrate %	Bedrock____	Gravel 25%	Sand 25%	Silt/Clay 25%	Organic 25%
Aquatic Habitats	(Sand Bar)	(Gravel Bar)	Mud Bar	Gravel Riffles	Deep Pools
Undercut Banks	Overhanging trees/shrubs	(In-stream emergent plants)	In-stream submerged plants	(Bank root systems)	Fringing Wetlands
Aquatic Organisms Observed	Waterfowl	Fish (adult)	Fish (juvenile)	Frogs	Turtles
	Snakes	Other:			
	Invertebrates:	Intolerant	Facultative	Tolerant	None
Riparian Zone	Width of natural vegetation zone from edge of active channel out onto flood plan: >5 (ft)				
	Circle vegetative layers: (trees) (shrubs) herbs				
	❑ Significant bare areas within riparian zone				
	❑ Evidence of non-buffered concentrated flows				
Channel Condition	(Channelization/Braiding)	Unnatural straitening	Downcutting	Dikes/Berms	Excessive bank erosion
Disturbances	❑ Livestock access to riparian zone		❑ Manure in stream or on banks		
	❑ Waste discharge pipes present		☒ Other: Terrain was observed to be disturbed.		

Comments

Quadrant S5-30 to S5-32, braiding channels were observed. Quadrant S5-31-32, turbid opaque water and slight sulfur smell was observed. Stream 5 meets Stream 6 at quadrant S5-43 point.

STREAM QUALITY (indicate)	❑ High	☒ Moderate	❑ Low

High Quality: Natural channel (no structures or dikes; no evidence of downcutting or excessive lateral cutting); evidence of past channel alteration with significant recovery; any dikes/levies are set back to provide access to adequate flood plain; natural vegetation extends at least one or two active channel widths on each side; banks stable and protected by roots that extend to the base-flow elevation; water clear to tea-colored; no barriers to fish movement (seasonal water withdrawals prevent movement); many fish cover types available; diverse and stable aquatic habitat; no disturbance by livestock or man; intolerant microinvertebrates present.

Moderate Quality: Altered channel evidenced by rip rap and/or channelization; dikes/levees restrict flood plain width; natural vegetation extends 1/3-1/2 of the active channel width on each side; filtering function of riparian vegetation only moderately compromised; banks moderately unstable (outside bends actively eroding with few fallen trees); considerable water cloudiness, submerged objects covered with green film; moderate odor; minor barriers to fish movement; 4-3 fish cover types available; fair aquatic habitat; minimum disturbance by livestock or man; Facultative microinvertebrates present.

Low Quality: Channel is actively downcutting or widening; rip rap and channilization excessive; flood plain restricted by dikes/levees; natural vegetation less than 1/3 of the active channel width on each side; lack of regeneration; filtering function severely compromised; Banks unstable (inside and outside bends actively eroding with numerous fallen trees); water very turbid to muddy; obvious pollutants (algal mats, surface scum, surface sheen); heavy odor; green color to water; severe barriers to fish movement; 2-0 fish cover types available; little to no aquatic habitat; severe disturbance by livestock or man; tolerant or no microinvertebrates present.

ATTACHMENT D
Wetland Photo Log

Attachment D – Wetland Photo Log



Wetland W1. Facing north.



Wetland W2. Facing northwest.



Wetland W3. Facing northwest.



Wetland W4. Facing north.



Wetland W5. Facing northeast.



Wetland W5B. Facing southeast.



Wetland W6. Facing southeast.



Wetland 7. Common vegetation.

ATTACHMENT E
USACE Vernal Pool Characterization Forms

US Army Corps of Engineers - New England District
DRAFT Vernal Pool Characterization Form

Project File # 0232473.00 Project Name Vernal Pool Assessment Pool ID VP1
Observer S. Rogacki and K. Apigian of Woodard & Curran Phone or E-mail
Landowner/Applicant US Army Corps Phone or E-mail
Address Stewart International Airport, Air Base City New Windsor State NY Zip 12553
Location of vernal pool: City/State New Windsor, NY
Survey date(s) April 26-27, 2021
Longitude/Latitude (in decimal degrees) 41.4908; -74.0894

A. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Landscape setting (check all that apply):

☐ Upland depression (4 pts; if this is also in a floodplain, use 2 pts)
☐ Pool part of wildlife corridor (4 pts)
☒ Pool part of a pool complex (within 1000 feet of one or more other vernal pools) (NA)
☐ Pool within larger wetland system (4 pts; if this is also in a floodplain, use 2 pts)
☐ Other: (variable pts)

2. Vernal pool condition:

Describe any recent modifications to the pool and associated landscape: Surrounding terrain was observed to be disturbed.

3. Parent material:

☐ Glacial fluvial ("outwash")
☒ Loose till
☐ Peat
☐ Dense till
☐ Alluvium
☐ Coastal marine sediments

4. Aquatic resource type that best applies to this pool (choose dominant):

☒ Forested wetland (4 pts)
☐ Herbaceous wetland (4 pts)
☐ Floodplain (overflow/oxbow) (3 pts)
☐ Shrub wetland (4 pts)
☐ Open water (2 pts)
☐ Other: (variable points)
☐ Peatland (acidic fen or bog) (4 pts)
☒ Intermittent stream reach (2 pts)

5. Pool canopy cover (%): 85-90%

6. Predominant substrate:

☐ Mineral soil
☒ Organic matter (peat/muck) Depth Sampling location (e.g., deepest zone, edge, etc.) Deepest: 12 in; Edge: >1in

7. Pool size:

a. Approximate dimensions of pool (at maximum capacity; include units): Length 180 Width 78
Area: 10,000 ft2

b. Maximum depth at deepest point at time of survey (include units): Deepest: 12 in

8. Hydrology:

a. Estimated hydroperiod (unless actual, observed hydroperiod value(s) is(are) known, use the presence of these example indicator species to best predict the expected hydroperiod of the pool):

☒ Dries between early March and early July (e.g., *Thelypteris palustris, Carex stricta, Impatiens capensis, Ilex verticillata*) (6 pts)
☐ Dries between early July and early September (e.g., *Sagittaria latifolia, Scirpus cyperinus, Dulichium arund., Cephalanthus occ.*) (8 pts)
☐ Dries between early September and early November (e.g., *Eleocharis palustris, Glyceria cana., Utricularia* spp., *Decodon vert.*) (8 pts)
☐ Dries between early November and late December, or intermittently exposed (e.g., *Nuphar* spp., *Potamogeton* spp.) (2 pts)

b. Inlet/outlet (pick one):

☐ No inlet/outlet (8 pts)
☐ Permanent inlet or outlet (channel with well-defined banks and permanent flow) (2 pts)
☒ Temporary inlet/outlet (6 pts)

9. Water quality:

☒ Clear
☐ High turbidity
☒ High algae content
☐ Tannic

18 **TOTAL for Pool Characteristics (out of 28 max.)**

B. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

1. Landuse type and approximate percentage within the 100-ft vernal pool envelope:

☒ Forested 100 % (16 pts) ☐ Open (e.g., meadow, agriculture, golf course) ____ % (4 pts)

☐ Shrub ____ % (10 pts) ☐ Developed ____ % (0 pts)

2. **Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat:**

☒ Forested 80 % (16 pts) ☒ Open (e.g., agriculture, golf course) 10 % (4 pts)

☐ Shrub ____ % (10 pts) ☒ Developed 10 % (0 pts)

☐ Are there one or more barriers to vernal pool fauna movement within the envelope and/or critical terrestrial habitat? If so, check here and see directions for explanation of how to incorporate this information.

Based on: ☐ Field estimate ☐ GIS ☐ Aerial photo estimate

29.2 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area (out of 32 max.)**

C. SPECIES PRESENT IN VERNAL POOL

INDICATOR SPECIES	**DATE**	**EGG MASSES (#)**	**TADPOLES/LARVAE**
Wood Frog (*Lithobates sylvaticus*)			
Spotted Salamander (*Ambystoma maculatum*)			
Blue-spotted Salamander (*Ambystoma laterale*)			
Jefferson's Salamander (*Ambystoma jeffersonianum*)			
Marbled Salamander (*Ambystoma opacum*)			
Fairy Shrimp (*Eubranchipus* spp.)		**PRESENT/ABSENT**	**ABUNDANCE:**
OTHER SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Facultative Species (e.g., Spring Peeper (*Pseudacris crucifer*), Gray Tree Frog (*Hyla versicolor*), Caddisflies (Limnephilidae, Phryganeidae), American Toad (*Anaxyrus americanus*), Eastern Spadefoot Toad (*Scaphiopus holbrookii*), Fowler's Toad (*Anaxyrus fowleri*), Fingernail Clams (Sphaeriidae, Pisidiidae))(list):	4/26/2021	Adult spring peepers heard in vicinity. Spring peeper tadpoles observed in pool	Few
Rare Species (list):			
Predator Species (e.g., Bullfrog/Green frog tadpoles, Fish) (list):			
Other species (e.g., Ducks, Turtles, etc.)(list): Mosquito larvae, water striders, beetle larvae, diving beetles			

Presence of Indicator Species ☐ Yes ☒ No

SUMMARY:

18 **TOTAL for Pool Characteristics** 29.2 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area**

Other comments (append photographs, additional notes, sketch of pool and surrounding landscape):

Plant species: *Phragmites*, *Cornus*, sp., *Viburnum* sp., *Equisetum* sp., *Carex stricta*, *Juncus effusus*, *Rosa multiflora*, *Symplocarpus foetidus*. Trees: swamp white oak, poplar, red oak, red maple.

Photographs:





US Army Corps of Engineers - New England District
DRAFT Vernal Pool Characterization Form

Project File # 0232473.00 Project Name Vernal Pool Assessment Pool ID VP2
Observer S. Rogacki and K. Apigian of Woodard & Curran Phone or E-mail
Landowner/Applicant US Army Corps Phone or E-mail
Address Stewart International Airport, Air Base City New Windsor State NY Zip 12553
Location of vernal pool: City/State New Windsor, NY
Survey date(s) April 26-27, 2021
Longitude/Latitude (in decimal degrees) 41.4905; -74.0847

A. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Landscape setting (check all that apply):

☐ Upland depression (4 pts; if this is also in a floodplain, use 2 pts)
☐ Pool part of wildlife corridor (4 pts)
☒ Pool part of a pool complex (within 1000 feet of one or more other vernal pools) (NA)
☐ Pool within larger wetland system (4 pts; if this is also in a floodplain, use 2 pts)
☐ Other: (variable pts)

2. Vernal pool condition:

Describe any recent modifications to the pool and associated landscape: Surrounding terrain was observed to be disturbed.

3. Parent material:

☐ Glacial fluvial ("outwash")
☒ Loose till
☐ Peat
☐ Dense till
☐ Alluvium
☐ Coastal marine sediments

4. Aquatic resource type that best applies to this pool (choose dominant):

☒ Forested wetland (4 pts)
☐ Herbaceous wetland (4 pts)
☐ Floodplain (overflow/oxbow) (3 pts)
☐ Shrub wetland (4 pts)
☐ Open water (2 pts)
☐ Other: (variable points)
☐ Peatland (acidic fen or bog) (4 pts)
☐ Intermittent stream reach (2 pts)

5. Pool canopy cover (%): 20%

6. Predominant substrate:

☐ Mineral soil
☒ Organic matter (peat/muck) Depth Sampling location (e.g., deepest zone, edge, etc.) Deepest: 12 in; Edge: >1in

7. Pool size:

a. Approximate dimensions of pool (at maximum capacity; include units): Length 65 Width 40
Area: 1,900 ft2

b. Maximum depth at deepest point at time of survey (include units): Deepest: 12 in

8. Hydrology:

a. Estimated hydroperiod (unless actual, observed hydroperiod value(s) is(are) known, use the presence of these example indicator species to best predict the expected hydroperiod of the pool):

☒ Dries between early March and early July (e.g., *Thelypteris palustris, Carex stricta, Impatiens capensis, Ilex verticillata*) (6 pts)
☐ Dries between early July and early September (e.g., *Sagittaria latifolia, Scirpus cyperinus, Dulichium arund., Cephalanthus occ.*) (8 pts)
☐ Dries between early September and early November (e.g., *Eleocharis palustris, Glyceria cana., Utricularia* spp., *Decodon vert.*) (8 pts)
☐ Dries between early November and late December, or intermittently exposed (e.g., *Nuphar* spp., *Potamogeton* spp.) (2 pts)

b. Inlet/outlet (pick one):

☒ No inlet/outlet (8 pts)
☐ Permanent inlet or outlet (channel with well-defined banks and permanent flow) (2 pts)
☐ Temporary inlet/outlet (6 pts)

9. Water quality:

☒ Clear
☐ High turbidity
☐ High algae content
☐ Tannic

16 **TOTAL for Pool Characteristics (out of 28 max.)**

B. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

1. Landuse type and approximate percentage within the 100-ft vernal pool envelope:

☒ Forested 100 % (16 pts) ☐ Open (e.g., meadow, agriculture, golf course) ____ % (4 pts)

☐ Shrub ____ % (10 pts) ☐ Developed ____ % (0 pts)

2. **Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat:**

☒ Forested 80 % (16 pts) ☒ Open (e.g., agriculture, golf course) 10 % (4 pts)

☐ Shrub ____ % (10 pts) ☒ Developed 10 % (0 pts)

☐ Are there one or more barriers to vernal pool fauna movement within the envelope and/or critical terrestrial habitat? If so, check here and see directions for explanation of how to incorporate this information.

Based on: ☐ Field estimate ☐ GIS ☐ Aerial photo estimate

29.2 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area (out of 32 max.)**

C. SPECIES PRESENT IN VERNAL POOL

INDICATOR SPECIES	**DATE**	**EGG MASSES (#)**	**TADPOLES/LARVAE**
Wood Frog (*Lithobates sylvaticus*)			
Spotted Salamander (*Ambystoma maculatum*)			
Blue-spotted Salamander (*Ambystoma laterale*)			
Jefferson's Salamander (*Ambystoma jeffersonianum*)			
Marbled Salamander (*Ambystoma opacum*)			
Fairy Shrimp (*Eubranchipus* spp.)		**PRESENT/ABSENT**	**ABUNDANCE:**
OTHER SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Facultative Species (e.g., Spring Peeper (*Pseudacris crucifer*), Gray Tree Frog (*Hyla versicolor*), Caddisflies (Limnephilidae, Phryganeidae), American Toad (*Anaxyrus americanus*), Eastern Spadefoot Toad (*Scaphiopus holbrookii*), Fowler's Toad (*Anaxyrus fowleri*), Fingernail Clams (Sphaeriidae, Pisidiidae))(list):	4/26/2021	Spring peeper, *Pseudacris crucifer*	Common - hatched egg masses
Rare Species (list):			
Predator Species (e.g., Bullfrog/Green frog tadpoles, Fish) (list):			
Other species (e.g., Ducks, Turtles, etc.)(list): Mosquito larvae; snail (Physidae: *Aplexa*)	4/26/2021		

Presence of Indicator Species ☐ Yes ☒ No

SUMMARY:

16 **TOTAL for Pool Characteristics** 29.2 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area**

Other comments (append photographs, additional notes, sketch of pool and surrounding landscape):

Plant species: *Carex* sp., *Rosa multiflora*. Trees: sycamore, swamp white oak, poplar, red oak, red maple.

Photographs:





APPENDIX C

HISTORICAL SAMPLING DETECTIONS

Appendix C
Historical Data Evaluation
and
2021 Geophysical Survey Report

Table of Contents

Abbreviations and Acronyms iv
Historical Data Evaluation 6
1 Introduction 6
2 Screening Criteria 6
3 Evaluation Approach 10
4 Soil 11
5 Groundwater 18
6 Sediment 26
7 Surface Water 33
8 Soil Gas Results 38
References 40

FIGURES

UFP-QAPP main document numbered Figures 15 through 18 are provided as part of this Appendix.

Figure 15. Historical Soil Sampling Locations
Figure 16. Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells
Figure 17. Historical Sediment and Surface Water Sampling Locations
Figure 18. Historical Landfill Extent, Contents, and Landfill Gas Investigations

TABLES

Table 1. Reports from which Data was included in the Historical Data Evaluation 7

Table 2. Sources of Screening Criteria Used in the Historical Data Evaluation 9

Table 3. Historical Maximum Subsurface Soil Sampling Results Exceeding One or Both Soil Screening Criteria. 15

Table 4. Maximum Metals Detections for Subsurface Soil 17

Table 5. Historical Monitoring Wells Evaluated 19

Table 6. Historical Maximum Groundwater Sampling Results Exceeding the Human Health Groundwater Screening Criteria. 24

Table 7. Maximum Metals Detections for Groundwater 25

Table 8. Historical Maximum Sediment Sampling Results Exceeding one or both Sediment Screening Criteria. 29

Table 9. Maximum Metals Detections for Sediment 32

Table 10. Historical Maximum Surface Water Sampling Results Exceeding one or both Surface Water Screening Criteria..... 36

Table 11. Maximum Metals Detections for Surface Water 37

Abbreviations and Acronyms

AFB	Air Force Base
Aneptek	Aneptek Corporation
AOC	Area of Concern
bgs	Below Ground Surface
Bluestone	Bluestone Environmental Group, Inc.
CAS	Chemical Abstract Service
CSM	Conceptual site model
DG	downgradient
DM	damaged
DDD	dichlorodiphenyldichloro-ethane
DDE	dichlorodiphenyldichloro-ethylene
DDT	dichlorodiphenyltrichloro-ethane
DoD	Department of Defense
DRO	Diesel Range Organics
DS	downstream
EDR	Environmental Data Resources, Inc
ETM	Expanded Technical Memorandum
GRO	Gasoline Range Organics
LEL	lower explosive limit
LMS	Lawler, Matusky and Skelly Engineers
MCC	Metal Container Corporation
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
mg/L	Milligrams per Liter
mg/kg	Milligrams per Kilogram
MW	Monitoring Well
NA	Not Analyzed
ND	No detections for any samples within the area specified
NE	No screening criteria exists
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
Ogden	Ogden Environmental and Energy Services Co., Inc.
PAH	polycyclic aromatic hydrocarbon
PCB	Poly Chlorinated Biphenyl
PCE	Tetrachloroethylene
%	Percent
ppm	Parts Per Million
PID	photoionization detector
PGM	portable gas meter
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
Roux	Roux Associates, Inc.
RSL	Regional Screening Level
SVOC	Semi-Volatile Organic Compounds
SWF	Stewart International Airport
SWFAA	SWF Airport Acquisition, Inc
SWQuadFF	Southwest Quadrant Fuel Farm

TAL	Target Analyte List	US	upstream
TOC	Total Organic Carbon	USACE	United States Army Corps of Engineers
UEL	upper explosive limit	USEPA	United States Environmental Protection Agency
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans	UST	Underground Storage Tank
UG	upgradient	VOC	Volatile Organic Compound

Historical Data Evaluation

1 Introduction

The Bluestone 2019 Expanded Technical Memorandum (ETM) developed the first Conceptual Site Model (CSM) that focused specifically on AOC 2 and AOC 3S. Following the completion of the ETM, reports were made available by the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Transportation (NYSDOT) that documented additional past investigations that were not known about at the time of the ETM development.

This appendix documents the combined evaluation of historical data from the reports made available through NYSDEC, NYSDOT, and reports previously available during preparation of the ETM. The evaluation included comparing data from 11 unique reports shown Table 1 in with a consistent set of screening criteria.

Significant historical data was available for AOC 2 and the nearby vicinity. Limited historical data was available for AOC 3S. No historical data was available for AOC 3N or AOC FI and therefore, AOC 3N and AOC FI are not further discussed. Key findings from this evaluation are summarized in the Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP) main document Worksheet #10.

2 Screening Criteria

The screening criteria used for this historical data evaluation were established in November 2019. Since then, the project screening levels (PSLs) presented in the UFP-QAPP main document have been updated in response to U.S. Army Corps of Engineers (USACE) comments and to reflect the latest Regional Screening Levels (RSLs) from the United States Environmental Protection Agency (USEPA).

Therefore, the screening criteria used in this appendix may differ from the PSLs used in the UFP-QAPP main document. Notably, the non-carcinogenic RSL was reported as the screening criteria only when a carcinogenic RSL did not exist. This approach was revised for the current PSLs to be the lower of the two values. Additionally, the RSL tables used for the screening criteria in this historical data evaluation were associated with a Hazard Quotient (HQ) of 1.0. This approach was revised for the current PSLs in the UFP-QAPP main document to be a HQ of 0.1. To avoid confusion, this historical data evaluation exclusively uses the terminology “screening criteria” instead of PSLs.

The sources of the screening criteria for each media are presented in Table 2. When multiple sources of screening criteria were available, the lowest value was selected.

The screening criteria values for specific analytes and media are provided in the tables presenting detections exceeding one or more screening criteria.

Table 1. Reports from which Data was included in the Historical Data Evaluation

Date	Report Title	Prepared By	Summary
March 2000	Final Former Stewart Air Force Base (AFB) HTRW Investigation, Newburgh, New York	Ogden Environmental and Energy Services Co., Inc. (Ogden) for Northern Ecological Associates Inc.	Ogden Environmental and Energy Services Co., Inc completed a HTRW investigation at Former Stewart AFB. The investigation included Area One - Former Fuel Tank Farm and Area Two - Older Base Landfill. Area One corresponds to AOC 1 (west of AOC 2), and Area Two is included within AOC 2. Eight soil boring were advanced in Area One and soil samples collected for analysis. Five groundwater samples were collected from existing wells within Area One. In Area Two, three collocated sediment and surface water samples were collected and analyzed. The original scope called for three subsurface soil and groundwater samples in Area Two. However, the hollow stem auger rig was unable to penetrate deeper than 10-ft due to compacted fill and construction debris. Logistics and weather prevented additional attempts with different drilling equipment and no subsurface samples were obtained from Area 2 (within AOC 2) (Ogden, 2000). Data underwent laboratory review and internal project review for data quality indicators. No data were rejected. Data did not undergo third-party validation.
September 2001	Phase II Site Investigation Results Stewart International Airport, New Windsor, New York	Roux Associates, Inc. (Roux)	Roux Associates, Inc. completed a Phase II Investigation with respect to the environmental conditions present at the Site prior to Stewart International Airport (SWF) Airport Acquisition, Inc (SWFAA) assuming control over and responsibility for the airport (Roux, 2001). Components of the investigation related to AOC 2 included performing a landfill gas investigation along the northern edge of what LMS defined as Area C (northeast of AOC 2). A total of 24, 0.5-inch-diamteter borings were advanced with a punchbar, approximately 200 feet apart. The maximum boring depth achieved was three feet below ground surface (bgs) due to the dense geology, and the study was terminated because a five-foot depth could not be attained. Near the northern portion of the punch bar study, one landfill gas monitoring well was installed and one soil boring was advanced for landfill gas measurement. Additionally, soil gas vents near the Metal Container Corporation (MCC) plant (southwest of AOC 2) were screened. While findings from the report had been previously included in the CSM, figures from the report were missing. Figures showing locations of investigation-related activities are new to CSM (Roux, 2001). A Data Usability Summary Report was performed by a third-party validator.
February 2002	Southern Landfill Area A Report	Lawler, Matusky & Skelly Engineers (LMS)	LMS advanced two soils borings and subsurface soil samples were collected for analysis in Area A. Both borings were converted to MWs and groundwater samples were collected for analysis. Area A is west and upgradient of AOC 2 (LMS, 2002a). A Data Usability Summary Report was performed the LMS project team.
March 2003	Southern Landfill Area B Report	LMS	LMS advanced 11 soils borings and subsurface soil samples were collected for analysis in Area B. Seven borings were converted to new overburden MWs and groundwater samples were collected for analysis. Area B includes portions of AOC 2 (LMS, 2003b). A Data Usability Summary Report was performed the LMS project team.
September 2003	Southern Landfill Groundwater Monitoring Report – Draft Format Only	LMS	LMS conducted a second round of groundwater sampling at the Area A and B wells installed for the Stage 1 PSA (9 wells) and at five wells from past investigations for a total of 14 wells sampled. The results of this investigation are available in only draft report format. A final version of the report was not available (LMS, 2003d). A Data Usability Summary Report was performed the LMS project team.

Date	Report Title	Prepared By	Summary
May 2004	Subsurface Soils and Groundwater Investigation at the Southwest Quadrant Fuel Farm, Stewart International Airport, Town of New Windsor, Orange County, New York	LMS	LMS carried out subsurface soil and groundwater investigation at the Southwest Quadrant Fuel Farm (SW Quad FF) located upgradient of AOC 2. Ten soil borings were advanced and soil samples collected. Five of the borings were converted to monitoring wells and groundwater was sampled for analysis (LMS, 2004). There is no mention of data review, usability, or validation in the report.
June 2007	Letter Report – Southern Landfill Complex – Area D Soil Vapor Sampling Results	HDR	HDR conducted a soil vapor investigation in portions of Area D that include a large portion of AOC 2. Soil vapor points attempted at 30 locations in Area D within the same area as the geophysical survey; 16 sample points were successful and analyzed with field instruments. Of the 16 successful points, six samples were collected and sent for laboratory analysis (HDR|LMS, 2007). There is no mention of data review, usability, or validation in the report.
October 2007	Groundwater Investigation Report, Stewart International Airport, Southwest Quadrant Fuel Farm, New Windsor, NY 12553, NYSDEC Spill # 06-11889	Miller Environmental Group	Miller Environmental Group investigated a fuel spill at the SW Quad FF. The investigation advanced four soil borings and collected soil samples. All four borings were converted to groundwater monitoring wells and the four new MWs plus five existing MWs were sampled for analysis (Miller Environmental Group, 2007). There is no mention of data review, usability, or validation in the report.
March 2009	Area D Reapportionment Subsurface Investigation Report	HDR	HDR conducted subsurface investigations in Area D reapportionment areas to support the transfer of portions of Area D into the lease agreement. The investigation involved advancing eight soil boring and collecting subsurface samples for analysis. Five of the borings were converted to MWs. The five new and two existing wells were sampled for analysis. Reapportionment area D2 is within AOC 2, and portions of D1 and D3 are within AOC 2 (HDR, 2009b). There is no mention of data review, usability, or validation in the report.
May 2009	Southern Landfill Area Surface Water & Sediment and Area D Groundwater Investigations Report, Stewart International Airport, Town of New Windsor, Orange County, New York	HDR	In Area D and along the southeastern property boundary of SWF, in 2001, 14 sediment and surface water samples were collected and analyzed. In 2003, 18 sediment and surface water samples were collected and analyzed, some outside of the SWF property boundary. In 2005, 24 soil borings were advanced and converted to 11 sets of paired monitoring wells (one screened within the shallow overburden aquifer and one open hole in bedrock) and one unpaired well due to absence of groundwater in the over burden aquifer at one location. Soil samples were collected from four soil boring. Groundwater samples were collected from the MWs for analysis in 2006. The 2006 round of groundwater sampling and analysis also included a well survey of groundwater elevations at all known, existing and accessible wells in the vicinity (a total of 60 wells) (HDR, 2009a). A Data Usability Summary Report was performed was performed the LMS project team for surface water and sediment samples only. There is no mention of data review, usability, or validation for soil or groundwater samples.
August 2011	Southern Area Landfill Groundwater & Surface Water/Sediment Investigation Report, Stewart International Airport	HDR	HDR conducted another round of groundwater sampling at 18 of the Area D monitoring wells. A follow up round of surface water and sediment sampling was also completed and included three sediment samples within AOC 2 and six surface water samples (four within AOC 2, two downstream) (HDR, 2011). There is no mention of data review, usability, or validation in the report.

Table 2. Sources of Screening Criteria Used in the Historical Data Evaluation

Media	Human Health	Ecological
Soil	USEPA Regional Screening Levels (RSLs) for Resident Soil (November 2019), HQ = 1.0	• USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Soil Screening Values for Hazardous Waste Sites (March 2018) • USEPA Interim Ecological Soil Screening Level documents (USEPA, 2003 through 2008). • Los Alamos National Laboratory ECORISK Database Ecological Screening Levels (LANL, 2020)
Sediment	USEPA Regional Screening Levels for Resident Soil (November 2019), THQ = 1.0	• USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018) • USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Ecological Screening Value for Step 2 (March 2018) • USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Sediment Screening Values for Hazardous Waste Sites for Non-Narcotic Mode of Action, Freshwater Sediment Screening Value, Refinement Screening Value for Step 3a (March 2018)
Groundwater	USEPA Regional Screening Levels for Tapwater, (November 2019)	No Screening criteria applicable because there is not a complete groundwater exposure route for ecological receptors at this time. If groundwater discharges to surface water, it is screened as surface water.
Surface water	USEPA Regional Screening Levels for Tapwater, (November 2019)	• USEPA Region 4 Ecological Risk Assessment Supplemental Guidance, Surface Water Screening Values for Hazardous Waste Sites, Chronic Toxicity Values for Freshwater (March 2018) • USEPA National Recommended Water Quality Criteria, Aquatic Life Criteria Table, Chronic Toxicity Value for Freshwater (USEPA, 2020).
Soil Gas	Methane above 20% LEL warn of potentially hazardous conditions (Ministry of the Environment, Conservation and Parks, 2020)	

3 Evaluation Approach

Historical organic contaminant data from the identified reports were entered into a Microsoft Access Database. Only detections were entered, and all associated laboratory qualifiers were included. Screening criteria were also entered into the database. When screening criteria did not exist for a specific contaminant, media, or receptor combination, data for that contaminant, media, or receptor combination was excluded from the screening criteria comparison process but was included in the summary of all detections. Of note, historical semi-volatile organic compound (SVOC) analyses did not include 1,4-Dioxane. Data will be obtained for 1,4-Dioxane as part of the SVOC analysis in the Remedial Investigation (RI) due to solvents as a potential source. Microsoft Access was used to generate two tables for each media, one showing all detections exceeding one or more screening criteria and one showing all detections. The tables generated by Microsoft Access were imported to Microsoft Excel to be formatted and information added regarding sampling locations relative to the AOCs.

Historical inorganic contaminant data were entered into excel spreadsheets. Inorganics data included metals and cyanide. Notably cyanide was never detected and therefore does not appear in any of the tables. For simplicity, this category of evaluation is referred to as metals versus inorganic contaminants since there were no cyanide detections. For groundwater and surface water, when both total and dissolved metals were analyzed only the results for total metals were entered. For metals analysis, one table was generated for each media providing the highest detection of a particular metal and the location of the detection for three areas AOC 2, AOC 3S and the nearby vicinity. Exceedances of screening criteria are identified with bolded or shaded formatting.

The historical soil gas data evaluation followed a simplified process with the data summarized into text and only methane values as available were compared with the screening criteria.

Results from the evaluation are presented by media with discussions of detections and exceedances for AOC 2, AOC 3S and the nearby vicinity. Tables showing the exceedances of organic contaminants and the highest detections of metals are provided in the text. Comprehensive tables showing all organic contaminant detections are provided in a separate Organic Contaminant Detection Tables section at the end of this appendix. The suite of analysis performed for each of the 10 investigations was variable. Within each media section, a description of the analysis performed from each investigation for that media is also included. Media specific data handling approaches are described as applicable.

UFP-QAPP main document numbered Figures 15 through 18 are provided as part of this Appendix as they show the historical sampling locations as follows:

Figure 15. Historical Soil Sampling Locations
Figure 16. Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells
Figure 17. Historical Sediment and Surface Water Sampling Locations
Figure 18. Historical Landfill Extent, Contents, and Landfill Gas Sampling Locations

Following the completion of the historical data evaluation and as a result of the 2021 Geophysical survey, the AOC 2 boundary was refined to be smaller than initially delineated in earlier phases of the QAPP development. As a result, two soil boring locations (SLMW-11S and SLWM-12S), four groundwater monitoring wells (SLMW-11S, SLMW-11D, SLMW-12S, and SLWM-12D), and two co-located sediment and surface water sample locations (SED-06/SW-06 and SED-14/SW-24) that were evaluated as part of AOC 2 are now shown to be downgradient of AOC 2. It was determined that this change does not impact how the conclusions from the historical data evaluation inform the current understanding of nature and extent of contamination and therefore the historical data evaluation was not altered.

4 Soil

There are no historical data for surface soil, all soil results pertain to subsurface soil. The use of the term soil within this section thus implies subsurface soil.

Figure 15 shows the locations of all historical soil sampling locations as well as the locations of certain soil boring referenced in other sections of the UFP-QAPP main document.

4.1 Soil investigations included in evaluation and associated analytical suites

The following soil investigations sampled soils:

4.1.1 AOC 2

- Eleven soil borings, B-03 through B-13, were advanced in March and April 2002 by LMS in the northern portion of AOC 2 (formerly delineated Area B), and 18 soil samples were collected. Soil borings were advanced in areas with evidence of bermed and/or stained soils, as indicated from historical photographs taken from 1957 to 1964. One or two samples were collected for laboratory analysis from each boring. If a positive bias sample was collected due to evidence of suspected contamination, a second sample was then collected from a depth interval below the contamination zone. If no positive bias sample was collected, a sample was collected from immediately above the saturated zone. *Soil samples were analyzed for VOCs, SVOCs, PCBs, pesticides, Target Analyte List (TAL) metals, cyanide, and total organic carbon (TOC) (LMS, 2003b).*
- Four soil borings, SLMW-10S through 13S, were advanced in September 2005 by HDR. No evidence of contamination was observed; therefore, a single soil sample was collected from the overburden material in three borings (SLMW-10S through 12S) and immediately above the saturated zone in one boring (SLMW-13S). The borings were located within the suspected trench areas in AOC 2. *The samples were analyzed for full /TAL parameters including VOCs, SVOCs, PCBs, pesticides, metals, cyanide, and TOC (HDR, 2009a).*
- Eight soil borings, BD-1 through BD-8, were advanced in October 2008 by HDR in the reapportionment areas of formerly delineated Area D. BD-7 is outside and downgradient of AOC 2 and is included in the nearby vicinity. One sample was collected from each boring for laboratory analysis. No field evidence of contaminant impacts was detected in

any of the borings in the unsaturated zone. As such, samples were collected from immediately above groundwater (when groundwater was present), or from the fill layer (if present), or immediately above a stratigraphic change. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, TAL metals and cyanide (HDR, 2009b). Note that for VOCs, a sample representing a two-foot range within the larger depth range indicated in the Organic Contaminant Detection Tables for Soil was used for analysis.

4.1.2 AOC 3S

There have been no soil investigations at AOC 3S.

4.1.3 Nearby Vicinity

The nearby vicinity evaluation focused on upgradient soil borings. Two soil borings, B-01 and B-02, were advanced in September 2001 by LMS in formerly delineated Area A, to the west of the northern portion of AOC 2. Two samples were collected and analyzed for VOCs, SVOCs, pesticides, PCBs, TAL metals and cyanide, and TOC.

Ten soil borings (FF_B-1 through FF_B-10) were advanced in December 2003 by LMS at the Southwest Quadrant Fuel Farm (SWQuadFF) located on the west side of Recreation Road, to the west of AOC 2. *Ten soil samples were collected and were analyzed for VOCs, SVOCs, pesticides, PCBs, metals and cyanide, and TOC.* Note that for VOCs, a sample representing a two-foot range within the larger depth range indicated in Organic Contaminant Detection Tables for Soil was used for analysis.

An additional 4 borings (B_MEG-1 through B_MEG-4) were advanced in October 2007 by Miller Environmental at the SWQuadFF to investigate a fuel spill. *Four soil samples were collected and were analyzed for VOCs with MTBE and SVOCs.*

4.1.4 Excluded Soil Data

Six soil borings, B-15 through B-20 were advanced in March 2002 by LMS in the formerly delineated Area C. Soil samples from these borings were not evaluated because they are cross gradient from AOC 2 and investigate an area where historical filling was unrelated to Department of Defense (DOD) activities.

The locations are shown in Figure 15 for reference.

4.2 Results Summary

4.2.1 Organic Contaminants Detections

The maximum detections of organic contaminants at each location and at each depth are shown in the Organic Contaminant Detection Table section. If an evaluated sample location is not shown in the table, it because there were no detections at that location and the location is identified as such in the table footnotes.

4.2.1.1 AOC 2 Detections

Within AOC 2, numerous VOCs, numerous SVOCs, pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, Aldrin, Dieldrin) and Aroclor 1248 and Aroclor 1260 were detected. All detections were relatively low levels with the highest being 15 mg/kg of 4, 4'-DDD at BD-1. Most detections are much less than 1 mg/kg.

4.2.2 Nearby Vicinity Detections

In the nearby vicinity, B-01, B-02, BD-7, B_MEG-3 and B_MEG-4 had no detections of organic contaminants. Soil samples from the SWQaudFF from 2003 showed VOC detections of primarily laboratory-related compounds, several SVOCs, and pesticides. One PCBs, Aroclor 1248 was detected. Soil samples from the SWQaudFF from 2007 showed several VOC detections in B_MEG-2 and SVOC detections in B_MEG-1 and B_MEG-2.

4.2.3 Organic Contaminants Screening Criteria Exceedances

Table 3 shows the maximum detections by location (for all evaluated depths at that location) that exceed one or both of the soil-specific screening criteria (human health or ecological). The table presents only the analytes for which the screening criteria were exceeded and shows the screening criteria as well as the results.

4.2.3.1 AOC 2 Screening Criteria Exceedances

Based on the results presented in the table, within AOC 2, no VOCs were detected above the screening criteria. Several SVOCs exceeded the ecological soil screening criteria, but only six maximum detections of benzo(a)pyrene and one maximum detection benzo(b)fluoranthene exceeded the human health soil screening criteria. Pesticides 4, 4'-DDD, 4, 4'-DDT, Aldrin, and Dieldrin were detected above the human health and ecological screening criteria, and 4, 4'-DDE was detected above only the ecological screening criteria. No PCBs were detected above screening criteria.

4.2.3.2 Nearby Vicinity Screening Criteria Exceedances

In the nearby vicinity, one detection of VOC isopropylbenzene exceeded the ecological soil screening criteria, but not the human health soil screening criteria. SVOCs Bis(2-Ethylhexyl)phthalate, Di-n-butylphthalate, and Pyrene were detected above the ecological soil screening criteria, but did not exceed the human health soil screening criteria. Pesticide dieldrin and PCB Aroclor 1248 were detected above the ecological soil screening criteria, but did not exceeded the human health screening criteria.

4.2.4 Metals

Metals in soils were evaluated by finding the maximum detection of each analyte by area (AOC 2 and Nearby Vicinity) and comparing the maximum value with the human health and ecological soil screening criteria. Table 4 shows the results of the evaluation.

4.2.4.1 Metals Screening Criteria Exceedances for AOC 2 and Nearby Vicinity

Cadmium, lead, manganese, mercury, selenium, vanadium and zinc all exceeded the ecological soil screening criteria both within AOC 2 and nearby vicinity. Of those compounds, lead and thallium also exceeded the human health screening criteria only within AOC 2. Additionally, arsenic exceeded only the human health soil screening criteria for both AOC 2 and the nearby vicinity. Unique to AOC 2, antimony, chromium, and copper were detected above the ecological soil screening criteria. Unique to the nearby vicinity, cobalt and iron exceeded the ecological soil screening criteria with iron also exceeding the human health soil screening criteria.

Table 3. Historical Maximum Subsurface Soil Sampling Results Exceeding One or Both Soil screening criteria. (page 1 of 2)

					Historical subsurface soil sampling results (maximum detections from each location) from within **AOC 2** exceeding one or both screening criteria (mg/kg)																			
Category	**CAS No.**	**Analyte**	**Human Health Project Screening Level (screening criteria) (mg/kg)**	**Ecological Soil screening criteria (mg/kg)**	**B-03**	**B-04**	**B-05**	**B-06**	**B-07**	**B-08**	**B-9**	**B-10**	**B-11**	**B-12**	**B-13**	**BD-1**	**BD-2**	**BD-3**	**BD-4**	**BD-6**	**BD-8**	**SLMW-10S**	**SLMW-13S**	**SLWM-11S†**	**SLMW-12S†**
VOCs	98-82-8	Isopropylbenzene	**1,900**	0.04	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
SVOCs	105-67-9	2,4-Dimethylphenol	**1,300**	0.04	/	/	/	/	/	/	/	/	/	0.045 j	/	/	/	/	/	/	/	/	/	/	/
	88-74-4	2-Nitroaniline	**630**	0.02	/	/	0.18 j	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	50-32-8	Benzo(a)pyrene	**0.11**	1.1	/	/	**0.64 j**	/	/	/	**0.13 j**	/	**0.21 j**	**0.62**	/	/	**0.16**	/	**0.22**	/	/	/	/	/	/
	205-99-2	Benzo(b)fluoranthene	**1.1**	1.1	/	/	1.3 j	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	92-52-4	Biphenyl	**87**	0.2	/	/	/	/	/	/	/	/	/	/	/	0.62	/	/	/	/	/	/	/	/	/
	117-81-7	Bis(2-Ethylhexyl)phthalate	**39**	0.02	0.39 j	0.81	0.34 j	0.84 j	0.5 j	0.63 j	0.78	0.36 j	0.31 j	1.8 j	1.5 j	/	/	/	/	0.15	0.17	1.2	0.48	0.66	0.29 j
	85-68-7	Butyl benzyl phthalate	**290**	0.59	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	1.6	/	/	/
	86-74-8	Carbazole	**NE**	0.07	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0.083	/	/	/	/	/	/
	84-74-2	Di-n-butylphthalate	**6,300**	0.011	/	/	/	0.039 j	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	0.05 j	0.12 j
	129-00-0	Pyrene	**1,800**	1.1	/	/	2.2	/	/	/	/	/	/	1.7	/	/	/	/	/	/	/	/	/	/	/
Pesticides	72-54-8	4,4'-DDD	**2.3**	0.021	/	/	0.051 p	0.52 p	/	/	/	/	0.77 p	**5.1 p**	0.052 j	**15**	0.55	0.023	/	0.022	/	/	/	/	/
	72-55-9	4,4'-DDE	**2.0**	0.021	/	/	/	0.053 j	/	/	/	/	0.073 j d	0.3 j d	/	/	/	/	/	/	/	/	/	/	0.23 D 10:1
	50-29-3	4,4'-DDT	**1.9**	0.021	/	/	/	0.1 j	/	/	/	/	0.058 j d	0.58 j d p	0.027	**6.8**	0.13	/	/	/	/	/	/	/	0.099 D 10:1
	309-00-2	Aldrin	**0.039**	0.03	/	/	/	/	/	/	/	/	0.24 d	/	/	/	/	/	/	/	/	/	/	/	/
	60-57-1	Dieldrin	**0.034**	0.0049	/	/	**0.093 p**	**0.24 j p**	/	0.01 p	/	/	**0.41 j p**	/	**0.075 d**	/	/	/	0.0093	0.0078	**0.014**	**0.011**	/	/	0.006
PCBs	12672-29-6	Aroclor 1248	**0.23**	0.0073	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
j – An estimated concentration; below reporting limit.
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
d – Concentration recovered from a diluted sample.
D – Dilution factor
NE: No screening criteria exists
NA: Not Analyzed
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
† Soil borings would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 3. Historical Maximum Subsurface Soil Sampling Results Exceeding One or Both Soil screening criteria. (page 2 of 2)

					Historical subsurface soil sampling results (maximum detections from each location) from **Nearby Vicinity** of AOC 2 exceeding one or both screening criteria (mg/kg)											
					Upgradient											
Category	**CAS No.**	**Analyte**	**Human Health screening criteria (mg/kg)**	**Ecological Soil screening criteria (mg/kg)**	**MEG-1**	**MEG-2**	**FF_B-1**	**FF_B-2**	**FF_B-3**	**FF_B-4**	**FF_B-5**	**FF_B-6**	**FF_B-7**	**FF_B-8**	**FF_B-9**	**FF_B-10**
VOCs	98-82-8	Isopropylbenzene	**1,900**	0.04	/	0.059	/	/	/	/	/	/	/	/	/	/
SVOCs	105-67-9	2,4-Dimethylphenol	**1,300**	0.04	/	/	/	/	/	/	/	/	/	/	/	/
	88-74-4	2-Nitroaniline	**630**	0.02	/	/	/	/	/	/	/	/	/	/	/	/
	50-32-8	Benzo(a)pyrene	**0.11**	1.1	/	/	/	/	/	/	/	/	/	/	/	/
	205-99-2	Benzo(b)fluoranthene	**1.1**	1.1	/	/	/	/	/	/	/	/	/	/	/	/
	92-52-4	Biphenyl	**87**	0.2	/	/	/	/	/	/	/	/	/	/	/	/
	117-81-7	Bis(2-Ethylhexyl)phthalate	**39**	0.02	/	/	0.53	0.2 j	0.15 j	0.19 j	0.099 j	0.31 j	0.27 j	0.31 j	0.11 j	0.054 j
	85-68-7	Butyl benzyl phthalate	**290**	0.59	/	/	/	/	/	/	/	/	/	/	/	/
	86-74-8	Carbazole	**NE**	0.07	/	/	/	/	/	/	/	/	/	/	/	/
	84-74-2	Di-n-butylphthalate	**6,300**	0.011	/	/	/	/	/	/	/	0.12 j	/	/	/	/
	129-00-0	Pyrene	**1,800**	1.1	1.7	/	/	/	/	/	/	/	/	/	/	/
Pesticides	72-54-8	4,4'-DDD	**2.3**	0.021	NA	NA	/	/	/	/	/	/	/	/	/	/
	72-55-9	4,4'-DDE	**2.0**	0.021	NA	NA	/	/	/	/	/	/	/	/	/	/
	50-29-3	4,4'-DDT	**1.9**	0.021	NA	NA	/	/	/	/	/	/	/	/	/	/
	309-00-2	Aldrin	**0.039**	0.03	NA	NA	/	/	/	/	/	/	/	/	/	/
	60-57-1	Dieldrin	**0.034**	0.0049	NA	NA	/	/	0.019 j	/	/	0.0058	/	/	/	/
PCBs	12672-29-6	Aroclor 1248	**0.23**	0.0073	NA	NA	0.12 p	/	/	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
j – An estimated concentration; below reporting limit.
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
d – Concentration recovered from a diluted sample.
D – Dilution factor
NE: No screening criteria exists
NA: Not Analyzed
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 4. Maximum Metals Detections for Subsurface Soil

				Maximum Detection Within AOC 2 (mg/kg)		Maximum Detection Nearby Vicinity Upgradient of AOC 2 (mg/kg)	
Analyte	**CAS No.**	**Human Health Project Screening Level (screening criteria) (mg/kg)**	**Ecological Soil screening criteria (mg/kg)**	**Result**	**Location**	**Result**	**Location**
Aluminum	7429-90-5	**77,000**	NE	14600	B-12	14500	FF_B-6
Antimony	7440-36-0	**31**	0.27	4.8 b n	B-10	ND	ND
Arsenic	7440-38-2	**1**	18	**10.2**	B-12	**8.4**	FF_B-7
Barium	7440-39-3	**15,000**	330	241	B-12	59.6	FF_B-8
Beryllium	7440-41-7	**1,600**	21	0.64 b	B-09	0.53 b	FF_B-6
Cadmium	7440-43-9	**2,100**	0.36	9.1 * n	B-12	0.95 b	B-02
Calcium	7440-70-2	**NE**	NE	20500 *	B-07	35200	B-01
Chromium	7440-47-3	**NE**	26	29.2	B-12	19.1	FF_B-1
Cobalt	7440-48-4	**420**	13	12.1	B-03	14.9	FF_B-6
Copper	7440-50-8	**3,100**	28	252 *	B-12	38.1	FF_B-3
Iron	7439-89-6	**55,000**	NE	33800	SLMW-10S	**275200**	B-02
Lead	7439-92-1	**400**	11	**490**	B-12	51.5	FF_B-1
Magnesium	7439-95-4	**NE**	NE	7700	BD-4	8790	FF_B-6
Manganese	7439-96-5	**1,800**	220	1690	SLMW-10S	1340 *	FF_B-8
Mercury	7439-97-6	**11**	0.013	0.25	BD-6	0.39	FF_B-1
Nickel	7440-02-0	**15,000**	38	31.9	B-05	30.6	FF_B-6
Potassium	9/7/7440	**NE**	NE	2210	B-06	1300	B-02
Selenium	7782-49-2	**390**	0.52	1.1 b w n	B-04	0.55 b w n	FF_B-1
Silver	7440-22-4	**390**	4.2	3.5 n	B-12	ND	ND
Sodium	7440-23-5	**NE**	NE	1370	B-12	231	FF_B-7
Thallium	7440-28-0	**1**	0.05	**4.2** *	B-05	ND	ND
Vanadium	7440-62-2	**390**	7.8	22	BD-8	65.2 e	B-02
Zinc	7440-66-6	**23,000**	46	536	B-12	205 n	FF_B-1

b – The reported value is less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL)
n – Spiked sample recovery is not within the control limits
* – Duplicate analysis not with control limits
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
NE: No screening criteria exists
ND: No detections for any samples within the area specified
See Section 2 and Table 2 for details on screening criteria sources and selection method.

5 Groundwater

Past investigations have resulted in the installation of many groundwater monitoring wells within AOC 2 and AOC 3S and in the nearby vicinity (upgradient and downgradient).

Figure 16 shows the locations of all known groundwater monitoring wells referenced in the UFP-QAPP main document. The figure shows the location of monitoring wells included in the following evaluation of historical groundwater data. In addition, for reference purposes only, the figure also shows the location of several cross-gradient monitoring wells located west and north of AOC 2 and wells within the New York Air National Guard (NYANG) base area referenced in the UFP-QAPP main document. No data from reference-only wells were included in the following evaluation of historical groundwater data.

5.1 Groundwater investigations included in evaluation and associated analytical suites

Records indicate the existence of many groundwater monitoring wells (MWs) within AOC 2 and the nearby vicinity, both upgradient and downgradient of AOC 2. In addition, there are several MWs within AOC 3S. Only well within the AOCs or in close proximity and either upgradient or downgradient are included. Cross gradient wells are omitted. Notably, there are no known upgradient or downgradient MWs in close proximity to AOC 3S.

5.1.1 AOC2, AOC 3S and Nearby Vicinity

The existing MWs and relevant details including evaluation category (based on location), year installed, overburden or bedrock and depth, years sampled and associated analytical suite are provided in Table 5.

Table 5. Historical Monitoring Wells Evaluated

Evaluation Category	MW ID	Year Installed	Overburden (O) or Bedrock (B) and Depth (ft bgs)	**Sampled in 2001 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, Diesel Range Organics (DRO), Gasoline Range Organics (GRO), explosive organic compounds, metals (total and dissolved), cyanide, TOC and wet chemistry parameters.	**Sampled in 2002 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, Diesel Range Organics (DRO), Gasoline Range Organics (GRO), explosive organic compounds, metals (total and dissolved), cyanide, TOC and wet chemistry parameters.	**Sampled in 2003 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, DRO, GRO, explosive organic compounds, metals (total and dissolved), cyanide, TOC and wet chemistry parameters. (Draft Results Only)	**Sampled in 2003 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, gylcols, metals (total and dissolved), and cyanide.	**Sampled in 2006 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, metals (total and dissolved), cyanide, TOC and wet chemistry parameters.	**Sampled in 2007 (x = Yes) Analytical Suite:** VOCs and SVOCs.	**Sampled in 2008 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, TAL metals (total and dissolved), and cyanide.	**Sampled in 2011 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, TAL metals (total and dissolved), cyanide and herbicides.
AOC 2	GWML-02	Unknown	Unknown	-	X	-	-	-	-	-	-
AOC 2	SLMW-3	2002	O – 17	-	X	X	-	-	-	-	-
AOC 2	SLMW-4	2002	O – 18	-	X	X	-	-	-	-	-
AOC 2	SLMW-5	2002	O – 23	-	X	X	-	-	-	-	-
AOC 2	SLMW-6	2002	O – 23	-	X	X	-	-	-	-	-
AOC 2	SLMW-7	2002	O – 16	-	X	X	-	-	-	-	-
AOC 2	SLMW-8	2002	O – 16	-	X	X	-	-	-	-	-
AOC 2	SLMW-9	2002	O – 19	-	X	X	-	-	-	-	-
AOC 2	SLMW-10S	2005	O – 24	-	-	-	-	X	-	-	X
AOC 2	SLMW-10D	2005	B – 91	-	-	-	-	X	-	-	X
AOC 2	SLMW-11S †	2005	O – 10	-	-	-	-	X (Dry)	-	-	X (Dry)
AOC 2	SLMW-11D †	2005	B – 27.5	-	-	-	-	X	-	-	X
AOC 2	SLMW-12S †	2005	O – 10	-	-	-	-	X	-	-	X
AOC 2	SLMW-12D †	2005	B – 53	-	-	-	-	X	-	-	X
AOC 2	SLMW-13S	2005	O – 11	-	-	-	-	X	-	-	X
AOC 2	SLMW-13D	2005	B – 27.5	-	-	-	-	X	-	-	X
AOC 2	SLMW-16S	2005	O – 14	-	-	-	-	X	-	-	X
AOC 2	SLMW-16D	2005	B – 201	-	-	-	-	X	-	-	X
AOC 2	SLMW-22	2008	O – 20	-	-	-	-	-	-	X	-
AOC 2	SLMW-23	2008	O – 19.5	-	-	-	-	-	-	X	-
AOC 2	SLMW-24	2008	O – 20	-	-	-	-	-	-	X	-
AOC 2	SLMW-25	2008	O – 20	-	-	-	-	-	-	X	-
AOC 2	SLMW-26	2008	O – 20	-	-	-	-	-	-	X	-
AOC 2	Old Well	Unknown	Unknown	-	-	-	-	-	-	X	-
AOC 3S	SLMW-20S	2005	O – 23	-	-	-	-	X	-	-	DM
AOC 3S	SLMW-20D	2005	B – 42.5	-	-	-	-	X	-	-	X
AOC 3S	SLMW-21C	2005	O – 64	-	-	-	-	X	-	-	-
AOC 3S	SLWM-21WT	2005	O – 15	-	-	-	-	X	-	-	-
Nearby Vicinity (UG)	SF-MW1	2003	O – 16	-	-	-	X	-	X	-	-
Nearby Vicinity (UG)	SF-MW2	2003	O – 16	-	-	-	X	-	X	-	-
Nearby Vicinity (UG)	SF-MW3	2003	B – 24	-	-	-	X	-	X	-	-
Nearby Vicinity (UG)	SF-MW4	2003	O – 20	-	-	-	X	-	X	-	-

Evaluation Category	MW ID	Year Installed	Overburden (O) or Bedrock (B) and Depth (ft bgs)	**Sampled in 2001 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, Diesel Range Organics (DRO), Gasoline Range Organics (GRO), explosive organic compounds, metals (total and dissolved), cyanide, TOC and wet chemistry parameters.	**Sampled in 2002 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, Diesel Range Organics (DRO), Gasoline Range Organics (GRO), explosive organic compounds, metals (total and dissolved), cyanide, TOC and wet chemistry parameters.	**Sampled in 2003 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, DRO, GRO, explosive organic compounds, metals (total and dissolved), cyanide, TOC and wet chemistry parameters. (Draft Results Only)	**Sampled in 2003 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, gylcols, metals (total and dissolved), and cyanide.	**Sampled in 2006 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, herbicides, metals (total and dissolved), cyanide, TOC and wet chemistry parameters.	**Sampled in 2007 (x = Yes) Analytical Suite:** VOCs and SVOCs.	**Sampled in 2008 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, TAL metals (total and dissolved), and cyanide.	**Sampled in 2011 (x = Yes) Analytical Suite:** VOCs, SVOCs, pesticides, PCBs, TAL metals (total and dissolved), cyanide and herbicides.
Nearby Vicinity (UG)	SF-MW5	2003	O – 18	-	-	-	X	-	X	-	-
Nearby Vicinity (UG)	MEG-1	2007	O – 15	-	-	-	-	-	X	-	-
Nearby Vicinity (UG)	MEG-2	2007	O – 15	-	-	-	-	-	X	-	-
Nearby Vicinity (UG)	MEG-3	2007	O – 15	-	-	-	-	-	X	-	-
Nearby Vicinity (UG)	MEG-4	2007	O – 15	-	-	-	-	-	X	-	-
Nearby Vicinity (UG)	SLMW-1	2001	O – 25	X	-	X	-	-	-	-	-
Nearby Vicinity (UG)	SLMW-2	2001	O – 25	X	-	X	-	-	-	-	-
Nearby Vicinity (DG)	CW-11	1988	Unknown	-	-	X	-	-	-	X	-
Nearby Vicinity (DG)	CW-14	1988	Unknown	-	-	X	-	X	-	-	-
Nearby Vicinity (DG)	CW-15	1988	Unknown	-	-	X	-	X	-	-	-
Nearby Vicinity (DG)	SLMW-14D	2005	B – 200	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-15S	2005	O – 11	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-15D	2005	B – 200	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-17S	2005	O – 32	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-17D	2005	B – 200	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-18S:	2005	O – 15	-	-	-	-	X (Dry)	-	-	X (Dry)
Nearby Vicinity (DG)	SLMW-18D	2005	B – 200	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-19S	2005	O – 26	-	-	-	-	X	-	-	X
Nearby Vicinity (DG)	SLMW-19D	2005	B – 200	-	-	-	-	X	-	-	X

"-" indicates well not sampled during event
UG = Upgradient of AOC 2, DG = Downgradient of AOC 2
DM = Reported damaged, could not be sampled.

5.1.2 Excluded Monitoring Wells

Monitoring wells CW-1, 3-10 are located to the south and west of AOC 2. They were installed to assess the contamination surrounding the MCC building. They are shown on the map for reference but are more cross-gradient than upgradient of the AOC 2 therefore no results are further evaluated from these wells. For reference, in August 2000,when LMS sampled CW-1, and CW-3 through CW-10 for VOCs, SVOCs, and metals and compared the results to NYSDEC's Class GA (drinking water) Standards screening levels outlined in their Division of Water TOGS, benzene (2 µg/L) was detected above its screening standard in one well; no other analyte concentrations exceeded their respective screening standards in the three analyte groups (LMS, 2000).

MW-01 though MW-11 and underground storage tank (UST) UST-MW-01 through UST-MW-06 are located south and west AOC 2. They were installed to investigate AOC 1 and AOC 6. They are shown on the map for reference but no results were further evaluated from these wells as they are more cross-gradient than upgradient of AOC 2. For reference in 2000, when LMS sampled MW-2,-3,-5,-7 through -11 for VOCs, SVOCs, and metals and compared the results to NYSDEC's Class GA (drinking water) Standards screening levels outlined in their Division of Water TOGS, several VOCs (benzene; ethylbenzene; 4-isopropyltoluene; n-butylbenzene; total xylenes; isopropylbenzene; n-propylbenzene; 1,2,4-trimethylbenzene; and sec-butylbenzene) and one SVOC (naphthalene) were detected above their respective screening standards; no detected metal concentrations exceeded their respective screening standards (LMS, 2000).

GLMW-01 is shown on the map, but is located northwest and cross gradient of AOC 2 therefore it's results are not included in the evaluation.

5.1.3 Downgradient Potable Wells

In November, as part of NYSDEC's request that the water supply downgradient of AOC 2 be sampled, EMP sampled eight private water supply wells. Groundwater samples were analyzed for VOCs, SVOCs, TAL metals, and pesticides, and results were compared to NYSDEC Class GA Groundwater Standards (LMS; 2003a).

The VOC chloroform was detected in at the Walter's Mobile Home Park well at 1.09 µg/L, which was below the NYSDEC Class GA Groundwater Standard (7 µg/L) and was attributed to chloroform being a typical laboratory contaminant. Additionally, methyl tert-butyl ether (MTBE) was detected at a private well at 26 Weather Oak Hill Rd at 5.1 µg/L, again below the NYSDEC Class GA Groundwater Standard (10 µg/L). It was concluded the MTBE had greater potential to have migrated from the impacted groundwater beneath the DBL/C MANNS Gasoline Station at 635 Little Britain Road than from the Southern Landfill Area.

One SVOC, di(2-ethylhexyl)phthalate, was detected in two water supply wells at concentrations of 0.9 µg/L and 1.4 µg/L; both below NYSDEC Class GA Groundwater Standard (20 µg/L), and below the human health groundwater screening criteria (5.6 µg/L). Several metals (copper, iron, manganese, sodium, and lead) were detected with concentrations above their respective

NYSDEC Class GA Groundwater Standards in at least one water supply well. Pesticides were not detected in any samples (LMS, 2003a).

5.2 Results Summary

5.2.1 Organic Contaminants Detections

The maximum detections of organic contaminants at monitoring well locations and are shown in the Organic Contaminant Detection Table section. If an evaluated sample location is not shown in the table, it because there were no detections at that location and the location is identified as such in the table footnotes.

5.2.1.1 AOC 2 Detections

Within AOC 2, numerous VOCs, numerous SVOCs, pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, Aldrin, Dieldrin, Beta-DHC, and Delta BHC), GRO, DRO, herbicide 2,4-D, and several explosive compounds were detected. The highest values and most frequent detections of organic contaminants occurred at SLMW-04, SLMW-09, and SLMW-10S.

5.2.1.2 AOC 3S Detections

Within AOC 3S, VOCs acetone and methylene chloride, both common laboratory contaminants, were detected. Chloroform was also detected. A single SVOC Bis(2-Ethylhexyl)phthalate was also detected.

5.2.1.3 Nearby Vicinity Detections

In the nearby vicinity, upgradient wells SLMW-01, -02 had detections of SVOC Bis(2-Ethylhexyl)phthalate, pesticide dieldrin, and GRO and DRO. At upgradient well MEG-2, VOCs 1,2,4-Trimethylbenzene, and benzene, and SVOC naphthalene were detected. All upgradient detections were low level (less than 10 µg/L), with the exception of GRO and DRO. Downgradient VOCs included acetone and methylene chloride, both common laboratory contaminants. SVOCs included Bis(2-Ethylhexyl)phthalate and Di-n-butylphthalate, and pesticide dieldrin. Herbicide 2,4-D was also detected at two downgradient locations. All downgradient detections were low level (less than 10 µg/L and most less than 1µg/L).

5.2.2 Organic Contaminants Screening Criteria Exceedances

Table 6 shows the maximum detections by location that exceed the groundwater-specific human health screening criteria. The table presents only the analytes for which the screening criteria were exceeded and shows the screening criteria as well as the results.

5.2.2.1 AOC 2 Screening Criteria Exceedances

Based on the results presented in the table, within AOC 2, several VOCs were detected above the screening criteria, with benzene detected over the screening criteria at 8 different locations. The locations with the highest number of different VOC detections above the screening criteria were SLWM-04, -05, and -09. Similarly, several SVOCs exceeded the screening criteria, with

naphthalene detected over the screening criteria at 7 different locations. SLMW-10S has the highest number of different SVOCs detected above the screening criteria. Of the pesticides, 4,4'-DDD was detected most frequently above the screening criteria, and SLMW-08 has the highest number of different pesticide detections above the screening criteria. Explosive compounds were detected above the screening criteria at SLMW-04, -08, and -09.

5.2.2.2 AOC 3S Screening Criteria Exceedances

There were no screening organic contaminant criteria exceedances for AOC 3S.

5.2.2.3 Nearby Vicinity Screening Criteria Exceedances

In the nearby vicinity, benzene and naphthalene were detected above the screening criteria at MEG-2 (upgradient), and two detections of dieldrin (one upgradient and one downgradient) exceeded the screening criteria.

5.2.3 Metals

Metals in groundwater were evaluated by finding the maximum detection of each compound by area (AOC 2, AOC 3S, Nearby Vicinity - Upgradient and Nearby Vicinity - Downgradient) and comparing the maximum value with the human health screening criteria. Table 7 shows the results of the evaluation.

5.2.3.1 Metals Screening Criteria Exceedances for AOC 2, AOC 3S and Nearby Vicinity

Manganese was the only inorganic to exceed the human health groundwater screening criteria for all areas. The human health groundwater screening criteria was exceeded for aluminum, arsenic, cobalt, iron, and lead for all areas except for AOC 3S. Unique to AOC 2, cadmium, copper, mercury, nickel, and vanadium exceeded the human health groundwater screening criteria. Unique to AOC 3S, thallium exceeded the human health groundwater screening criteria. Finally, unique to the nearby vicinity downgradient, antimony was detected in exceedance of the human health groundwater screening criteria.

Table 6. Historical Maximum Groundwater Sampling Results Exceeding the Human Health Groundwater screening criteria. (page 1 of 1)

				Historical groundwater sampling results (maximum detection from each location) from within **AOC 2** exceeding screening criteria (µg/L)														Historical groundwater sampling results (maximum detection from each location) from **Nearby Vicinity** exceeding screening criteria (µg/L)		
Category	**CAS No.**	**Analyte**	**Human Health Project Screening Level (screening criteria) (µg/L)**	**SLMW-03**	**SLMW-04**	**SLMW-05**	**SLMW-07**	**SLMW-08**	**SLMW-09**	**SLMW-10S**	**SLMW-12S†**	**SLMW-13D**	**SLMW-22**	**SLMW-23**	**SLMW-24**	**SLMW-25**	**Old Well**	**SLMW-01 (upgradient)**	**CW-11 (downgradient)**	**MEG-2 (upgradient)**
VOCs	75-34-3	1,1-Dichloroethane	**2.8**	/	/	**92**	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	107-06-2	1,2-Dichloroethane	**0.17**	/	/	**3**	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	106-46-7	1,4-Dichlorobenzene	**0.48**	/	/	/	/	/	**20 j**	/	/	/	/	/	/	/	/	/	/	/
	71-43-2	Benzene	**0.46**	/	**4**	**1.98 j**	**0.51 j**	**6.4**	**22**	**0.98 j**	**2.4**	/	/	/	/	**1.5**	/	/	/	**2**
	108-90-7	Chlorobenzene	**78**	/	/	/	/	/	**88**	/	/	/	/	/	/	/	/	/	/	/
	100-41-4	Ethylbenzene	**1.5**	/	**1.6**	/	/	/	**1.9**	/	/	/	/	/	/	/	/	/	/	/
	79-01-6	Trichloroethene	**0.49**	/	**0.76 j**	**0.58 j**	/	/	/	/	/	/	**3.4**	/	/	**2.1**	/	/	/	/
	75-01-4	Vinyl chloride	**0.019**	/	**3.3**	**3.4**	/	/	/	/	/	**0.94 j**	/	/	/	/	/	/	/	/
SVOCs	56-55-3	Benzo(a)anthracene	**0.03**	/	/	/	/	/	/	**0.88**	/	/	/	/	/	/	/	/	/	/
	50-32-8	Benzo(a)pyrene	**0.025**	/	/	/	/	/	/	**0.7**	/	/	/	/	/	/	/	/	/	/
	205-99-2	Benzo(b)fluoranthene	**0.25**	/	/	/	/	**1 j**	/	**0.83**	/	/	/	/	/	/	/	/	/	/
	117-81-7	Bis(2-Ethylhexyl)phthalate	**5.6**	/	/	/	/	/	/	/	/	/	/	**15**	/	/	**8.8**	/	/	/
	53-70-3	Dibenzo(a,h)anthracene	**0.025**	/	/	/	/	/	/	**0.38**	/	/	/	/	/	/	/	/	/	/
	193-39-5	Indeno(1,2,3-cd)Pyrene	**0.25**	/	/	/	/	/	/	**0.57**	/	/	/	/	/	/	/	/	/	/
	91-20-3	Naphthalene	**0.17**	**2 j**	**3 j**	/	**1 j**	**3 j**	**28 j**	**1.5**	/	/	/	/	/	**11**	/	/	/	**7**
Pesticides	72-54-8	4,4'-DDD	**0.032**	/	/	/	**0.29 p**	**14 g[D: 3:1]**	**0.78 j**	/	/	/	**0.34**	/	/	/	/	/	/	/
	72-55-9	4,4'-DDE	**0.046**	/	/	/	/	**1 pg**	/	/	/	/	/	/	/	/	/	/	/	/
	50-29-3	4,4'-DDT	**0.23**	/	/	/	/	**10 g[D: 3:1]**	/	/	/	/	/	/	/	/	/	/	/	/
	309-00-2	Aldrin	**0.00092**	**0.023 j**	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	319-85-7	Beta-BHC	**0.025**	/	/	/	/	/	**0.14 pg**	/	/	/	/	/	/	/	/	/	/	/
	60-57-1	Dieldrin	**0.0018**	/	/	/	/	/	**0.042 jp**	/	/	/	/	/	**0.038**	/	/	**0.045 j**	**0.17 j**	/
Explosive Organic Compounds	121-14-2	2,4-Dinitrotoluene	**0.24**	/	**0.67**	/	/	**0.59**	**0.89**	/	/	/	/	/	/	/	/	/	/	/
	606-20-2	2,6-Dinitrotoluene	**0.049**	/	/	/	/	/	**0.51**	/	/	/	/	/	/	/	/	/	/	/
	88-72-2	2-Nitrotoluene	**0.31**	/	**0.5**	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
j – An estimated concentration; below reporting limit.
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
g – Results estimated based on DUSR findings
D – Dilution factor
NE: No screening criteria exists
Bold indicates the Human Health screening criteria is exceeded
† Groundwater well would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 7. Maximum Metals Detections for Groundwater

			Maximum Detection Within AOC 2 (µg/L)		Maximum Detection Within AOC 3S (µg/L)		Maximum Detection Nearby Vicinity - Upgradient (µg/L)		Maximum Detection Nearby Vicinity - Downgradient (µg/L)	
Analyte	**CAS No.**	**Human Health Project Screening Level (screening criteria) (µg/L)**	**Result**	**Location**	**Result**	**Location**	**Result**	**Location**	**Result**	**Location**
Aluminum	7429-90-5	**20000**	**380000**	SLMW-25	1570	SLMW-21WT	**66500** e	SF-MW2	**45000**	SLMW-19S
Antimony	7440-36-0	**7.8**	ND	ND	ND	ND	ND	ND	**37.6** **b w**	CW-11
Arsenic	7440-38-2	**0.052**	**190**	SLMW-25	ND	ND	**26.4**	SF-MW2	**18.6**	SLMW-19S
Barium	7440-39-3	**3800**	3000	SLMW-25	78	SLMW-20S	411	SF-MW2	209	SLMW-14D
Beryllium	7440-41-7	**25**	20	SLMW-25	ND	ND	2.7 b	SF-MW2	2 b	SLMW-19S
Cadmium	7440-43-9	**9.2**	**20**	SLMW-25	ND	ND	0.72 b	SF-MW1	3 b	SLMW-19S
Calcium	7440-70-2	**NE**	250000	SLMW-25	94100	SLMW-20S	140000	SLMW-01	86000	SLMW-14D
Chromium	7440-47-3	**NE**	520	SLMW-25	3.3 b	SLMW-21WT	64	SF-MW2	61.3	SLMW-19S
Cobalt	7440-48-4	**6**	**690**	SLMW-25	ND	ND	**61.8**	SF-MW2	**55.6**	SLMW-19S
Copper	7440-50-8	**800**	**1200**	SLMW-25	3.5 b	SLMW-20D	139	SF-MW2	102	SLMW-19S
Iron	7439-89-6	**14000**	**790000**	SLMW-25	4870	SLMW-20D	**110000**	SF-MW2	**79400**	SLMW-19S
Lead	7439-92-1	**15**	**770**	SLMW-25	3 b	SLMW-20S	**51.8** **n**	SF-MW2	**53.7**	SLMW-19S
Magnesium	7439-95-4	**NE**	170000	SLMW-23	17100	SLMW-21WT	36800	SF-MW4	27000	SLMW-15D
Manganese	7439-96-5	**430**	**79000**	SLMW-25	**1620**	SLMW-20S	**10800**	SF-MW1	**2910** **e**	SLMW-15S
Mercury	7439-97-6	**0.63**	**3.2**	SLMW-25	ND	ND	ND	ND	ND	ND
Nickel	7440-02-0	**390**	**870**	SLMW-25	ND	ND	97	SF-MW2	74.4	SLMW-19S
Potassium	2023695	**NE**	47000	SLMW-23	6650 e	SLMW-20S	10700	SF-MW3	10900	SLMW-19S
Selenium	7782-49-2	**100**	ND	ND	ND	ND	ND	ND		ND
Silver	7440-22-4	**94**	ND	ND	2.6 b n	SLMW-21WT	1.9 b n	SF-MW4	2.6 b n	SLMW-19S
Sodium	7440-23-5	**NE**	677000	SLMW-10S	10100	SLMW-20D	45300	SF-MW2	47000	CW-11
Thallium	7440-28-0	**0.2**	ND	ND	**4.8** b	SLMW-20S	ND	ND	ND	ND
Vanadium	7440-62-2	**86**	**470**	SLMW-25	3.3 b	SLMW-21WT	85.2	SF-MW2	64	SLMW-19S
Zinc	7440-66-6	**6000**	2900	SLMW-25	14.8 b	SLMW-20S	362	SF-MW2	191	SLMW-19S

b – The reported value is less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL)
w – Post-digestion spike for Furnace AA analysis is out of the control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.
e – The reported value is estimated because of the presence of interference
n – Spiked sample recovery is not within the control limits
Bold indicates the Human Health screening criteria is exceeded
NE: No screening criteria exists
ND: No detections for any samples within the area specified
See Section 2 and Table 2 for details on screening criteria sources and selection method.

6 Sediment

Sediment and surface water were investigated over four unique events. Figure 17 shows both the sediment and surface water sampling locations, which are commonly co-located.

6.1 Sediment investigations included in evaluation

6.1.1 AOC 2

Three sediment samples were collected from the central intermittent stream in AOC 2 in October 1999 by Ogden (S2-1, S2-2, S2-3). Three sediment samples were collected in AOC 2 in October 2001 by HDR (SED-06 and SED-14 in the southwest portion of AOC 2 and SED-07 near the SW/S2-1 location along the central intermittent stream). Three sediment samples were collected in AOC 2 in April 2011 by HDR (SLSED-07A, 07B, 07C all located near the central intermittent stream near SW/S2-2)

6.1.2 AOC 3S

A single sediment sample location (SED-13) was located from very near the southwest corner of AOC 3S. This location was sampled in October 2001 and August 2003 by HDR.

6.1.3 Nearby Vicinity and Off Property

During the October 2001 event, samples were also collected in the vicinity of AOC 2 and AOC 3S. SED-01, 02, 03 and 04 are upstream of drainage from AOC 2, and SED-05 and SED-08 are located downstream of AOC 2 drainage. SED-09, 10, 11 and 12 upstream of AOC 3S. During the July/August 2003 event, some locations were resampled including SED-01, 02, 05, and 08. New locations added included SED-15 through SED-21 located further downstream from 2001 locations and in some cases off SWF property. Off property evaluated samples include SED-15, 16, 17, 18, 20 and 21.

SED-26 and SED-27 are located upstream along the east-west tributary to silver stream. SED-22 through SED-25 are located far upstream and to the northwest of AOC 2 and AOC 3S and were collected from the former demolition and burning facility (DBF) for a separate investigation. SED-22 through SED 17 were excluded from the evaluation.

6.2 Analytical suite for sediment investigations

All sediment samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals and cyanide, and TOC, with the exception of the samples from 2003 in which cyanide was omitted from analysis and the 1999 samples which omitted cyanide and TOC.

6.3 Results Summary

6.3.1 Organic Contaminants Detections

The maximum detections of organic contaminants at sediment sampling locations are shown in the Organic Contaminant Detection Table section. If an evaluated sample location is not shown

in the table, it because there were no detections at that location and the location is identified as such in the table footnotes.

6.3.1.1 AOC 2 Detections

Within AOC 2, only two VOCs, 2-butanone and chloromethane, were detected at the same two locations, with 2-butanone being a common laboratory contaminant. Numerous SVOCs were detected at many locations at relatively higher concentrations up to levels of 19,000 µg/kg of pyrene at S2-3. A combination of pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and Dieldrin) were detected at most locations, and PCB Aroclor 1254 was detected at S2-3 only.

6.3.1.2 AOC 3S Detections

Within AOC 3S, at the single location SED-13 sampled twice, no VOCs were detected. SVOCs benzo(b)fluoranthene, chrysene, fluoranthene and pyrene and pesticides 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and dieldrin were detected. There were no PCBs detected at SED-13.

6.3.1.3 Nearby Vicinity and Off Property Detections

In the nearby vicinity and off property, no VOCs were detected. Numerous SVOCs were detected at many locations at relatively higher concentrations. Pesticides (4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, Dieldrin, Endrin, and Methoxychlor) were detected at most locations. No PCBs were detected in the nearby vicinity and off property samples.

6.3.2 Organic Contaminants Screening Criteria Exceedances

Table 8 shows the maximum detections by location that exceed either of the sediment-specific human health or ecological screening criteria. The table presents only the analytes for which one or both of the screening criteria were exceeded and shows the screening criteria as well as the results.

6.3.2.1 AOC 2 Screening Criteria Exceedances

Based on the results presented in the table, within AOC 2, only VOC 2-butanone was detected above the ecological screening criteria. Numerous SVOC detections exceeded the ecological screening criteria by several orders of magnitude and several SVOCs, many of which are polycyclic aromatic hydrocarbons (PAHs), exceeded the human health screening criteria as well. The highest SVOC detections were at S3-2, SLSED-07A, SED-07, and S2-1. All three locations in relatively close proximity to each other and near the intermittent stream within AOC 2. Both the human health and ecological sediment screening criteria were exceeded for pesticides 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and Dieldrin, again by several orders of magnitude.

6.3.2.2 AOC 3S Screening Criteria Exceedances

Within AOC 3S, all four SVOCs detected also exceeded both the human health and ecological screening criteria by several orders of magnitude. For pesticides 4'-DDD, 4, 4'-DDE, 4, 4'-DDT,

and dieldrin exceeded the ecological screening criteria, but only dieldrin also exceeded the human health screening criteria.

6.3.2.3 Nearby Vicinity and Off Property Screening Criteria Exceedances

In the nearby vicinity, similar to AOC 2, numerous SVOCs were detected above the ecological screening criteria and several SVOCs, many of which are PAHs, exceeded the human health screening criteria as well. With the exception of benzoic acid, carbazole, and diethyl phthalate, the highest detections for SVOCs above one or both the screening criteria are at nearby vicinity locations and not within AOC 2. Pesticides 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT, and dieldrin detections were commonly above the ecological and human health screening criteria in the nearby vicinity with the highest values at SED-08, which is immediately downstream of the SED-07 location within AOC 2. In general, compared with pesticide values above one or both screening criteria within AOC 2, pesticide detections above one or both screening criteria at locations within Former Stewart AFB (SED-01, -02, -03, -04, -05, -10, -11, -12) have relatively lower concentrations. However, the remaining nearby vicinity locations which are off Former Stewart AFB property (SED-15 through SED-21) have values higher than those nearby vicinity locations on property but still lower than those within AOC 2. Notably, endrin and endrin aldehyde were detected above screening criteria only at SED-01, and Methoxychlor was detected only above ecological screening criteria at locations off Former Stewart AFB property.

6.3.3 Metals

Metals in sediments were evaluated by finding the maximum detection of each analyte by area (AOC 2, AOC 3S, Nearby Vicinity and Off Property) and comparing the maximum value with the human health and ecological soil screening criteria. Table 9 shows the results of the evaluation.

6.3.3.1 Metals Screening Criteria Exceedances for AOC 2, AOC 3S, Nearby Vicinity and Off Property

Arsenic, barium, cadmium, iron, manganese, nickel, and zinc exceeded the ecological sediment screening criteria in all areas. Arsenic also exceeded the human health sediment screening criteria for all areas. Iron exceeded the human health sediment screening criteria only for AOC 2, and manganese exceeded the human health sediment screening criteria for all areas except AOC 3S. Unique to AOC 2, antimony, cobalt, mercury, and silver were all detected above the ecological sediment screening criteria. Unique to the nearby vicinity, chromium exceeded the ecological sediment screening criteria. Copper exceeded the ecological screening criteria for all areas except AOC 3S and selenium exceeded the ecological screening criteria for all areas except the nearby vicinity.

Table 8. Historical Maximum Sediment Sampling Results Exceeding one or both Sediment screening criteria. (page 1 of 3)

Category	CAS No.	Analyte	Human Health Project Screening Level (screening criteria) (µg/kg)	Ecological Sediment screening criteria (µg/kg)	Historical sediment sampling results (maximum detection from each location) from within **AOC 2** or **AOC 3S (SED-13 only)** exceeding one or both screening criteria (µg/kg)									
					S2-1	**S2-2**	**S2-3**	**SED-06**	**SED-07**	**SED-14**	**SLSED-07A**	**SLSED-07B**	**SLSED-07C**	**SED-13**
VOCs	78-93-3	2-Butanone	**27,000**	7.604	/	/	/	/	11 j	72 s	/	/	/	/
SVOCs	91-57-6	2-Methylnaphthalene	**240**	0.0202	/	/	/	/	/	/	/	/	/	/
	83-32-9	Acenaphthene	**3,600**	0.0067	24 j	17 j	760 j	/	/	/	/	/	/	/
	208-96-8	Acenaphthylene	**NE**	0.0059	16 j	7 j	310 j	/	/	/	/	/	/	/
	120-12-7	Anthracene	**18,000**	0.057	50 j	27 j	440 j	/	68 j	/	/	/	/	/
	56-55-3	Benzo(a)anthracene	**1.1**	0.108	**250 j**	**63 j**	**9500**	**120 jg**	**350 jg**	**110 jsg**	**440 [DL 20:1]**	**210 [DL 5:1]**	/	/
	50-32-8	Benzo(a)pyrene	**0.11**	0.15	**300 j**	**56 j**	**8500**	**120 jg**	**450 jg**	**160 jsg**	**550 [DL 20:1]**	**260 [DL 5:1]**	/	/
	205-99-2	Benzo(b)fluoranthene	**1**	0.19	**260 j**	**54 j**	**6800**	**170 jg**	**800 jg**	**210 jsg**	**790 [DL 20:1]**	**220 [DL 5:1]**	/	**65 j**
	191-24-2	Benzo(ghi)perylene	**NE**	0.17	150 j	30 j	3000 j	41 jg	180 jg		540 [DL 20:1]	170 [DL 5:1]	/	/
	207-08-9	Benzo(k)fluoranthene	**11**	0.24	**400 j**	**75 j**	**9000**	**72 jg**	**350 jg**	**110 jsg**	/	**250 [DL 5:1]**	/	/
	117-81-7	Bis(2-Ethylhexyl)phthalate	**39**	0.18	**84 jb**	/	**290 jb**	/	/	/	/	/	/	/
	85-68-7	Butyl benzyl phthalate	**290**	0.1	/	/	/	/	/	/	/	/	/	/
	86-74-8	Carbazole	**NE**	0.069	57 j	8 j	490 j	/	/	/	570 [DL 20:1]	/	/	/
	218-01-9	Chrysene	**110**	0.166	**420** j	79 j	**12000**	**120 jg**	**500 jg**	**160 jsg**	/	**200 [DL 5:1]**	/	48 j
	53-70-3	Dibenzo(a,h)anthracene	**0.11**	0.033	**60 j**	**14 j**	**1400 j**	/	/	/	/		/	/
	132-64-9	Dibenzofuran	**73**	0.51	16 j	7 j	**240 j**	/	/	/	/	/	/	/
	84-66-2	Diethyl phthalate	**51,000**	0.63	18 jb	7 jb	/	/	/	/	/	/	/	/
	131-11-3	Dimethyl phthalate	**NE**	0.678	/	/	/	/	/	/	/	/	/	/
	84-74-2	Di-n-butylphthalate	**6,300**	0.011	120 jb	42 jb	5200 b		120 j		/	/	/	/
	117-84-0	Di-n-octylphthalate	**630**	0.039	20 jb	8 jb	36 jb	/	/	/	/	/	/	/
	206-44-0	Fluoranthene	**2,400**	0.423	630 j	140 j	**16000**	250 j	710 j	180 js	1300 [DL 20:1]	290 [DL 5:1]	/	82 j
	86-73-7	Fluorene	**2,400**	0.077	38 j	27 j	780 jb	/	/	/	/	/	/	/
	193-39-5	Indeno(1,2,3-cd)Pyrene	**1.1**	0.2	**190 j**	**35 j**	**4200**		**160 jg**		**580 [DL 20:1]**	**170 [DL 5:1]**	/	/
	91-20-3	Naphthalene	**3.8**	0.176	/	/	/	/	/	/	/	/	/	/
	85-01-8	Phenanthrene	**NE**	0.204	290 j	65 j	2500 j	170 j	390 j	/	700 [DL 20:1]	/	/	/
	129-00-0	Pyrene	**1,800**	0.195	570 j	140 j	**19000**	380 jg	1700 g	400 jsg	1000 [DL 20:1]	240 [DL 5:1]	/	90 j
Pesticides	72-54-8	4,4'-DDD	**2.3**	0.0035	**170**	**16**	**810**	**22 g**	**240 g [DL 5:1]**	**120 sg**	**100**	**541**	/	0.91 j
	72-55-9	4,4'-DDE	**2.00**	0.0014	**86**	**12**	**160**	/	/	/	**25.1**	**168**	**26.8**	1.4 j
	50-29-3	4,4'-DDT	**1.9**	0.001	**72**	**26**	**1400**	**14 g**	**52 g**	**68 psg**	**46.5**	**196**	/	/
	60-57-1	Dieldrin	**0.034**	0.0019	**29 j**	**7.7**	/	**8.1 g**	**4.7 jg**	**23 psg**	**24**	**94.1**	**57.6**	**1.1 jpg**
	72-20-8	Endrin	**19**	0.0022	/	/	/	/	/	/	/	/	/	/
	7421-93-4	Endrin Aldehyde	**19**	0.0022	/	/	/	/	/	/	/	/	/	/
	72-43-5	Methoxychlor	**320**	0.03	/	/	/	/	/	/	/	/	/	/
PCBs	11097-69-1	Aroclor 1254	**0.24**	NE	/	/	**121**	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
J – An estimated concentration; below reporting limit.
s – Results estimated based on DUSR findings: % solids less than 50%
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
g – Results estimated based on DUSR findings
b – analyte is found in the method blank as well as the sample
DL – Dilution factor
NE: No screening criteria exists
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 8. Historical Maximum Sediment Sampling Results Exceeding one or both Sediment screening criteria. (page 2 of 3)

Category	CAS No.	Analyte	Human Health (screening criteria) (µg/kg)	Ecological Sediment screening criteria (µg/kg)	Historical sediment sampling results (maximum detection from each location) from **Nearby Vicinity and Off Property** exceeding one or both screening criteria (µg/kg)								
					SED-01	**SED-02**	**SED-03**	**SED-04**	**SED-05**	**SED-08**	**SED-10**	**SED-11**	**SED-12**
VOCs	78-93-3	2-Butanone	**27,000**	7.604	/	/	/	/	/	/	/	/	/
SVOCs	91-57-6	2-Methylnaphthalene	**240**	0.0202	/	/	/	/	/	/	/	/	/
	83-32-9	Acenaphthene	**3,600**	0.0067	620 j	/	/	/	/	/	/	/	310 j
	208-96-8	Acenaphthylene	**NE**	0.0059	65 j	/	/	/	/	/	/	/	/
	120-12-7	Anthracene	**18,000**	0.057	2000	54 j	/	/	/	53 j	/	/	990
	56-55-3	Benzo(a)anthracene	**1.1**	0.108	**16000 j[DL 5:1]**	**220 jg**	**120 j**	**110 js**	/	**250 j**	**46 jg**	**100 jg**	**3300 g**
	50-32-8	Benzo(a)pyrene	**0.11**	0.15	**22000 jg[DL 5:1]**	**200 jg**	**150 j**	**100 js**	/	**290 j**	**64 jg**	**120 jg**	**3100 g**
	205-99-2	Benzo(b)fluoranthene	**1**	0.19	**34000 jg[DL 5:1]**	**330 jg**	**180 j**	**130 js**	/	**430 j**	**91 jg**	**170 jg**	**4500 jg [DL 5:1]**
	191-24-2	Benzo(ghi)perylene	**NE**	0.17	15000 g	110 jg	/	/	/	100 j			970 g
	207-08-9	Benzo(k)fluoranthene	**11**	0.24	**13000 g**	**140 jg**	**85 j**	/	/	**160 j**	**41 jg**	**95 jg**	**2100 g**
	117-81-7	Bis(2-Ethylhexyl)phthalate	**39**	0.18	**1200 g**	**860**	/	/	/	/	/	/	**1100**
	85-68-7	Butyl benzyl phthalate	**290**	0.1	**84 jg**	460 j	/	/	/	/	/	/	/
	86-74-8	Carbazole	**NE**	0.069	/	/	/	/	/	/	/	/	/
	218-01-9	Chrysene	**110**	0.166	**24000 j[DL 5:1]**	**270 j**	**140 j**	110 js	/	**270 j**	**51 jg**	**150 jg**	**4100 g**
	53-70-3	Dibenzo(a,h)anthracene	**0.11**	0.033	**760 g**	/	/	/	/	/	/	/	**250 jg**
	132-64-9	Dibenzofuran	**73**	0.51	**350 j**	/	/	/	/	/	/	/	**170 j**
	84-66-2	Diethyl phthalate	**51,000**	0.63	/	/	/	/	/	/	/	/	/
	131-11-3	Dimethyl phthalate	**NE**	0.678	/	360 j	/	/	/	/	/	/	/
	84-74-2	Di-n-butylphthalate	**6,300**	0.011	/	88 j	/	/	/	/	/	/	/
	117-84-0	Di-n-octylphthalate	**630**	0.039	120 j	54 j	/	/	/	/	/	/	/
	206-44-0	Fluoranthene	**2,400**	0.423	**44000 j[DL 5:1]**	350 j	240 j	180 js	/	310 j	83 j	320 j	900 j [DL 5:1]
	86-73-7	Fluorene	**2,400**	0.077	940 j		/	/	/	/	/	/	520 j
	193-39-5	Indeno(1,2,3-cd)Pyrene	**1.1**	0.2	**17000 g**	**78 jg**	/	/	/	**87 j**	/	/	**860 g**
	91-20-3	Naphthalene	**3.8**	0.176			/	/	/	/	/	/	64 j
	85-01-8	Phenanthrene	**NE**	0.204	19000 j[DL 5:1]	270 j	100 j	91 js	/	210 j	/	370 j	5200 j [DL 5:1]
	129-00-0	Pyrene	**1,800**	0.195	**37000 j[DL 5:1]**	850 j	300 j	220 js	160 js	400 j	170 j	580 g	1100 j [DL 5:1]
Pesticides	72-54-8	4,4'-DDD	**2.3**	0.0035	**8 jg**	1.8 jg	1.8 jg	**6.2 jsg**	**8.2 jsg**	**460 g [DL 20:1]**	/	**14 g**	**23 g**
	72-55-9	4,4'-DDE	**2.00**	0.0014	/	/	/	/	**16 s**	**66**	/	/	/
	50-29-3	4,4'-DDT	**1.9**	0.001	**2.2 jg**	1 jg	**2.1 jg**	**5.5 jsg**	**4.3 jsg**	**86 g [DL 20:1]**	/	1.1 jg	**10 pg**
	60-57-1	Dieldrin	**0.034**	0.0019	**28 pg**	**4.7 pg**	**12 g**	**13 sg**	**27 sg**	**7.3 g**	/	**2.2 jg**	/
	72-20-8	Endrin	**19**	0.0022	17 g	/	/	/	/	/	/	/	/
	7421-93-4	Endrin Aldehyde	**19**	0.0022	**21 pg**	/	/	/	/	/	/	/	/
	72-43-5	Methoxychlor	**320**	0.03	/	/	/	/	/	/	/	/	/
PCBs	11097-69-1	Aroclor 1254	**0.24**	NE	/	/	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
J – An estimated concentration; below reporting limit.
s – Results estimated based on DUSR findings: % solids less than 50%
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
g – Results estimated based on DUSR findings
b – analyte is found in the method blank as well as the sample
DL – Dilution factor
NE: No screening criteria exists
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 8. Historical Maximum Sediment Sampling Results Exceeding one or both Sediment screening criteria. (page 3 of 3)

Category	CAS No.	Analyte	Human Health (screening criteria) (µg/kg)	Ecological Sediment screening criteria (µg/kg)	Historical sediment sampling results (maximum detection from each location) from **Nearby Vicinity and Off Property** exceeding one or both screening criteria (µg/kg)						
					SED-15	**SED-16**	**SED-17**	**SED-18**	**SED-19**	**SED-20**	**SED-21**
VOCs	78-93-3	2-Butanone	**27,000**	7.604	/	/	/	/	/	/	/
SVOCs	91-57-6	2-Methylnaphthalene	**240**	0.0202	54 j	/	/	180 js	/	/	/
	83-32-9	Acenaphthene	**3,600**	0.0067	77 j	200 js	130 j	1400 s	/	/	/
	208-96-8	Acenaphthylene	**NE**	0.0059	/	/	/	180 js	/	/	/
	120-12-7	Anthracene	**18,000**	0.057	220 j	460 js	370 j	2400 s	/	/	/
	56-55-3	Benzo(a)anthracene	**1.1**	0.108	**1100 g**	**2600 gs**	**1400 g**	**9300 [DL 5:1] gs**	**280 js**	**400 js**	**110 jg**
	50-32-8	Benzo(a)pyrene	**0.11**	0.15	**1400 g**	**3500 gs**	**1600 g**	**5800 gs**	**520 js**	**510 jgs**	**150 jg**
	205-99-2	Benzo(b)fluoranthene	**1**	0.19	**1900 g**	**5600 gs**	**2700 g**	**11000 [DL 5:1] gs**	**1100 s**	**920 gs**	**190 jg**
	191-24-2	Benzo(ghi)perylene	**NE**	0.17	610 g	1900 gs	670 g	2000 gs	/	250 jgs	51 jg
	207-08-9	Benzo(k)fluoranthene	**11**	0.24	**830 g**	**2100 gs**	**930 g**	**2500 gs**	**390 js**	**290 jgs**	**76 jg**
	117-81-7	Bis(2-Ethylhexyl)phthalate	**39**	0.18	**220 jg**	**4800 gs**	**1500 g**	**200 jgs**	**470 js**	**180 js**	**70 j**
	85-68-7	Butyl benzyl phthalate	**290**	0.1	/	160 js	**300 jg**	/	/	/	/
	86-74-8	Carbazole	**NE**	0.069	/	/	/	/	/	/	/
	218-01-9	Chrysene	**110**	0.166	**140 g**	**3400 gs**	**1900 g**	**8400 [DL 5:1] gs**	**650 js**	**560 jgs**	**150 jg**
	53-70-3	Dibenzo(a,h)anthracene	**0.11**	0.033	/	580 js	230 j	670 js	/	/	/
	132-64-9	Dibenzofuran	**73**	0.51	/		**75 j**	**510 js**	/	/	/
	84-66-2	Diethyl phthalate	**51,000**	0.63	/	/	/	/	/	/	/
	131-11-3	Dimethyl phthalate	**NE**	0.678	/	/	/	/	/	/	/
	84-74-2	Di-n-butylphthalate	**6,300**	0.011	/	/	/	/	/	/	/
	117-84-0	Di-n-octylphthalate	**630**	0.039	/	460 js	120 j	/	/	/	/
	206-44-0	Fluoranthene	**2,400**	0.423	1600	**3400 s**	2200	**20000 [DL 5:1] s**	1100 s	750 js	210 j
	86-73-7	Fluorene	**2,400**	0.077	84 j	200 js	170 j	1200 s	/	/	/
	193-39-5	Indeno(1,2,3-cd)Pyrene	**1.1**	0.2	**660 g**	**1800 gs**	**710 g**	**1900 gs**	**190 js**	**240 jgs**	**56 jg**
	91-20-3	Naphthalene	**3.8**	0.176	**46 j**	/	/	**220 js**	/	/	/
	85-01-8	Phenanthrene	**NE**	0.204	1400	2400 s	2200	14000 [DL 5:1] s	570 js	380 js	90 j
	129-00-0	Pyrene	**1,800**	0.195	**3700 [DL 2:1]**	**9800 gs**	**5700 [DL 2:1]**	**19000 [DL 5:1] gs**	**1900 s**	1600 gs	330 j
Pesticides	72-54-8	4,4'-DDD	**2.3**	0.0035	**6.9 pg**	**33 pgs**	**88 g**	**58 pgs**	**11 gs**	**57 gs**	**6.4 g**
	72-55-9	4,4'-DDE	**2.00**	0.0014	**5.6 g**	**27 gs**	**22 g**	**19 gs**	**12 gs**	**32 gs**	**4.1 jpg**
	50-29-3	4,4'-DDT	**1.9**	0.001	**2.4 jpg**	**9.3 jgs**	**4.8 jpg**	**4.9 jpgs**	/	**5.6 jpgs**	/
	60-57-1	Dieldrin	**0.034**	0.0019	**33 g**	**94 pgs**	**32 g**	**12 gs**	**24 pgs**	**23 pgs**	**4.9 g**
	72-20-8	Endrin	**19**	0.0022	/	/	/	/	/	/	3.2 jpg
	7421-93-4	Endrin Aldehyde	**19**	0.0022	/	/	/	/	/	/	/
	72-43-5	Methoxychlor	**320**	0.03	67 pg	120 pgs	99 pg	95 pgs	/	76 pgs	14 jpg
PCBs	11097-69-1	Aroclor 1254	**0.24**	NE	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
J – An estimated concentration; below reporting limit.
s – Results estimated based on DUSR findings: % solids less than 50%
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
g – Results estimated based on DUSR findings
b – analyte is found in the method blank as well as the sample
DL – Dilution factor
NE: No screening criteria exists
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 9. Maximum Metals Detections for Sediment

Analyte	CAS No.	Human Health Project Screening Level (screening criteria) (mg/kg)	Ecological Sediment screening criteria (mg/kg)	Maximum Detection Within AOC 2 (mg/kg)		Maximum Detection Within AOC 3S (mg/kg)		Maximum Detection Nearby Vicinity (mg/kg)		Maximum Detection Off Property (mg/kg)	
				Result	Location	Result	Location	Result	Location	Result	Location
Aluminum	7429-90-5	77,000	25000	17000	SLSED-07B	11600	SED-13	15900	SED-08	16900	SED-16
Antimony	7440-36-0	31	2	20	SLSED-07C	1.4 b n	SED-13	1.4 b n	SED-02	ND	ND
Arsenic	7440-38-2	1	9.8	**27**	SLSED-07C	**10.2**	SED-13	**20.4**	SED-05	**12.3**	SED-16
Barium	7440-39-3	15,000	20	730	SLSED-07C	95.8	SED-13	693	SED-05	166	SED-16
Beryllium	7440-41-7	1,600	NE	0.65 b	SED-14	0.52 b	SED-13	0.97 b n	SED-05	0.75 b	SED-16
Cadmium	7440-43-9	2,100	1	9.9	SLSED-07B	1.1 b	SED-13	2.1	SED-05	1.4 b	SED-16
Calcium	7440-70-2	NE	NE	87900	S2-2	3800	SED-13	27800	SED-12	42400 *	SED-15
Chromium	7440-47-3	NE	43.4	28	SLSED-07B	18.2	SED-13	62.7 *	SED-02	31.1 *	SED-16
Cobalt	7440-48-4	420	50	61	SLSED-07C	11.2	SED-13	25.2	SED-02	17.1 b	SED-16
Copper	7440-50-8	3,100	31.6	120	SLSED-07B	21.1	SED-13	158 e	SED-02	80.3	SED-16
Iron	7439-89-6	55,000	20000	**210000**	SLSED-07C	33000	SED-13	48100	SED-08	37500	SED-16
Lead	7439-92-1	400	35.8	130	SLSED-07B	13.1	SED-13	136 n	SED-02	102 *	SED-16
Magnesium	7439-95-4	NE	NE	44400	S2-2	6550	SED-13	10000 * e	SED-02	18900	SED-15
Manganese	7439-96-5	1,800	460	**29000**	SLSED-07C	845	SED-13	**30300** n	SED-05	**2590**	SED-16
Mercury	7439-97-6	11	0.18	0.44	SLSED-07B	ND	ND	ND	ND	ND	ND
Nickel	7440-02-0	15,000	22.7	46	SLSED-07B	27.2	SED-13	32.9	SED-01	34.9	SED-16
Potassium	9/7/7440	NE	NE	2200	SLSED-07B	1310 e	SED-13	18780 x *	SED-05	2830 x	SED-16
Selenium	7782-49-2	390	0.72	32	SLSED-07C	1.2 b w	SED-13	0.65 b	SED-05	1.7 b w	SED-16
Silver	7440-22-4	390	1	4.7	SLSED-07C	ND	ND	2.1 b	SED-02	0.96 b	SED-15
Sodium	7440-23-5	NE	NE	710	SLSED-07C	332	SED-13	441	SED-08	601 e x	SED-16
Thallium	7440-28-0	1	NE	2.38 B	S2-1	ND	ND	2.1 b n	SED-01	ND	ND
Vanadium	7440-62-2	390	NE	44	SLSED-07B	18.1	SED-13	29.3	SED-05	36	SED-16
Zinc	7440-66-6	23,000	121	500	SLSED-07B	108	SED-13	948 n	SED-01	856	SED-16

b or B – The reported value is less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL)
w – Post-digestion spike for Furnace AA analysis is out of the control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.
x – Detected in associated field blank, may not be representative of site conditions
e – The reported value is estimated because of the presence of interference
n – Spiked sample recovery is not within the control limits
* – Duplicate analysis not with control limits
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
NE: No screening criteria exists
ND: No detections for any samples within the area specified
See Section 2 and Table 2 for details on screening criteria sources and selection method.

7 Surface Water

Figure 17 shows both the sediment and surface water sampling locations which are commonly co-located.

7.1 Surface water investigations included in evaluation:

Surface water samples were co-located and collected along with all sediment samples in the 1999, 2001, 2003 and 2011 sampling events. The description of sediment sampling locations in Sediment section applies also to surface water locations with the sample ID pre-fix adjusted to reflect surface water as follows:

- 1999 sediment prefix – S2 | surface water prefix - SW2
- 2001 sediment prefix - SED | surface water prefix – SW (SW-1 through SW-14)
- 2003 sediment prefix - SED | surface water prefix – SW (SW-1, 2, 5, 8, and 15 through 21)
- 2011 sediment prefix – SLSED | surface water prefix – SLSW

In addition, three surface water only samples (SLSW-07, 08 and 17) were collected in April 2011 located near past surface water sampling locations SW-07, SW-08, and SW-17 respectively.

7.2 Analytical suite for surface water investigations

1999 surface water samples were analyzed for: VOCs, SVOCs, pesticides, PCBs, and TAL metals (total only).

2001 surface water samples were analyzed for VOCs, SVOCs, Gasoline Range Organics (GRO), Diesel Range Organics (DRO), pesticides, PCBs, herbicides, TAL metals (total and dissolved) and cyanide, TOC, and other water chemistry parameters.

2003 surface water samples were analyzed for SVOCs, pesticides, and TAL metals (total and dissolved).

2011 surface water samples were analyzed for pesticides at all locations and at SLSW-07A through -07C samples were also analyzed for VOCs, SVOCs, PCBs, herbicides, and metals (total) and cyanide.

7.3 Results Summary

7.3.1 Organic Contaminants Detections

The maximum detections of organic contaminants at surface water sampling locations are shown in **Error! Reference source not found.**. If an evaluated sample location is not shown in the table is it because there were no detections at that location.

7.3.1.1 AOC 2 Detections

Within AOC 2, only one VOC, chlorobenzene, was detected. Only one SVOC, Bis(2-Ethylhexyl)phthalate, was detected at one location. Pesticides 4,4'-DDD, 4,4'-DDE, Alpha-BHC, Beta-BHC, Delta-BHC, Dieldrin and Heptachlor were detected at one or more locations. All SVOC detections were low level, less than 0.1 µg/L. DRO and GRO were also detected.

7.3.1.2 AOC 3S Detections

Within AOC 3S, at the single location SW-13 sampled twice, no VOCs or SVOCs were detected. The pesticide dieldrin and GRO and DRO were detected.

7.3.1.3 Nearby Vicinity and Off Property Detections

In the nearby vicinity, only one VOC, acetone, a common laboratory contaminant, was detected at one location. Numerous SVOCs were detected at relatively low levels, with the highest being Bis(2-Ethylhexyl)phthalate at 15 µg/L at SW-02 and most other SVOC detections less than 5 µg/L. The SVOC detection locations in the nearby vicinity are those closest to the MCC facility (SW-01, 02, 03, 04, and 05). Those same five locations had no detections of pesticides. Pesticides were detected at SW-08, downstream of SW-07 within AOC 2 and at SW-09, -10, -11 which are within formerly delineated Area C. GRO and DRO were detected in many of the nearby vicinity samples.

7.3.2 Organic Contaminants Screening Criteria Exceedances

Table 10 shows the maximum detections by location that exceed either of the surface water-specific human health or ecological screening criteria. The table presents only the analytes for which one or both of the screening criteria were exceeded and shows the screening criteria as well as the results.

7.3.2.1 AOC 2 Screening Criteria Exceedances

Based on the results presented in the table, within AOC 2, no VOCs or SVOCs were detected above screening criteria. Pesticide 4,4'-DDD was detected above the ecological screening criteria at several locations and the human health screening criteria was exceeded at two locations. Pesticides, alpha-BHC, dieldrin, endosulfan sulfate, and heptachlor exceeded the human health screening criteria at one or more location, and alpha-BHC and heptachlor also exceeded the ecological screening criteria at one or more locations.

7.3.2.2 AOC 3S Screening Criteria Exceedances

Within AOC 3S, at the single location SW-13 sampled twice, only the pesticide dieldrin exceeded the human health screening criteria, but not the ecological screening criteria.

7.3.2.3 Nearby Vicinity and Off Property Screening Criteria Exceedances

In the nearby vicinity, SVOCs benzo(b)fluoranthene, bis(2-Ethylhexyl)phthalate, fluoranthene, and naphthalene exceeded the human health and/or ecological screening criteria at only one location each, with all locations near the MCC facility. Fluoranthene was also detected only above the ecological screening criteria at SW-16, which is off the Former Stewart AFB property. Of the pesticides, dieldrin exceeded only the human health screening criteria at four locations, 4,4'-DDD exceeded both the human health and ecological screening criteria at one location, and endosulfan sulfate exceeded only the ecological screening criteria at one location. In general, the detections of SVOCs and pesticides above one or both screening criteria were of relatively similar orders of magnitude as the screening criteria.

7.3.3 Metals

Metals in surface water were evaluated by finding the maximum detection of each analyte by area (AOC 2, AOC 3S, Nearby Vicinity and Off Property) and comparing the maximum value with the human health and ecological surface water screening criteria.

Table 11 shows the results of the evaluation.

7.3.3.1 Metals Screening Criteria Exceedances for AOC 2, AOC 3S, Nearby Vicinity and Off Property

Aluminum and manganese exceeded the ecological surface water screening criteria in all areas, with all maximum detections of manganese also exceeding the human health screening criteria. Copper, iron, and lead exceeded the ecological surface water screening criteria in all areas except for AOC 3S, with iron also exceeding the human health screening criteria in AOC 2 only. Calcium and beryllium exceeded the ecological surface water screening criteria for AOC 2 and the nearby vicinity, with beryllium exceeding the human health screening criteria as well. The human health screening criteria for arsenic was exceeded at AOC 2 and the nearby vicinity. Unique to the nearby vicinity, zinc exceeded the ecological surface water screening criteria, and antimony exceeded the human health screening criteria.

Table 10. Historical Maximum Surface Water Sampling Results Exceeding one or both Surface Water screening criteria. (1 of 1)

Category	CAS No.	Analyte	Human Health Project Screening Level (screening criteria) (µg/L)	Ecological Surface Water screening criteria (µg/L)	Historical surface water sampling results (maximum detection from each location) from within **AOC 2** or **AOC 3S (SW-13 only)** exceeding one or both screening criteria (µg/L)				
					SW2-1	**SW2-2**	**SW2-3**	**SW-07**	**SW-13**
SVOCs	205-99-2	Benzo(b)fluoranthene	**0.25**	2.6	/	/	/	/	/
	117-81-7	Bis(2-Ethylhexyl)phthalate	**5.6**	8	/	/	/	/	/
	206-44-0	Fluoranthene	**800**	0.8	/	/	/	/	/
	91-20-3	Naphthalene	**0.17**	21	/	/	/	/	/
Pesticides	72-54-8	4,4'-DDD	**0.032**	0.01	0.03	0.0266	**0.0732**	**0.058 j p**	/
	319-84-6	Alpha-BHC	**0.0072**	0.01	**0.0098 j**	**0.0263**	**0.0304 p**	/	/
	60-57-1	Dieldrin	**0.0018**	0.056	**0.02**	**0.0348**	/	**0.012 j**	**0.004 j**
	1031-07-8	Endosulfan sulfate	**110**	0.06	/	/	/	/	/
	76-44-8	Heptachlor	**0.0014**	0.0038	**0.00685 j**	/	/	/	/

Category	CAS No.	Analyte	Human Health (screening criteria) (µg/L)	Ecological Surface Water screening criteria (µg/L)	Historical surface water sampling results (maximum detection from each location) from **Nearby Vicinity** exceeding one or both screening criteria (µg/L)									
					SW-01	**SW-02**	**SW-04**	**SW-05**	**SW-08**	**SW-09**	**SW-10**	**SW-11**	**SW-15**	**SW-16**
SVOCs	205-99-2	Benzo(b)fluoranthene	**0.25**	2.6	**1.6 j**	/	/	/	/	/	/	/	/	/
	117-81-7	Bis(2-Ethylhexyl)phthalate	**5.6**	8	/	**15**	**9.2 j**	/	/	/	/	/	/	/
	206-44-0	Fluoranthene	**800**	0.8	2.3 j	/	/	/	/	/	/	/	/	1 j
	91-20-3	Naphthalene	**0.17**	21	/	/	/	**2.8 j**	/	/	/	/	/	/
Pesticides	72-54-8	4,4'-DDD	**0.032**	0.01	/	/	/	/	**0.061 j p +**	/	/	/	/	/
	319-84-6	Alpha-BHC	**0.0072**	0.01	/	/	/	/	/	/	/	/	/	/
	60-57-1	Dieldrin	**0.0018**	0.056	/	/	/	/	**0.015 j +**	**0.039 j**	**0.023 j**	**0.019 j**	/	/
	1031-07-8	Endosulfan sulfate	**110**	0.06	/	/	/	/	/	/	/	/	0.11 g	/
	76-44-8	Heptachlor	**0.0014**	0.0038	/	/	/	/	/	/	/	/	/	/

"/" indicates no detections above the screening criteria
j – An estimated concentration; below reporting limit.
p – When there is >25% difference for detected concentrations between the two GC column; the lower of the two is reported and flagged with a "p"
g – Results estimated based on DUSR findings

+ - SVOCs sample exceeded holding time and therefore results may be suspect.
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
See Section 2 and Table 2 for details on screening criteria sources and selection method.

Table 11. Maximum Metals Detections for Surface Water

Analyte	CAS No.	Human Health Project Screening Level (screening criteria) (µg/L)	Ecological Surface Water screening criteria (µg/L)	Maximum Detection Within AOC 2 (µg/L)		Maximum Detection Within AOC 3S (µg/L)		Maximum Detection Nearby Vicinity (µg/L)		Maximum Detection Off Property (µg/L)	
				Result	Location	Result	Location	Result	Location	Result	Location
Aluminum	7429-90-5	**20000**	87	655	SW2-3	214	SW-13	1600	SW-05	1510	SW-16
Antimony	7440-36-0	**7.8**	190	ND	ND	ND	ND	**10.4 b**	SW-19	ND	ND
Arsenic	7440-38-2	**0.052**	150	**25 b**	SW-06	ND	ND	**27 b**	SW-08	ND	ND
Barium	7440-39-3	**3800**	220	198	SW2-3	19.3	SW-13	49.3 b	SW-08	66.1 b	SW-16
Beryllium	7440-41-7	**25**	11	**32 b g**	SW-07	ND	ND	**36 b g**	SW-01	ND	ND
Cadmium	7440-43-9	**9.2**	0.72	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	7440-70-2	**NE**	116000	149000	SW2-3	57000	SW-13	189000	SW-05	87100	SW-16
Chromium	7440-47-3	**NE**	74	4.5 b	SW-07	2.8 b	SW-13	5.6 b	SW-05	3.4 b	SW-21
Cobalt	7440-48-4	**6**	19	2.21 B	SW2-2	ND	ND	4.4 b	SW-03	2.2 b	SW-16
Copper	7440-50-8	**800**	4.95	5.13 B	SW2-3	ND	ND	5.9 b	SW-05	6.6 b	SW-16
Iron	7439-89-6	**14000**	1000	**89000**	SLSW-07C	364 e	SW-13	2170	SW-05	4910 e	SW-16
Lead	7439-92-1	**15**	3.2	4.8 b g	SW-07	ND	ND	14.8	SW-02	11.6	SW-21
Magnesium	7439-95-4	**NE**	82000	17200	SW2-3	8710	SW-13	21900	SW-05	13100	SW-16
Manganese	7439-96-5	**430**	93	**9630**	SW2-3	**5060**	SW-13	**9200**	SW-03	**2360**	SW-16
Mercury	7439-97-6	**0.63**	0.77	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	7440-02-0	**390**	52	5.76 B	SW2-2	ND	ND	4 b	SW-02	3.2 b	SW-16
Potassium	2023695	**NE**	53000	4770 e g	SW-06	2770 e g	SW-13	4880 b e x	SW-05	3700 b e x	SW-16
Selenium	7782-49-2	**100**	5	4.1 B	SW2-2	ND	ND	3 b w	SW-02	ND	ND
Silver	7440-22-4	**94**	0.06	ND	ND	ND	ND	3.6 b n	SW-10	ND	ND
Sodium	7440-23-5	**NE**	680000	95200 e g	SW-14	22000 x	SW-13	81100 e g	SW-03	81300 x	SW-15
Thallium	7440-28-0	**0.2**	6	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	7440-62-2	**86**	27	2.63 B	SW2-3	ND	ND	2.4 b	SW-05	3.4 b	SW-16
Zinc	7440-66-6	**6000**	120	82.2	SW2-3	3.3 b	SW-13	211	SW-02	61	SW-16

b or B – The reported value is less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL)
w – Post-digestion spike for Furnace AA analysis is out of the control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.
x – Detected in associated field blank, may not be representative of site conditions
e – The reported value is estimated because of the presence of interference
n – Spiked sample recovery is not within the control limits
g – Results estimated based on DUSR findings
Bold indicates the Human Health screening criteria is exceeded
Gray cells indicate the Ecological Soil screening criteria is exceeded
NE: No screening criteria exists
ND: No detections for any samples within the area specified
See Section 2 and Table 2 for details on screening criteria sources and selection method.

8 Soil Gas Results

Figure 18 shows the locations of past landfill soil gas investigations.

8.1 Soil gas investigations included in evaluation and results

8.1.1 AOC 2

Soil gas was investigated over a significant portion of the southern half of AOC 2 in formerly delineated Area D in June 2005 by HDR|LMS (HDR|LMS, 2007). Installation of soil vapor sampling points was attempted at 30 locations along the gridlines established for the geophysical survey. A total of 16 sample points, SG-1 through SG-16 were installed to a maximum depth of 3.5-ft bgs using an electric hand drill. Soil gas from all 16 points was field analyzed with a photoionization detector (PID) and portable gas meter (PGM). The 14 locations that were unsuccessful could not be completed due various reasons including: refusal of installation tools at two locations, presence of water at five locations, tight formation producing no air flow upon sampling at one location, and unspecified reason at two locations. Soil vapor samples were collected from 6 locations (SG-1, 4, 5, 8, 10, and 12) and sent for laboratory analysis. Samples were analyzed for VOCs and methane.

The PID readings were all within background levels. The PGM detected no hydrogen sulfide. Oxygen was at normal atmospheric concentration (20.9%) at SG-11 and SG-13 through SG-15. Oxygen was below 20.9% at SG-1 through SG-10, SG-12, and SG-16, and below 7% at SG-4, 5, 10 and 12. The percent lower explosive limit (LEL) for methane was 81% at SG-4 and 12% at SG-10. The laboratory analysis detected tetrachloroethylene (PCE) at 0.7 ug/L in SG-8. Methane was detected at 1.8 mg/L at SG-10 and 140 mg/L at SG-4. The locations with methane detections in the laboratory analysis were the same locations with the lowest oxygen reading in the field. Methane at SG-10 was significantly below the LEL at 5% LEL. Methane at SG-4 was above both the LEL and upper explosive limit (UEL). Available guidance indicates methane above 20% LEL warn of potentially hazardous conditions (Ministry of the Environment, Conservation and Parks, 2020).

8.1.2 AOC 3S

There have been no soil gas investigations at AOC 3S.

8.1.3 Nearby Vicinity

Soil gas was investigated along the western edge of the northern portion of formerly delineated Area C in 2000 by Roux, Inc. A total of 24, 0.5-inch-diamteter borings were advanced with a punchbar, approximately 200 feet apart. The maximum boring depth achieved was three feet bgs due to the dense geology, and the study was terminated because a five-foot depth could not be attained. Screening of the punchbar borings indicated no detection of explosive gases, carbon monoxide, hydrogen sulfide, methane or VOCs. Because the early termination of and failure to reach desired depth in the study, a modification was made, and one soil gas monitoring well was installed (Soil Boring LG-1). When the boring reached 30 ft bgs, elevated levels of potentially explosive gas (8,300 ppm) was detected, and the drilling activities were immediately terminated. An additional boring for monitoring well LG-2 was advanced adjacent to LG-1 and screening

results indicated similar presence of organic vapors in soil gas at potentially explosive conditions. Existing passive soil gas vents near the MCC plant (southwest of AOC 2) were also screened. The results from the passive soil gas vents indicated concentrations representative of atmospheric air.

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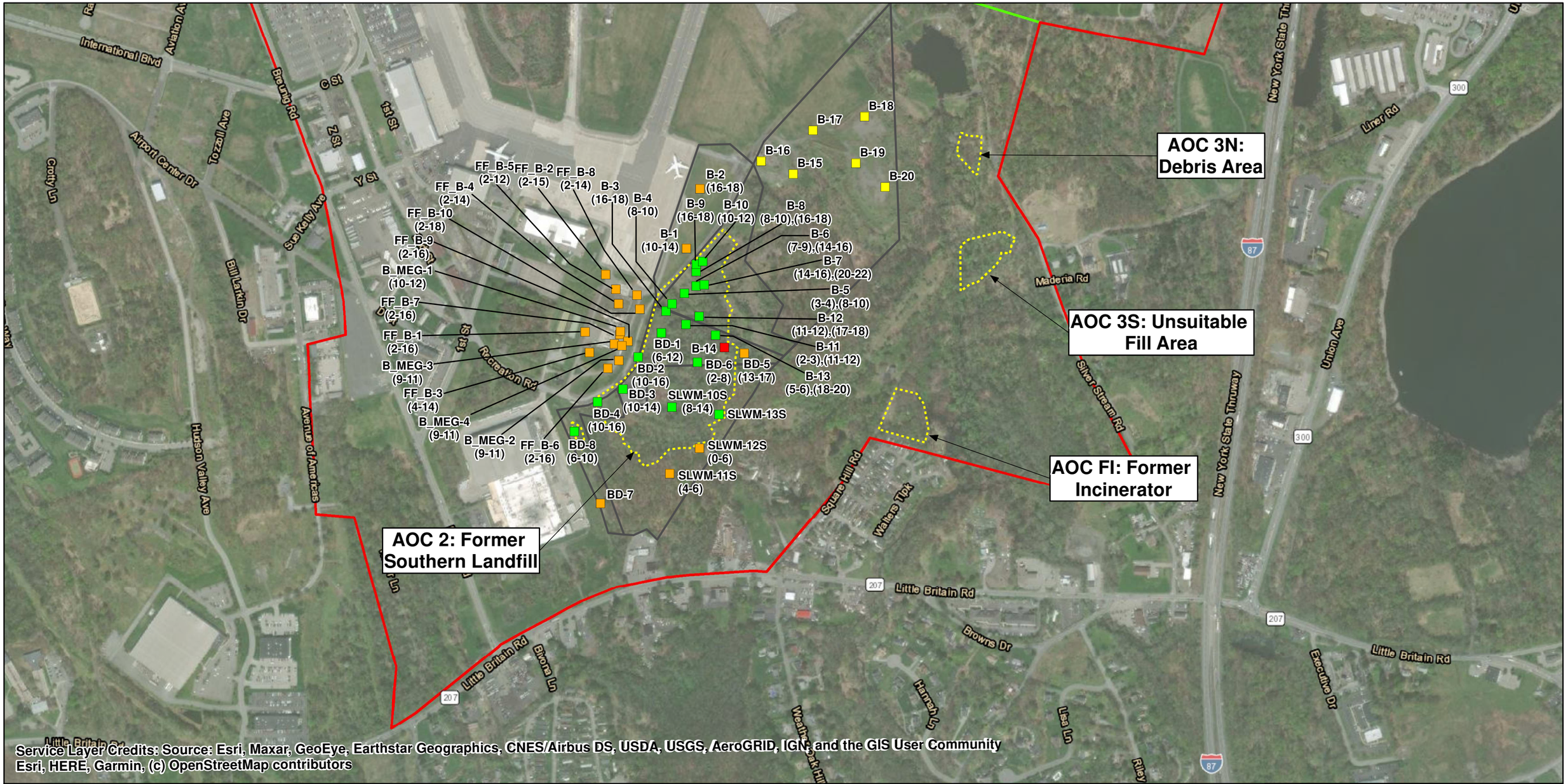
Figures:

Figure 15. Historical Soil Sampling Locations

Figure 16. Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells

Figure 17. Historical Sediment and Surface Water Sampling Locations

Figure 18. Historical Landfill Extent, Contents, and Landfill Gas Investigations



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC
- New York Air National Guard (NYANG) Base
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force
- Soil boring in AOC
- Soil boring in nearby vicinity
- Attempted but unsuccessful soil boring in AOC
- Area C soil borings shown for

N W E S

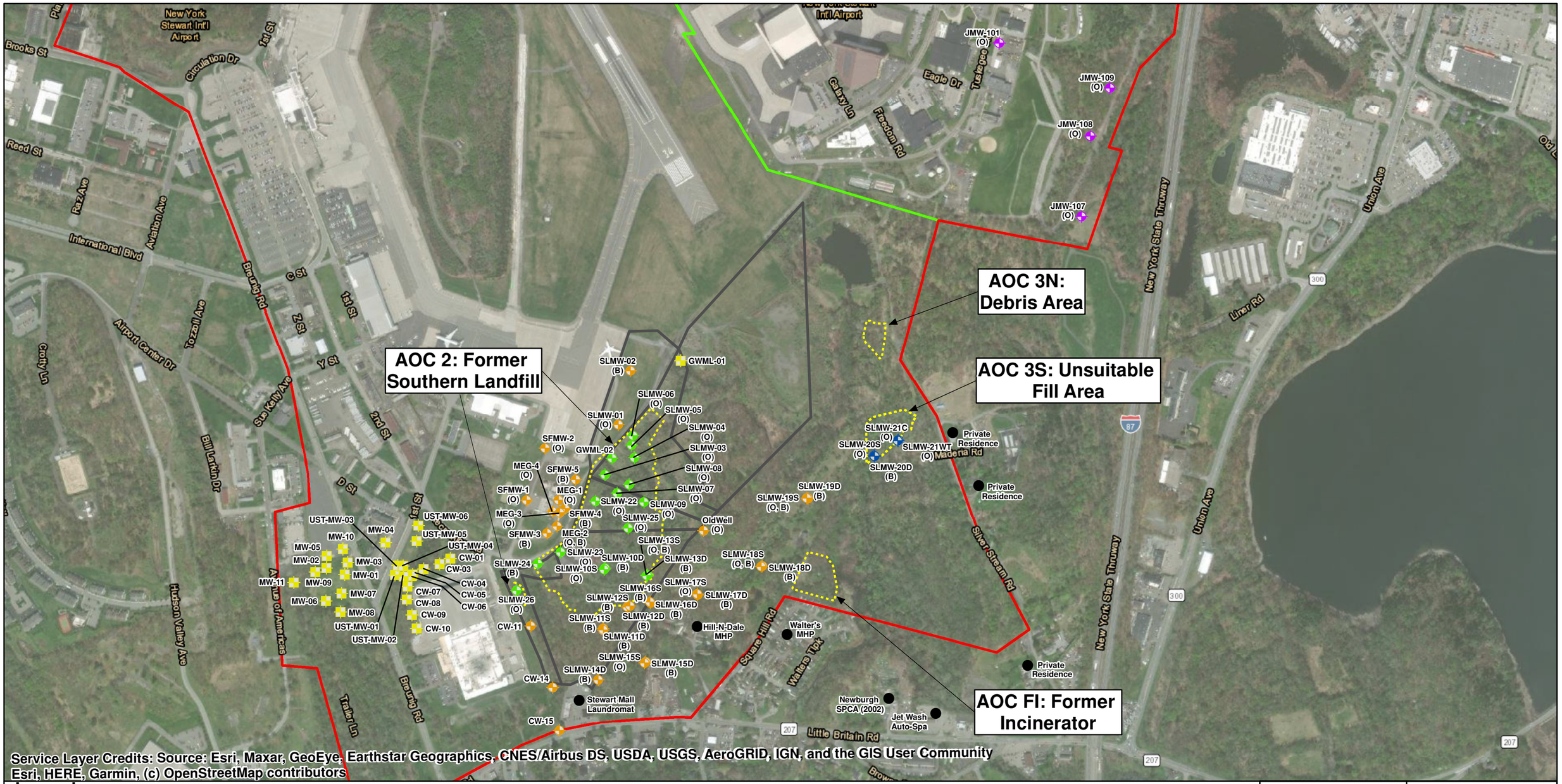
0 425 850 1,275 1,700 Feet

FIGURE 15

Historical Soil Sampling Locations

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- New York Air National Guard (NYANG) Base
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force

- Monitoring wells AOC 2
- Monitoring wells AOC 3
- NYANG wells shown for reference
- Monitoring wells nearby vicinity upgradient or downgradient
- Monitoring wells cross-gradient
- Downgradient Drinking Water Wells

O - Overburden
B - Bedrock

NOTE: This figure shows groundwater monitoring well locations as documented in past reports. The condition of the wells is unknown.

N W E S

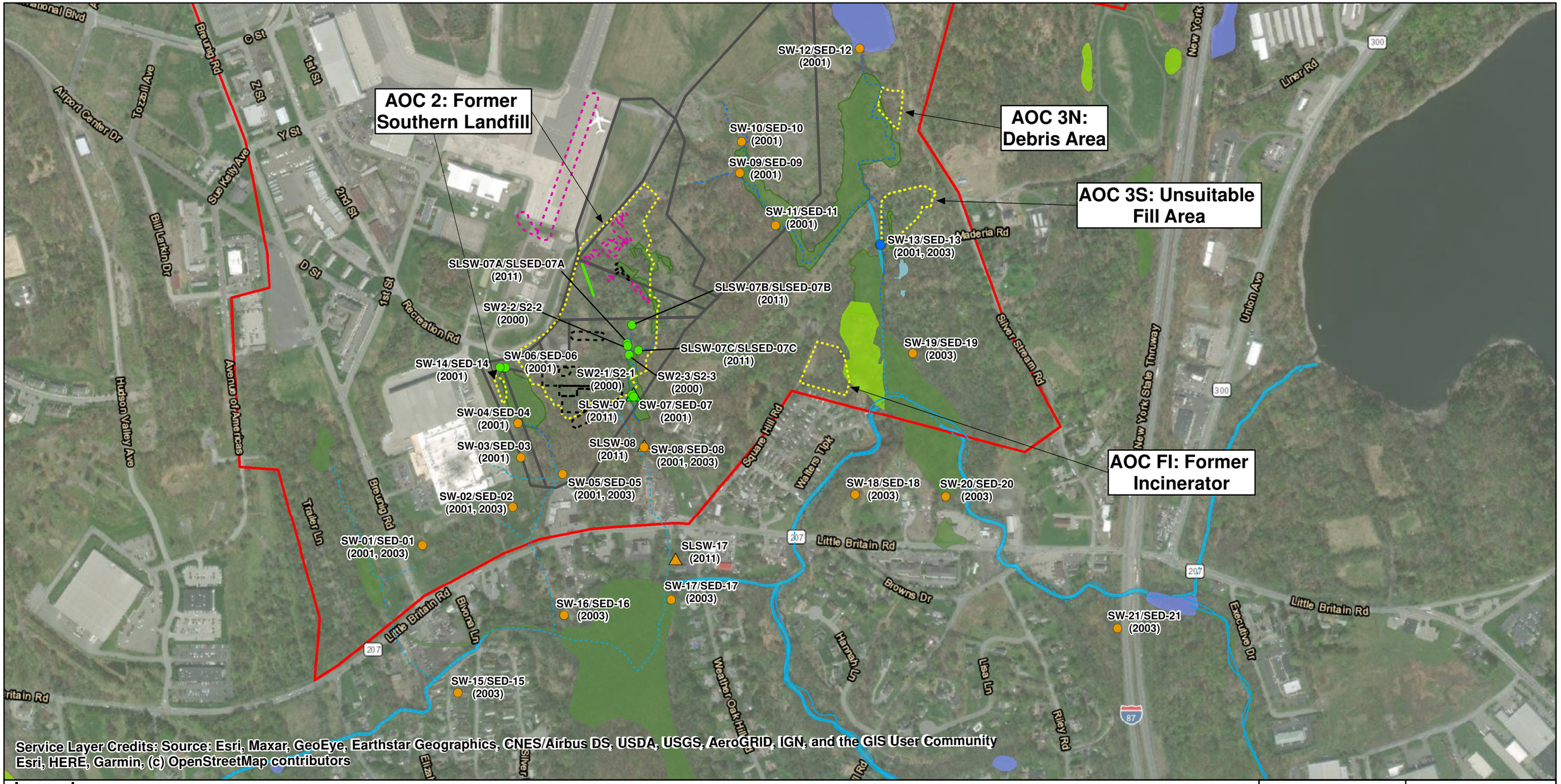
0 480 960 1,440 1,920 Feet

FIGURE 16

Historical Groundwater Sampling Locations and Downgradient Drinking Water Wells

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force Base
- Disposal Trench
- Stained Soil
- Trench from 2021 Geophysical Investigation
- Field Delineated Wetlands
- Freshwater Forested/Shrub Wetland
- Freshwater Emergent Wetland
- Freshwater Pond
- Riverine
- Vernal Pools
- Surface water and sediment sample locations in AOC 2
- Surface water and sediment sample locations nearby AOC 3
- Surface water and sediment sample locations in vicinity (upstream or downstream)
- Drainage Lines
- Field delineated Streams
- Streams
- Surface Water Only Samples
- Sediment and Surface Water Samples

N W E S

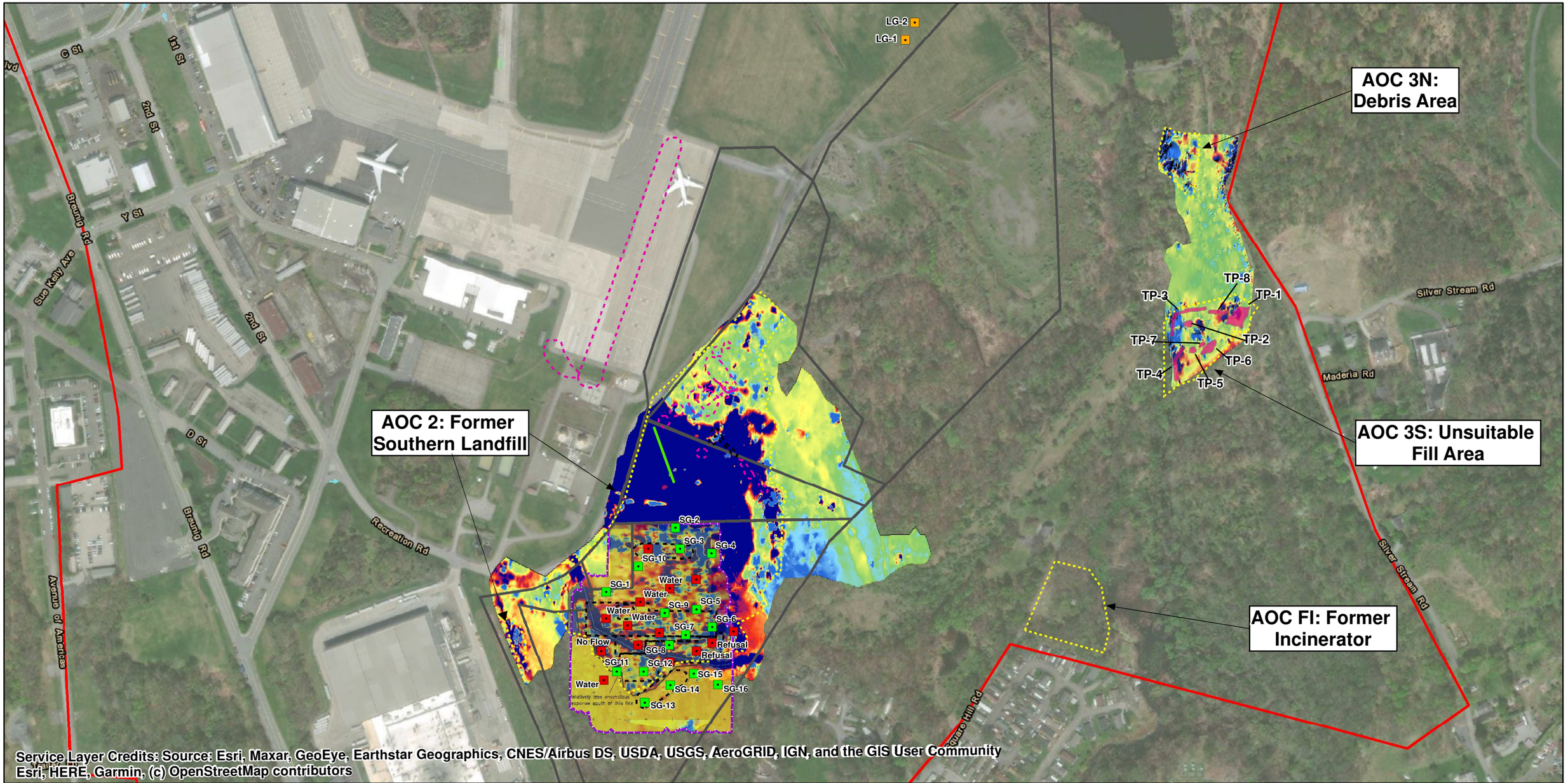
0 420 840 1,260 1,680 Feet

FIGURE 17

Historical Sediment and Surface Water Sampling Locations

Former Stewart Air Force Base, New York

Dec 2021



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Legend

- Approximate extent of Area of Concern (AOC) 2, AOC 3S, AOC 3N, and AOC FI.
- Formerly delineated Areas A, B, C and D. (LMS, 2001)
- Former Stewart Air Force Base
- Trench from 2021 Geophysical Investigation
- AOC 3 Test Pits from 2001
- 2001 Landfill Gas Boring Locations
- Disposal Trench
- Stained Soil
- 2005 Geophysical Survey Boundary

2007 Soil Gas Sample Locations

- Successful
- Unsuccessful

2005 Geophysical EM Results showing extent of waste fill material

High : 2.7

Low : - 3.3

2021 Geophysical EM Results showing extent of waste fill material

High : 32

Low : - 10

N W E S

0 250 500 750 1,000 Feet

FIGURE 18

Historical Landfill Extent, Contents, and Landfill Gas Sampling Locations

Former Stewart Air Force Base, New York

July 2021

Organic Contaminant Detection Tables

Tables are presented in the following order by media:

Soil

Groundwater

Sediment

Surface water

Historical Maximum Organic Contaminant Detections in Soil Samples, by Location and Depth Interval (feet below ground surface) (mg/kg)

Location (Samples grouped by location)			UG	UG	UG	UG	UG	UG	UG	UG	UG	UG	UG	UG
Category	**CAS No.**	**Analyte**	**B_MEG-1 (10-12)**	**B_MEG-2 (9-11)**	**FF_B-1 (2-16)**	**FF_B-2 (2-15)**	**FF_B-3 (4-14)**	**FF_B-4 (2-14)**	**FF_B-5 (2-12)**	**FF_B-6 (2-16)**	**FF_B-7 (2-16)**	**FF_B-8 (2-14)**	**FF_B-9 (2-19)**	**FF_B-10 (2-18)**
VOCs	75-34-3	1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
	95-63-6	1,2,4-Trimethylbenzene	-	1.7	-	-	-	-	-	-	-	-	-	-
SVOC	207-08-9	Benzo(k)fluoranthene	-	-	0.05 j	-	-	-	-	-	-	-	-	-
	92-52-4	Biphenyl	-	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	-	-	0.53	0.2 j	0.15 j	0.19 j	0.099 j	0.31 j	0.27 j	0.31 j	0.11 j	0.054 j
	85-68-7	Butyl benzyl phthalate	-	-	0.045 j	-	-	-	-	0.044 j	0.073 j	0.079 j	-	-
	86-74-8	Carbazole	-	-	-	-	-	-	-	-	-	-	-	-
	218-01-9	Chrysene	-	-	0.083 j	-	-	-	-	-	-	-	-	-
	53-70-3	Dibenzo(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
	132-64-9	Dibenzofuran	-	-	-	-	-	-	-	-	-	-	-	-
	131-11-3	Dimethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	-	-	-	-	-	-	0.12 j	-	-	-	-
	117-84-0	Di-n-octylphthalate	-	-	0.056 j	-	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	2.1	-	0.18 j	-	-	-	-	-	-	-	-	-
	86-73-7	Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	-	0.041 j	-	-	-	-	-	-	-	-	-
	91-20-3	Naphthalene	0.074	0.57	-	-	-	-	-	-	-	-	-	-
	85-01-8	Phenanthrene	1.5	-	0.081 j	-	-	-	-	-	-	-	-	-
	129-00-0	Pyrene	1.7	-	0.19 j	-	-	-	-	-	-	-	-	-
Pesticides	72-54-8	4,4'-DDD	NA	NA	-	0.00094 j	-	-	-	-	0.0052	-	-	-
	72-55-9	4,4'-DDE	NA	NA	-	0.0071	0.0027 j	-	-	0.00081 j	0.0042	-	-	-
	50-29-3	4,4'-DDT	NA	NA	-	0.0029 j	0.0037 j	-	-	0.0018 j	0.0036 j	-	-	-
	309-00-2	Aldrin	NA	NA	-	-	-	-	-	-	-	-	-	-
	60-57-1	Dieldrin	NA	NA	-	0.0023 j	0.019 j	-	-	0.0058	0.0028 j p	-	-	-
PCBs	12672-29-6	Aroclor 1248	NA	NA	0.12 p	-	-	-	-	-	-	-	-	-
	11096-82-5	Aroclor 1260	NA	NA	-	-	-	-	-	-	-	-	-	-
Herbicides			NA											
Petroleum Hydrocarbons (DRO and GRO)			NA											
Explosive Organic Compounds			NA											

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.
p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.
d - Concentration recovered from a diluted sample.
NA = Not Analyzed

† Soil borings would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2
B-01, B-02, BD-7, B_MEG-3 and B_MEG-4 had no detections of organic

Historical Maximum Organic Contaminant Detections in Soil Samples, by Location and Depth Interval (feet below ground surface) (mg/kg)

Location (Samples grouped by location)			AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2
Category	**CAS No.**	**Analyte**	**B-03 (16-18)**	**B-04 (8-10)**	**B-05 (3-4)**	**B-05 (8-10)**	**B-06 (14-16)**	**B-06 (7-9)**	**B-07 (14-16)**	**B-07 (20-22)**	**B-08 (16-18)**	**B-08 (8-10)**	**B-9 (16-18)**	**B-10 (10-12)**	**B-11 (11-12)**	**B-11 (2-3)**	**B-12 (11-12)**	**B-12 (17-18)**
VOCs	75-34-3	1,1-Dichloroethane	-	-	-	-	0.0043 j	-	-	-	-	-	-	-	-	-	-	-
	95-63-6	1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOC	207-08-9	Benzo(k)fluoranthene	-	-	1.1	0.14 j	-	0.078 j	-	-	-	-	-	-	-	0.17 j	0.38 j	-
	92-52-4	Biphenyl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	0.39 j	0.81	0.17 j	0.34 j	0.21 j	0.84	0.5	0.11 j	0.63	0.36 j	0.78	0.36 j	0.22 j	0.31 j	1.8	0.22 j
	85-68-7	Butyl benzyl phthalate	-	0.12 j	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	86-74-8	Carbazole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	218-01-9	Chrysene	-	-	0.57	0.25 j	-	0.15 j	-	-	-	-	-	-	-	0.23 j	0.56	-
	53-70-3	Dibenzo(a,h)anthracene	-	-	0.063 j	-	-	-	-	-	-	-	-	-	-	-	-	-
	132-64-9	Dibenzofuran	-	-	-	-	-	0.04 j	-	-	-	-	-	-	-	-	0.066 j	-
	131-11-3	Dimethyl phthalate	-	-	-	-	-	0.067 j	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	-	-	-	-	0.039 j	-	-	-	-	-	-	-	-	-	-
	117-84-0	Di-n-octylphthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	-	-	0.83	0.53	-	0.25 j	-	-	-	-	-	-	-	0.46	0.77	-
	86-73-7	Fluorene	-	-	0.06 j	-	-	0.075 j	-	-	-	-	-	-	-	0.073 j	0.11 j	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	-	0.23 j	0.093 j	-	-	-	-	-	-	-	-	-	0.058 j	0.22 j	-
	91-20-3	Naphthalene	-	-	-	-	-	0.19 j	0.28 j	-	-	-	-	-	-	-	0.1 j	-
	85-01-8	Phenanthrene	-	-	0.49	0.3 j	-	0.24 j	0.071 j	-	-	-	-	-	-	0.48	0.65	-
	129-00-0	Pyrene	-	-	2.2	0.62	-	0.77	-	-	-	-	-	-	-	0.96	1.7	-
Pesticides	72-54-8	4,4'-DDD	-	0.0036 j	0.051	0.0058 p	0.01 p	0.52 d p	-	-	-	0.00089 j p	0.0014 j p	0.00041 j p	0.025 p	0.77 d p	5.1 d p	0.03 p
	72-55-9	4,4'-DDE	-	0.0046 p	0.01 p	0.0034 j p	0.0009 j	0.053	-	-	-	0.00057 j p	-	0.0007 j	0.0034 j	0.073 j d	0.3 j d	0.0019 j
	50-29-3	4,4'-DDT	-	0.021	0.0078	0.0055 p	0.0011 j	0.1 d	-	-	-	0.0021 j p	-	0.00075 j	0.013	0.058 j d	0.58 j d p	0.0031 j
	309-00-2	Aldrin	-	-	0.0071 p	0.0036	-	0.011	-	-	-	-	-	-	-	0.24 d	-	-
	60-57-1	Dieldrin	-	-	0.093 d	0.013 p	0.0038 j p	0.24 d p	-	-	-	0.01 p	-	0.002 j p	0.00043 j p	0.41	-	-
PCBs	12672-29-6	Aroclor 1248	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11096-82-5	Aroclor 1260	-	-	0.036 j p	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides			NA															
Petroleum Hydrocarbons (DRO and GRO)			NA															
Explosive Organic Compounds			NA															

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.
p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.
d - Concentration recovered from a diluted sample.
NA = Not Analyzed

† Soil borings would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2
B-01, B-02, BD-7, B_MEG-3 and B_MEG-4 had no detections of organic

Historical Maximum Organic Contaminant Detections in Soil Samples, by Location and Depth Interval (feet below ground surface) (mg/kg)

Location (Samples grouped by location)			AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2 †	AOC 2 †
Category	**CAS No.**	**Analyte**	**B-13 (18-20)**	**B-13 (5-6)**	**BD-1 (6-12)**	**BD-2 (10-16)**	**BD-3 (10-14)**	**BD-4 (10-16)**	**BD-5 (13-17)**	**BD-6 (2-8)**	**BD-8 (6-10)**	**SLMW-10S (8-14)**	**SLMW-13S (Depth not specified)**	**SLMW-12S (0-6)**	**SLWM-11S (4-6)**
VOCs	75-34-3	1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
	95-63-6	1,2,4-Trimethylbenzene	-	-	0.0038	-	-	-	-	-	-	-	-	-	-
	207-08-9	Benzo(k)fluoranthene	-	-	-	-	-	0.11	-	-	-	-	-	-	-
	92-52-4	Biphenyl	-	-	0.62	-	-	-	-	-	-	-	-	-	-
SVOC	117-81-7	Bis(2-Ethylhexyl)phthalate	0.25 j	1.5	-	-	-	-	-	0.15	0.17	1.2	0.48	0.29 j	0.66
	85-68-7	Butyl benzyl phthalate	-	-	-	-	-	-	-	-	-	1.6	-	-	-
	86-74-8	Carbazole	-	-	-	-	-	0.083	-	-	-	-	-	-	-
	218-01-9	Chrysene	-	0.047 j	-	0.13	-	0.23	-	-	0.09	0.056 j	-	-	-
	53-70-3	Dibenzo(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-
	132-64-9	Dibenzofuran	-	-	-	-	-	-	-	-	-	0.038 j	-	-	-
	131-11-3	Dimethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	-	-	-	-	-	-	-	-	-	-	0.12 j	0.05 j
	117-84-0	Di-n-octylphthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	-	0.056 j	-	0.33	-	0.94	-	-	0.21	0.075 j	-	-	-
	86-73-7	Fluorene	-	-	-	-	-	0.089	-	-	-	0.045 j	-	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	-	-	0.098	-	0.077	-	-	-	-	-	-	-
	91-20-3	Naphthalene	-	-	3	0.092	-	-	-	-	-	0.072 j	-	-	-
	85-01-8	Phenanthrene	-	-	-	0.23	-	0.79	-	-	0.14	0.19 j	-	-	-
	129-00-0	Pyrene	-	0.071 j	-	0.34	-	1	-	-	0.16	0.34 j	-	-	-
Pesticides	72-54-8	4,4'-DDD	0.0031 j	0.052 d p	15	0.55	0.023	-	-	0.022	-	0.021	-	0.0053	-
	72-55-9	4,4'-DDE	-	0.018 p	-	-	-	-	-	0.0068	-	0.012	0.0017 j	0.23 D 10:1	0.0015 j
	50-29-3	4,4'-DDT	-	0.027	6.8	0.13	0.0044	-	-	0.0057	-	0.0066	0.0014 j	0.099 D 10:1	0.0012 j
	309-00-2	Aldrin	-	0.0061	-	-	-	-	-	-	-	-	-	-	-
	60-57-1	Dieldrin	-	0.075 d	-	-	-	0.0093	-	0.0078	0.014	0.011	-	0.006	-
PCBs	12672-29-6	Aroclor 1248	-	-	-	-	-	-	-	-	-	-	-	-	-
	11096-82-5	Aroclor 1260	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides			NA												
Petroleum Hydrocarbons (DRO and GRO)			NA												
Explosive Organic Compounds			NA												

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.
p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.
d - Concentration recovered from a diluted sample.
NA = Not Analyzed

† Soil borings would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2
B-01, B-02, BD-7, B_MEG-3 and B_MEG-4 had no detections of organic

Historical Maximum Organic Contaminant Detections in Groundwater Samples, by Location (ug/L)

Location (Samples grouped by location)			UG	UG	UG	UG	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2
Category	**CAS No.**	**Analyte**	**SLMW-01**	**SLMW-02**	**SF-MW2**	**MEG-2**	**GLMW-02**	**Old Well**	**SLMW-03**	**SLMW-04**	**SLMW-05**	**SLMW-06**	**SLMW-07**	**SLMW-08**	**SLMW-09**
VOCs	71-55-6	1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	12	-	-	-	-
	75-34-3	1,1-Dichloroethane	-	-	-	-	0.55 j	-	-	2.7	92	-	-	-	-
	75-35-4	1,1-Dichloroethene	-	-	-	-	-	-	-	-	8.2	-	-	-	-
	95-93-2	1,2,4,5-Tetramethylbenzene	-	-	-	-	-	-	-	26	-	-	-	-	-
	95-63-6	1,2,4-Trimethylbenzene	-	-	-	7	-	-	-	53	-	-	-	-	66
	107-06-2	1,2-Dichloroethane	-	-	-	-	-	-	-	-	3	-	-	-	-
	108-67-8	1,3,5-Trimethylbenzene	-	-	-	-	-	-	-	19	-	-	-	-	18
	106-46-7	1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	20 j
	78-93-3	2-Butanone	-	-	-	-	-	-	-	-	-	-	-	-	-
	622-96-8	4-Ethyltoluene	-	-	-	-	-	-	-	-	-	-	-	-	12
	108-10-1	4-Methyl-2-pentanone	-	-	-	-	-	-	-	-	-	-	-	-	-
	67-64-1	Acetone	-	-	-	-	-	-	-	-	-	3.1 j	-	-	3.3 j
	71-43-2	Benzene	-	-	-	2	-	-	-	4	1.98 j	-	0.51 j	6.4	22
	108-90-7	Chlorobenzene	-	-	-	-	-	-	-	13	-	-	-	-	88
	75-00-3	Chloroethane	-	-	-	-	-	-	-	0.74 j	1.4	-	-	0.7 j	1.1
	67-66-3	Chloroform	-	-	-	-	-	-	-	-	-	-	-	-	-
	156-59-2	cis-1,2-Dichloroethene	-	-	-	-	-	-	-	11	-	-	-	-	0.51 j
	10061-01-5	cis-1,3-Dichloropropene	-	-	-	-	-	-	-	-	3.5	-	-	-	-
	100-41-4	Ethylbenzene	-	-	-	-	-	-	-	1.6	-	-	-	-	1.9
	98-82-8	Isopropylbenzene	-	-	-	-	-	-	-	17	-	-	-	-	3
	75-09-2	Methylene chloride	-	-	-	-	0.76 j	-	-	-	-	-	-	0.5 j	0.86 j
	103-65-1	n-Propylbenzene	-	-	-	-	-	-	-	15	-	-	-	-	5
	106-42-3/108-38-3	p/m-Xylene	-	-	-	-	-	-	-	0.68 j	-	-	0.69 j	-	69
	99-87-6	p-Isopropyltoluene	-	-	-	-	-	-	-	-	-	-	-	-	4
	135-98-8	sec-Butylbenzene	-	-	-	-	-	-	-	6	-	-	-	-	-
	108-88-3	Toluene	-	-	-	-	-	-	-	-	-	-	0.86 j	-	0.78 j
	79-01-6	Trichloroethene	-	-	-	-	-	-	-	0.76 j	0.58 j	-	-	-	-
	75-01-4	Vinyl chloride	-	-	-	-	-	-	-	3.3	3.4	-	-	-	-
SVOCs	95-50-1	1,2-Dichlorobenzene	-	-	-	-	-	-	-	1 j	-	-	-	-	1 j
	91-57-6	2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	2 j
	108-39-4	3-Methylphenol/4-Methylphenol	-	-	-	-	-	-	-	-	-	-	-	2 j	2 j
	83-32-9	Acenaphthene	-	-	-	-	-	-	-	-	-	-	-	-	-
	120-12-7	Anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-
	56-55-3	Benzo(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-
	50-32-8	Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-
	205-99-2	Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	1 j	-
	191-24-2	Benzo(ghi)perylene	-	-	-	-	-	-	-	-	-	-	-	-	-
	207-08-9	Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	3.5 j	2.7 j	1 j	-	-	8.8	2 jb	2 jb	-	2 jb	2 jb	3 jb	2 j
	218-01-9	Chrysene	-	-	-	-	-	-	-	-	-	-	-	-	-
	53-70-3	Dibenzo(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-	-
	84-66-2	Diethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	7 j
	84-74-2	Di-n-butylphthalate	-	-	6 j	-	-	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	2 j	-
	86-73-7	Fluorene	-	-	-	-	-	-	-	-	-	-	-	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-
	80-62-6	Methylmethacrylate	-	-	-	-	-	-	-	-	-	6 j	-	-	-
	91-20-3	Naphthalene	-	-	-	7	-	-	2 j	3 j	-	-	1 j	3 j	28 j
	85-01-8	Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	2 j	-
	108-95-2	Phenol	-	-	-	-	-	-	-	-	-	-	-	-	1 j
	129-00-0	Pyrene	-	-	-	-	-	-	-	-	-	-	-	2 j	-

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - Reported value was obtained from a reading < Contract Reporting Limit, but > or equal to the Instrument Detection Limit.

g - Value considered estimated based on data review.

D - Dilution factor

NA = Not Analyzed

† Groundwater wells would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2, DG = Downgradient AOC 2

Wells SLMW-11S, SLWM-18S, SLMW-19D, SLWM-20S, SLMW-26, CW-14, CW-15 SF-MW1, SF-MW3, SF-MW4, SF-MW5, MEG-1, MEG-3 and MEG4 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Groundwater Samples, by Location (ug/L)

Location (Samples grouped by location)			AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2
Category	**CAS No.**	**Analyte**	**SLMW-10D**	**SLMW-10S**	**SLMW-11D †**	**SLMW-12D †**	**SLMW-12S †**	**SLMW-13D**	**SLMW-13S**	**SLMW-16D**	**SLMW-16S**	**SLMW-22**	**SLMW-23**	**SLMW-24**	**SLMW-25**
VOCs	71-55-6	1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
	75-34-3	1,1-Dichloroethane	-	0.7 j	-	-	1.1	-	-	-	-	-	-	-	-
	75-35-4	1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-
	95-93-2	1,2,4,5-Tetramethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	95-63-6	1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	2.6
	107-06-2	1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-
	108-67-8	1,3,5-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	106-46-7	1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	78-93-3	2-Butanone	-	3	-	-	-	-	-	-	-	-	-	-	-
	622-96-8	4-Ethyltoluene	-	-	-	-	-	-	-	-	-	-	-	-	-
	108-10-1	4-Methyl-2-pentanone	-	-	-	-	1.1 j	-	-	-	-	-	-	-	-
	67-64-1	Acetone	1.6 j	22	-	1.7 j	-	1.3 j	-	-	-	-	11	-	-
	71-43-2	Benzene	-	0.98 j	-	-	2.4	-	-	-	-	-	-	-	1.5
	108-90-7	Chlorobenzene	-	-	-	-	1.3	-	1.2	-	-	-	-	-	11
	75-00-3	Chloroethane	-	-	-	-	3.5	-	-	-	-	-	-	-	-
	67-66-3	Chloroform	-	-	-	-	-	-	-	-	-	-	-	-	-
	156-59-2	cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	1.6	-	-	1.3
	10061-01-5	cis-1,3-Dichloropropene	-	-	-	-	-	-	-	-	-	-	-	-	-
	100-41-4	Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	98-82-8	Isopropylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	75-09-2	Methylene chloride	-	-	0.65 j	-	-	0.55 j	-	0.51 j	0.55 j	-	-	-	-
	103-65-1	n-Propylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	106-42-3/108-38-3	p/m-Xylene	-	-	-	-	-	-	-	-	-	-	-	-	-
	99-87-6	p-Isopropyltoluene	-	-	-	-	-	-	-	-	-	-	-	-	-
	135-98-8	sec-Butylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	108-88-3	Toluene	-	-	-	-	-	-	-	-	-	-	-	-	-
	79-01-6	Trichloroethene	-	-	-	-	-	-	-	-	-	3.4	-	-	2.1
	75-01-4	Vinyl chloride	-	-	-	-	-	0.94 j	-	-	-	-	-	-	-
SVOCs	95-50-1	1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-
	91-57-6	2-Methylnaphthalene	-	0.62	-	-	-	-	-	-	-	-	-	-	-
	108-39-4	3-Methylphenol/4-Methylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-
	83-32-9	Acenaphthene	-	2.8	-	-	-	-	-	-	-	-	-	-	3.5
	120-12-7	Anthracene	-	0.9	-	-	-	-	-	-	-	-	-	-	-
	56-55-3	Benzo(a)anthracene	-	0.88	-	-	-	-	-	-	-	-	-	-	-
	50-32-8	Benzo(a)pyrene	-	0.7	-	-	-	-	-	-	-	-	-	-	-
	205-99-2	Benzo(b)fluoranthene	-	0.83	-	-	-	-	-	-	-	-	-	-	-
	191-24-2	Benzo(ghi)perylene	-	0.47	-	-	-	-	-	-	-	-	-	-	-
	207-08-9	Benzo(k)fluoranthene	-	0.56	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	-	-	-	1.1 j	-	-	1.1 j	-	-	-	15	-	2.2
	218-01-9	Chrysene	-	0.67	-	-	-	-	-	-	-	-	-	-	-
	53-70-3	Dibenzo(a,h)anthracene	-	0.38	-	-	-	-	-	-	-	-	-	-	-
	84-66-2	Diethyl phthalate	-	7.3 j	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	-	-	2.1 j	2.7 j	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	-	2.4	-	-	-	-	-	-	-	-	-	-	-
	86-73-7	Fluorene	-	2.4	-	-	-	-	-	-	-	-	-	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	0.57	-	-	-	-	-	-	-	-	-	-	-
	80-62-6	Methylmethacrylate	-	-	-	-	-	-	-	-	-	-	-	-	-
	91-20-3	Naphthalene	-	1.5	-	-	-	-	-	-	-	-	-	-	11
	85-01-8	Phenanthrene	-	3.5	-	-	-	-	-	-	-	-	-	-	-
	108-95-2	Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
	129-00-0	Pyrene	-	1.7	-	-	-	-	-	-	-	-	-	-	-

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - Reported value was obtained from a reading < Contract Reporting Limit, but > or equal to the Instrument Detection Limit.

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† Groundwater wells would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2, DG = Downgradient AOC 2

Wells SLMW-11S, SLWM-18S, SLMW-19D, SLWM-20S, SLMW-26, CW-14, CW-15 SF-MW1, SF-MW3, SF-MW4, SF-MW5, MEG-1, MEG-3 and MEG4 had no detections of organic contaminants and are not included in the table.

Location (Samples grouped by location)			DG	DG	DG	DG	DG	DG	DG	DG	AOC 3S	AOC 3S	AOC 3S
Category	**CAS No.**	**Analyte**	**CW-11**	**SLMW-14D**	**SLMW-15D**	**SLMW-15S**	**SLMW-17D**	**SLMW-17S**	**SLMW-18D**	**SLMW-19S**	**SLMW-20D**	**SLMW-21C**	**SLWM-21WT**
VOCs	71-55-6	1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-
	75-34-3	1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-
	75-35-4	1,1-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-
	95-93-2	1,2,4,5-Tetramethylbenzene	-	-	-	-	-	-	-	-	-	-	-
	95-63-6	1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-
	107-06-2	1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-
	108-67-8	1,3,5-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-
	106-46-7	1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-
	78-93-3	2-Butanone	-	-	-	-	-	-	-	-	-	-	-
	622-96-8	4-Ethyltoluene	-	-	-	-	-	-	-	-	-	-	-
	108-10-1	4-Methyl-2-pentanone	-	-	-	-	-	-	-	-	-	-	-
	67-64-1	Acetone	-	-	-	-	2.2 j	-	-	-	1.8 j	2.2 j	2.3 j
	71-43-2	Benzene	-	-	-	-	-	-	-	-	-	-	-
	108-90-7	Chlorobenzene	-	-	-	-	-	-	-	-	-	-	-
	75-00-3	Chloroethane	-	-	-	-	-	-	-	-	-	-	-
	67-66-3	Chloroform	-	-	-	-	-	-	-	-	-	0.79 j	-
	156-59-2	cis-1,2-Dichloroethene	-	-	-	-	-	-	-	-	-	-	-
	10061-01-5	cis-1,3-Dichloropropene	-	-	-	-	-	-	-	-	-	-	-
	100-41-4	Ethylbenzene	-	-	-	-	-	-	-	-	-	-	-
	98-82-8	Isopropylbenzene	-	-	-	-	-	-	-	-	-	-	-
	75-09-2	Methylene chloride	-	-	0.61 j	0.64 j	-	-	0.5 j	-	-	0.71 j	0.56 j
	103-65-1	n-Propylbenzene	-	-	-	-	-	-	-	-	-	-	-
	106-42-3/108-38-3	p/m-Xylene	-	-	-	-	-	-	-	-	-	-	-
	99-87-6	p-Isopropyltoluene	-	-	-	-	-	-	-	-	-	-	-
	135-98-8	sec-Butylbenzene	-	-	-	-	-	-	-	-	-	-	-
	108-88-3	Toluene	-	-	-	-	-	-	-	-	-	-	-
	79-01-6	Trichloroethene	-	-	-	-	-	-	-	-	-	-	-
	75-01-4	Vinyl chloride	-	-	-	-	-	-	-	-	-	-	-
SVOCs	95-50-1	1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	-	-	-
	91-57-6	2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-
	108-39-4	3-Methylphenol/4-Methylphenol	-	-	-	-	-	-	-	-	-	-	-
	83-32-9	Acenaphthene	-	-	-	-	-	-	-	-	-	-	-
	120-12-7	Anthracene	-	-	-	-	-	-	-	-	-	-	-
	56-55-3	Benzo(a)anthracene	-	-	-	-	-	-	-	-	-	-	-
	50-32-8	Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-
	205-99-2	Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-
	191-24-2	Benzo(ghi)perylene	-	-	-	-	-	-	-	-	-	-	-
	207-08-9	Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	-	-	-	-	-	1.5 j	-	3 j	0.75 j	-	-
	218-01-9	Chrysene	-	-	-	-	-	-	-	-	-	-	-
	53-70-3	Dibenzo(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-
	84-66-2	Diethyl phthalate	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	2.7 j	-	6.1 j	-	2.4 j	-	-	-	-	-
	206-44-0	Fluoranthene	-	-	-	-	-	-	-	-	-	-	-
	86-73-7	Fluorene	-	-	-	-	-	-	-	-	-	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	-	-	-	-	-	-	-	-	-	-
	80-62-6	Methylmethacrylate	-	-	-	-	-	-	-	-	-	-	-
	91-20-3	Naphthalene	-	-	-	-	-	-	-	-	-	-	-
	85-01-8	Phenanthrene	-	-	-	-	-	-	-	-	-	-	-
	108-95-2	Phenol	-	-	-	-	-	-	-	-	-	-	-
	129-00-0	Pyrene	-	-	-	-	-	-	-	-	-	-	-

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - Reported value was obtained from a reading < Contract Reporting Limit, but > or equal to the Instrument Detection Limit.

g - Value considered estimated based on data review.

D - Dilution factor

NA = Not Analyzed

† Groundwater wells would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2, DG = Downgradient AOC 2

Wells SLMW-11S, SLWM-18S, SLMW-19D, SLWM-20S, SLMW-26, CW-14, CW-15 SF-MW1, SF-MW3, SF-MW4, SF-MW5, MEG-1, MEG-3 and MEG4 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Groundwater Samples, by Location (ug/L)

Location (Samples grouped by location)			UG	UG	UG	UG	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2
Category	**CAS No.**	**Analyte**	**SLMW-01**	**SLMW-02**	**SF-MW2**	**MEG-2**	**GLMW-02**	**Old Well**	**SLMW-03**	**SLMW-04**	**SLMW-05**	**SLMW-06**	**SLMW-07**	**SLMW-08**	**SLMW-09**
Pesticides	72-54-8	4,4'-DDD	-	-	-	NA	-	-	-	-	-	-	0.29 p	14 g[D: 3:1]	0.78 j
	72-55-9	4,4'-DDE	-	-	-	NA	-	-	-	-	-	-	0.033 j	1 pg	0.015 j
	50-29-3	4,4'-DDT	-	-	-	NA	-	-	-	-	-	-	0.14	10 g[D: 3:1]	0.015 j
	309-00-2	Aldrin	-	-	-	NA	-	-	0.023 j	-	-	-	-	-	-
	319-85-7	Beta-BHC	-	-	-	NA	-	-	-	-	-	-	-	-	0.14 pg
	319-86-8	Delta-BHC	-	-	-	NA	-	-	-	-	-	-	-	-	0.026 jp
	60-57-1	Dieldrin	0.045 j	-	-	NA	-	-	-	-	-	-	-	-	0.042 jp
PCBs						NA									
Herbicides	94-75-7	2,4-D	-	-	NA	NA	-	NA	-	-	-	-	-	-	-
Petroleum Hydrocarbons	Not Exist	Diesel Range Organics (DRO)	43	160	NA	NA	-	NA	250	160	590	140	420	110	1300
	Not Exist	Gasoline Range Organics (GRO)	-	24 b	NA	NA	-	NA	30 b	760	29	24	24 b	42 b	520
Explosive Organic Compounds	118-96-7	2,4,6-Trinitrotoluene	-	-	NA	NA	-	NA	-	-	-	-	-	-	0.56
	121-14-2	2,4-Dinitrotoluene	-	-	NA	NA	-	NA	-	0.67	-	-	-	0.59	0.89
	606-20-2	2,6-Dinitrotoluene	-	-	NA	NA	-	NA	-	-	-	-	-	-	0.51
	35572-78-2	2-Amino-4,6-dinitrotluene	-	-	NA	NA	-	NA	-	0.94	-	-	-	-	0.52
	88-72-2	2-Nitrotoluene	-	-	NA	NA	-	NA	-	0.5	-	-	-	-	-
	99-08-1	3-Nitrotoluene	-	-	NA	NA	-	NA	-	0.9	-	-	-	-	-
	99-99-0	4-Nitrotoluene	-	-	NA	NA	-	NA	-	2.9	-	-	-	-	-

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - Reported value was obtained from a reading < Contract Reporting Limit, but > or equal to the Instrument Detection Limit.

g - Value considered estimated based on data review.

D - Dilution factor

NA = Not Analyzed

† Groundwater wells would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2, DG = Downgradient AOC 2

Wells SLMW-11S, SLWM-18S, SLMW-19D, SLWM-20S, SLMW-26, CW-14, CW-15 SF-MW1, SF-MW3, SF-MW4, SF-MW5, MEG-1, MEG-3 and MEG4 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Groundwater Samples, by Location (ug/L)

Location (Samples grouped by location)			AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2
Category	**CAS No.**	**Analyte**	**SLMW-10D**	**SLMW-10S**	**SLMW-11D †**	**SLMW-12D †**	**SLMW-12S †**	**SLMW-13D**	**SLMW-13S**	**SLMW-16D**	**SLMW-16S**	**SLMW-22**	**SLMW-23**	**SLMW-24**	**SLMW-25**
Pesticides	72-54-8	4,4'-DDD	-	-	-	-	-	-	-	-	-	0.34	0.03	-	0.02
	72-55-9	4,4'-DDE	-	-	-	-	-	-	-	-	-	-	-	-	-
	50-29-3	4,4'-DDT	-	-	-	-	-	-	-	-	-	0.11	-	-	-
	309-00-2	Aldrin	-	-	-	-	-	-	-	-	-	-	-	-	-
	319-85-7	Beta-BHC	-	-	-	-	-	-	-	-	-	-	-	-	-
	319-86-8	Delta-BHC	-	-	-	-	-	-	-	-	-	-	-	-	-
	60-57-1	Dieldrin	-	-	-	-	-	-	-	-	-	-	-	0.038	-
PCBs															
Herbicides	94-75-7	2,4-D	-	-	-	0.31 j	0.16 j	-	1.8	-	-	NA	NA	NA	NA
Petroleum Hydrocarbons	Not Exist	Diesel Range Organics (DRO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Not Exist	Gasoline Range Organics (GRO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Explosive Organic Compounds	118-96-7	2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	121-14-2	2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	606-20-2	2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	35572-78-2	2-Amino-4,6-dinitrotluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	88-72-2	2-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	99-08-1	3-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	99-99-0	4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - Reported value was obtained from a reading < Contract Reporting Limit, but > or equal to the Instrument Detection Limit.

g - Value considered estimated based on data review.

D - Dilution factor

NA = Not Analyzed

† Groundwater wells would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2, DG = Downgradient AOC 2

Wells SLMW-11S, SLWM-18S, SLMW-19D, SLWM-20S, SLMW-26, CW-14, CW-15 SF-MW1, SF-MW3, SF-MW4, SF-MW5, MEG-1, MEG-3 and MEG4 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Groundwater Samples, by Location (ug/L)

Location (Samples grouped by location)			DG	DG	DG	DG	DG	DG	DG	DG	AOC 3S	AOC 3S	AOC 3S
Category	**CAS No.**	**Analyte**	**CW-11**	**SLMW-14D**	**SLMW-15D**	**SLMW-15S**	**SLMW-17D**	**SLMW-17S**	**SLMW-18D**	**SLMW-19S**	**SLMW-20D**	**SLMW-21C**	**SLWM-21WT**
Pesticides	72-54-8	4,4'-DDD	-	-	-	-	-	-	-	-	-	-	-
	72-55-9	4,4'-DDE	-	-	-	-	-	-	-	-	-	-	-
	50-29-3	4,4'-DDT	-	-	-	-	-	-	-	-	-	-	-
	309-00-2	Aldrin	-	-	-	-	-	-	-	-	-	-	-
	319-85-7	Beta-BHC	-	-	-	-	-	-	-	-	-	-	-
	319-86-8	Delta-BHC	-	-	-	-	-	-	-	-	-	-	-
	60-57-1	Dieldrin	0.17 j	-	-	-	-	-	-	-	-	-	-
PCBs													
Herbicides	94-75-7	2,4-D	-	-	-	-	0.31 j	-	0.28 j	-	-	-	-
Petroleum Hydrocarbons	Not Exist	Diesel Range Organics (DRO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Not Exist	Gasoline Range Organics (GRO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Explosive Organic Compounds	118-96-7	2,4,6-Trinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	121-14-2	2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	606-20-2	2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	35572-78-2	2-Amino-4,6-dinitrotluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	88-72-2	2-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	99-08-1	3-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	99-99-0	4-Nitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - Reported value was obtained from a reading < Contract Reporting Limit, but > or equal to the Instrument Detection Limit.

g - Value considered estimated based on data review.

D - Dilution factor

NA = Not Analyzed

† Groundwater wells would shift to be considered downgradient of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

UG = Upgradient AOC 2, DG = Downgradient AOC 2

Wells SLMW-11S, SLWM-18S, SLMW-19D, SLWM-20S, SLMW-26, CW-14, CW-15 SF-MW1, SF-MW3, SF-MW4, SF-MW5, MEG-1, MEG-3 and MEG4 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Sediment Samples, by Location (µg/Kg)

Location (Samples grouped by location)			US AOC 2	US AOC 2	US AOC 2	US AOC 2	AOC 2 †	AOC 2 †	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2
Cat	**CAS**	**Analyte**	**SED-01**	**SED-02**	**SED-03**	**SED-04**	**SED-06**	**SED-14**	**S2-1**	**S2-2**	**S2-3**	**SLSED-07A**	**SLSED-07B**	**SLSED-07C**	**SED-07**
VOCs	78-93-3	2-Butanone	-	-	-	-	-	72 s	-	-	-	-	-	-	11 j
	74-87-3	Chloromethane	-	-	-	-	-	7.3 js	-	-	-	-	-	-	3.1 j
SVOCs	91-57-6	2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-
	108-39-4	3-Methylphenol/4-Methylphenol	66 j	73 j	-	-	-	-	-	-	-	-	-	-	-
	83-32-9	Acenaphthene	620 j	-	-	-	-	-	24 j	17 j	760 j	-	-	-	-
	208-96-8	Acenaphthylene	65 j	-	-	-	-	-	16 j	7 j	310 j	-	-	-	-
	120-12-7	Anthracene	2000	54 j	-	-	-	-	50 j	27 j	440 j	-	-	-	68 j
	56-55-3	Benzo(a)anthracene	16000 j[DL 5:1]	220 jg	120 j	110 js	120 jg	110 jsg	250 j	63 j	9500	440 [DL 20:1]	210 [DL 5:1]	-	350 jg
	50-32-8	Benzo(a)pyrene	22000 jg[DL 5:1]	200 jg	150 j	100 js	120 jg	160 jsg	300 j	56 j	8500	550 [DL 20:1]	260 [DL 5:1]	-	450 jg
	205-99-2	Benzo(b)fluoranthene	34000 jg[DL 5:1]	330 jg	180 j	130 js	170 jg	210 jsg	260 j	54 j	6800	790 [DL 20:1]	220 [DL 5:1]	-	800 jg
	191-24-2	Benzo(ghi)perylene	15000 g	110 jg	-	-	41 jg	-	150 j	30 j	3000 j	540 [DL 20:1]	170 [DL 5:1]	-	180 jg
	207-08-9	Benzo(k)fluoranthene	13000 g	140 jg	85 j	-	72 jg	110 jsg	400 j	75 j	9000	-	250 [DL 5:1]	-	350 jg
	65-85-0	Benzoic Acid	-	-	-	-	-	-	120 j	-	-	-	-	-	-
	100-51-6	Benzyl Alcohol	-	180 j	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	1200 g	860	-	-	-	-	84 jb	-	290 jb	-	-	-	-
	85-68-7	Butyl benzyl phthalate	84 jg	460 j	-	-	-	-	-	-	-	-	-	-	-
	86-74-8	Carbazole	-	-	-	-	-	-	57 j	8 j	490 j	570 [DL 20:1]	-	-	-
	218-01-9	Chrysene	24000 j[DL 5:1]	270 j	140 j	110 js	120 jg	160 jsg	420 j	79 j	12000	-	200 [DL 5:1]	-	500 jg
	53-70-3	Dibenzo(a,h)anthracene	760 g	-	-	-	-	-	60 j	14 j	1400 j	-	-	-	-
	132-64-9	Dibenzofuran	350 j	-	-	-	-	-	16 j	7 j	240 j	-	-	-	-
	84-66-2	Diethyl phthalate	-	-	-	-	-	-	18 jb	7 jb	-	-	-	-	-
	131-11-3	Dimethyl phthalate	-	360 j	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	88 j	-	-	-	-	120 jb	42 jb	5200 b	-	-	-	120 j
	117-84-0	Di-n-octylphthalate	120 j	54 j	-	-	-	-	20 jb	8 jb	36 jb	-	-	-	-
	206-44-0	Fluoranthene	44000 j[DL 5:1]	350 j	240 j	180 js	250 j	180 js	630 j	140 j	16000	1300 [DL 20:1]	290 [DL 5:1]	-	710 j
	86-73-7	Fluorene	940 j	-	-	-	-	-	38 j	27 j	780 jb	-	-	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	17000 g	78 jg	-	-	-	-	190 j	35 j	4200	580 [DL 20:1]	170 [DL 5:1]	-	160 jg
	91-20-3	Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-
	85-01-8	Phenanthrene	19000 j[DL 5:1]	270 j	100 j	91 js	170 j	-	290 j	65 j	2500 j	700 [DL 20:1]	-	-	390 j
	129-00-0	Pyrene	37000 j[DL 5:1]	850 j	300 j	220 js	380 jg	400 jsg	570 j	140 j	19000	1000 [DL 20:1]	240 [DL 5:1]	-	1700 g
Pesticides	72-54-8	4,4'-DDD	8 jg	1.8 jg	1.8 jg	6.2 jsg	22 g	120 sg	170	16	810	100	541	-	240 g [DL 5:1]
	72-55-9	4,4'-DDE	-	-	-	-	-	-	86	12	160	25.1	168	26.8	-
	50-29-3	4,4'-DDT	2.2 jg	1 jg	2.1 jg	5.5 jsg	14 g	68 psg	72	26	1400	46.5	196	-	52 g
	60-57-1	Dieldrin	28 pg	4.7 pg	12 g	13 sg	8.1 g	23 psg	29 j	7.7	-	24	94.1	57.6	4.7 jg
	72-20-8	Endrin	17 g	-	-	-	-	-	-	-	-	-	-	-	-
	7421-93-4	Endrin Aldehyde	21 pg	-	-	-	-	-	-	-	-	-	-	-	-
	72-43-5	Methoxychlor	-	-	-	-	-	-	-	-	-	-	-	-	-
PCBs	11097-69-1	Aroclor 1254	-	-	-	-	-	-	-	-	121	-	-	-	-
Herbicides			NA												
Petroleum Hydrocarbons (DRO and GRO)			NA												
Explosive Organic Compounds			NA												

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - analyte is found in the method blank as well as the sample

s - Results estimated based on DUSR findings: % solids less than 50%

g - Value considered estimated based on data review.

DL - Dilution factor

NA = Not Analyzed

† Sediment samples would shift to be considered upstream of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

US = Upstream, DS = Downstream; US and DS locations are evaluated in the Nearby Vicinity category

SED-09 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Sediment Samples, by Location (µg/Kg)

Location (Samples grouped by location)			DS AOC 2	US AOC 3S	US AOC 3S	US AOC 3S	AOC 3S	DS AOC 3S	DS AOC 3S	Off Property	Off Property	Off Property	Off Property	Off Property	Off Property
Cat	**CAS**	**Analyte**	**SED-05**	**SED-10**	**SED-11**	**SED-12**	**SED-13**	**SED-08**	**SED-19**	**SED-15**	**SED-16**	**SED-17**	**SED-18**	**SED-20**	**SED-21**
VOCs	78-93-3	2-Butanone	-	-	-	-	-	-	-	-	-	-	-	-	-
	74-87-3	Chloromethane	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs	91-57-6	2-Methylnaphthalene	-	-	-	-	-	-	-	54 j	-	-	180 js	-	-
	108-39-4	3-Methylphenol/4-Methylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-
	83-32-9	Acenaphthene	-	-	-	310 j	-	-	-	77 j	200 js	130 j	1400 s	-	-
	208-96-8	Acenaphthylene	-	-	-	-	-	-	-	-	-	-	180 js	-	-
	120-12-7	Anthracene	-	-	-	990	-	53 j	-	220 j	460 js	370 j	2400 s	-	-
	56-55-3	Benzo(a)anthracene	-	46 jg	100 jg	3300 g	-	250 j	280 js	1100 g	2600 gs	1400 g	9300 [DL 5:1] gs	400 js	110 jg
	50-32-8	Benzo(a)pyrene	-	64 jg	120 jg	3100 g	-	290 j	520 js	1400 g	3500 gs	1600 g	5800 gs	510 jgs	150 jg
	205-99-2	Benzo(b)fluoranthene	-	91 jg	170 jg	4500 jg [DL 5:1]	65 j	430 j	1100 s	1900 g	5600 gs	2700 g	11000 [DL 5:1] gs	920 gs	190 jg
	191-24-2	Benzo(ghi)perylene	-	-	-	970 g	-	100 j	-	610 g	1900 gs	670 g	2000 gs	250 jgs	51 jg
	207-08-9	Benzo(k)fluoranthene	-	41 jg	95 jg	2100 g	-	160 j	390 js	830 g	2100 gs	930 g	2500 gs	290 jgs	76 jg
	65-85-0	Benzoic Acid	-	-	-	-	-	-	-	-	-	-	-	-	-
	100-51-6	Benzyl Alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	-	-	-	1100	-	-	470 js	220 jg	4800 gs	1500 g	200 jgs	180 js	70 j
	85-68-7	Butyl benzyl phthalate	-	-	-	-	-	-	-	-	160 js	300 jg	-	-	-
	86-74-8	Carbazole	-	-	-	-	-	-	-	-	-	-	-	-	-
	218-01-9	Chrysene	-	51 jg	150 jg	4100 g	48 j	270 j	650 js	140 g	3400 gs	1900 g	8400 [DL 5:1] gs	560 jgs	150 jg
	53-70-3	Dibenzo(a,h)anthracene	-	-	-	250 jg	-	-	-	-	580 js	230 j	670 js	-	-
	132-64-9	Dibenzofuran	-	-	-	170 j	-	-	-	-	-	75 j	510 js	-	-
	84-66-2	Diethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
	131-11-3	Dimethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
	117-84-0	Di-n-octylphthalate	-	-	-	-	-	-	-	-	460 js	120 j	-	-	-
	206-44-0	Fluoranthene	-	83 j	320 j	900 j [DL 5:1]	82 j	310 j	1100 s	1600	3400 s	2200	20000 [DL 5:1] s	750 js	210 j
	86-73-7	Fluorene	-	-	-	520 j	-	-	-	84 j	200 js	170 j	1200 s	-	-
	193-39-5	Indeno(1,2,3-cd)Pyrene	-	-	-	860 g	-	87 j	190 js	660 g	1800 gs	710 g	1900 gs	240 jgs	56 jg
	91-20-3	Naphthalene	-	-	-	64 j	-	-	-	46 j	-	-	220 js	-	-
	85-01-8	Phenanthrene	-	-	370 j	5200 j [DL 5:1]	-	210 j	570 js	1400	2400 s	2200	14000 [DL 5:1] s	380 js	90 j
	129-00-0	Pyrene	160 js	170 j	580 g	1100 j [DL 5:1]	90 j	400 j	1900 s	3700 [DL 2:1]	9800 gs	5700 [DL 2:1]	19000 [DL 5:1] gs	1600 gs	330 j
Pesticides	72-54-8	4,4'-DDD	8.2 jsg	-	14 g	23 g	0.91 j	460 g [DL 20:1]	11 gs	6.9 pg	33 pgs	88 g	58 pgs	57 gs	6.4 g
	72-55-9	4,4'-DDE	16 s	-	-	-	1.4 j	66	12 gs	5.6 g	27 gs	22 g	19 gs	32 gs	4.1 jpg
	50-29-3	4,4'-DDT	4.3 jsg	-	1.1 jg	10 pg	-	86 g [DL 20:1]	-	2.4 jpg	9.3 jgs	4.8 jpg	4.9 jpgs	5.6 jpgs	-
	60-57-1	Dieldrin	27 sg	-	2.2 jg	-	1.1 jpg	7.3 g	24 pgs	33 g	94 pgs	32 g	12 gs	23 pgs	4.9 g
	72-20-8	Endrin	-	-	-	-	-	-	-	-	-	-	-	-	3.2 jpg
	7421-93-4	Endrin Aldehyde	-	-	-	-	-	-	-	-	-	-	-	-	-
	72-43-5	Methoxychlor	-	-	-	-	-	-	-	67 pg	120 pgs	99 pg	95 pgs	76 pgs	14 jpg
PCBs	11097-69-1	Aroclor 1254	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides			NA												
Petroleum Hydrocarbons (DRO and GRO)			NA												
Explosive Organic Compounds			NA												

"-" indicates no detection of the specific analyte at the location

j - Estimated concentration; compound present below quantitation limit.

p - Pesticide/Aroclor target analyte had >25% difference for the detected concentrations between the two GC columns.

b - analyte is found in the method blank as well as the sample

s - Results estimated based on DUSR findings: % solids less than 50%

g - Value considered estimated based on data review.

DL - Dilution factor

NA = Not Analyzed

† Sediment samples would shift to be considered upstream of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation

US = Upstream, DS = Downstream; US and DS locations are evaluated in the Nearby Vicinity category

SED-09 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Surface Water Samples, by Location (ug/L)

Location (Samples grouped by location)			US AOC 2	US AOC 2	US AOC 2	US AOC 2	AOC 2 †	AOC 2 †	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	AOC 2	DS AOC 2
Category	**CAS no.**	**Analyte**	**SW-01**	**SW-02**	**SW-03**	**SW-04**	**SW-06**	**SW-14**	**SW2-1**	**SW2-2**	**SW2-3**	**SLSW-07A**	**SLSW-07B**	**SLSW-07C**	**SW-07**	**SW-05**
VOCs	67-64-1	Acetone	-	5.7	-	-	-	-	-	-	-	-	-	-	-	-
	108-90-7	Chlorobenzene	-	-	-	-	-	-	-	-	-	0.66	2.4	1.2	-	-
SVOCs	205-99-2	Benzo(b)fluoranthene	1.6 j	-	-	-	-	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	3.4 j	15	-	9.2 j	-	-	-	-	-	-	-	5.2	-	-
	218-01-9	Chrysene	1.1 j	-	-	-	-	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	3.1 j	-	-	-	-	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	2.3 j	-	-	-	-	-	-	-	-	-	-	-	-	-
	91-20-3	Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8 j
	129-00-0	Pyrene	1.7 j	-	-	-	-	-	-	-	-	-	-	-	-	-
Pesticides	72-54-8	4,4'-DDD	-	-	-	-	-	-	0.03	0.0266	0.0732	-	-	-	0.058 j p	-
	72-55-9	4,4'-DDE	-	-	-	-	-	-	-	-	-	-	-	-	0.007 j	-
	319-84-6	Alpha-BHC	-	-	-	-	-	-	0.0098 j	0.0263	0.0304 p	-	-	-	-	-
	319-85-7	Beta-BHC	-	-	-	-	-	-	0.01	0.0171	0.0155	-	-	-	-	-
	319-86-8	Delta-BHC	-	-	-	-	-	-	-	0.00809 j	-	-	-	-	-	-
	60-57-1	Dieldrin	-	-	-	-	-	-	0.02	0.0348	-	-	-	-	0.012 j	-
	1031-07-8	Endosulfan sulfate	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	76-44-8	Heptachlor	-	-	-	-	-	-	0.00685 j	-	-	-	-	-	-	-
PCBs			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides			-	-	-	-	-	-	NA	NA	NA	-	-	-	-	-
Petroleum	Not exist	Diesel Range Organics (DRO)	36 b g	180 b g	-	24 b g	18.8 b	-	NA	NA	NA	-	-	-	-	30 b g
Hydrocarbons	Not exist	Gasoline Range Organics (GRO)	22 b g	19 b g	19 b g	23 b g	22 b g	23 b g	NA	NA	NA	-	-	-	16 j b g	-
Explosive Ogranic Compounds			NA													

"-" indicates no detection of the specific analyte at the location
j - Estimated concentration; compound present below quantitation limit.

p - When there is a >25% difference for detected concentrations between two GC columns; the lower of the two is reported and flagged with a 'p'.
b - Indicates the compound was found in the blank as well as the sample.
g - Results estimated based on DUSR findings.
+ - SVOCs sample exceeded the holding time and therefore results may be suspect.
NA = Not Analyzed
† Surface water samples would shift to be considered upstream of AOC 2 following revisions to AOC 2 boundary from 2021 Geophysical Investigation
US = Upstream, DS = Downstream; US and DS locations are evaluated in the Nearby Vicinity category
SW-17, 18, 20, 21 had no detections of organic contaminants and are not included in the table.

Historical Maximum Organic Contaminant Detections in Surface Water Samples, by Location (ug/L)

Location (Samples grouped by location)			US AOC 3S	US AOC 3S	US AOC 3S	US AOC 3S	AOC 3S	DS AOC 3S	DS AOC 3S	Off Property	Off Property
Category	**CAS no.**	**Analyte**	**SW-09**	**SW-10**	**SW-11**	**SW-12**	**SW-13**	**SW-08**	**SW-19**	**SW-15**	**SW-16**
VOCs	67-64-1	Acetone	-	-	-	-	-	-	-	-	-
	108-90-7	Chlorobenzene	-	-	-	-	-	-	-	-	-
SVOCs	205-99-2	Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-
	117-81-7	Bis(2-Ethylhexyl)phthalate	-	-	-	-	-	-	3 j	-	1 j
	218-01-9	Chrysene	-	-	-	-	-	-	-	-	-
	84-74-2	Di-n-butylphthalate	-	-	-	-	-	-	-	-	-
	206-44-0	Fluoranthene	-	-	-	-	-	-	-	-	1 j
	91-20-3	Naphthalene	-	-	-	-	-	-	-	-	-
	129-00-0	Pyrene	-	-	-	-	-	-	-	-	1 j
Pesticides	72-54-8	4,4'-DDD	-	-	-	-	-	0.061 j p +	-	-	-
	72-55-9	4,4'-DDE	-	-	-	-	-	0.004 j +	-	-	-
	319-84-6	Alpha-BHC	-	-	-	-	-	-	-	-	-
	319-85-7	Beta-BHC	-	-	-	-	-	-	-	-	-
	319-86-8	Delta-BHC	-	-	-	-	-	-	-	-	-
	60-57-1	Dieldrin	0.039 j	0.023 j	0.019 j	-	0.004 j	0.015 j +	-	-	-
	1031-07-8	Endosulfan sulfate	-	-	-	-	-	-	-	0.11 g	-
	76-44-8	Heptachlor	-	-	-	-	-	-	-	-	-
PCBs			-	-	-	-	-	-	-	-	-
Herbicides			-	-	-	-	-	-	NA	NA	NA
Petroleum	Not exist	Diesel Range Organics (DRO)	-	20 b g	21 b g	59 b g	32 b g	-	NA	NA	NA
Hydrocarbons	Not exist	Gasoline Range Organics (GRO)	25 b g	23 b g	23 b g	23 b g	20 b g	36 b g +	NA	NA	NA
Explosive Ogranic Compounds			NA								

"-" indicates no detection of the specific analyte at the location
j - Estimated concentration; compound present below quantitation limit.

p - When there is a >25% difference for detected concentrations between two GC columns; the lower of the two is reported and flagged with a 'p'.
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SW-17, 18, 20, 21 had no detections of organic contaminants and are not included in the table.

2021 Geophysical Survey Report

GEOPHYSICAL ENGINEERING SURVEY REPORT

Stewart Airport
Recreation Road,
New Windsor, New York 12553

NOVA PROJECT NUMBER:
21-2236

DATED:
May 6, 2021

PREPARED FOR:

TIDEWATER
ENGINEERS / SCIENTISTS / PROGRAM MANAGERS

3761 Attucks Drive
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PREPARED BY:

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May 6, 2021

Bob Janosy
Sr. Geologist



3761 Attucks Drive
Powell, Ohio 43065
P: 614.593.5541
E: Bob.Janosy@tideh2o.net

Re: Geophysical Engineering Survey (GES) Report
Stewart Airport
Recreation Road,
New Windsor, New York 12553

Dear Mr. Janosy,

Nova Geophysical Services (NOVA) is pleased to provide the findings of the geophysical engineering survey (GES) at the above referenced project site: Recreation Road, New Windsor, New York 12553 (the "Site")

NOVA performed a geophysical engineering survey (GES) consisting of a frequency domain electromagnetic survey (FDEM). The purpose of this survey was to identify the limits of buried metallic waste within the areas of concern (AOC 2 & AOC 3) on March 24th, March 25th, and April 26th, 2021. The purpose of the subsequent April survey was to fill data gaps identified after the March event as well as investigate metallic debris in the vicinity of AOC 3.

INTRODUCTION TO GEOPHYSICAL ENGINEERING SURVEY (GES)

The equipment selected for this investigation was a GSSI Profiler EMP-400 multi-frequency EM conductivity meter. A Juniper Geode Multi-GNSS GPS with sub-meter accuracy was used to locate collected FDEM data. Brush clearing was not performed prior to the GES. Survey lines were collected where accessible.

The survey area consisted of portions of open field, forest with open to dense understory, marsh, and overgrown thorny thickets. The survey time was selected to reduce the leaf cover therefore increasing GPS accuracy.

GEOPHYSICAL METHODS

Of the various types of geophysical survey methods considered, a FDEM was ultimately chosen as the preferred method based on site conditions. The extent of the completed FDEM work allowed identification of areas of higher conductivity and both ferrous and non-ferrous metals. Other methods, such as magnetics, and ground penetrating radar (GPR) were considered to obtain additional information of the subsurface. However, magnetics would only identify ferrous metals and therefore, provide a limited additional information when combined with the FDEM survey. Ground penetrating radar could provide data on the depth of potential buried waste, however, collection of GPR data would be exceedingly difficult in many areas of the site due to existing conditions of extensive vegetation and steep, undulating terrain.

Both 7 kHz and 15 kHz frequency data were collected. The selected frequency for the FDEM survey was 7 kHz in order to reduce the effect of the differing conditions in the very near surface (due to rain). It also provided better/improved visualizations in the negative inphase/positive quadrature area that exceeded the scale while keeping anomalies visible. The quadrature (apparent conductivity) and inphase data components were collected using the GSSI Profiler EMP-400 during the GES. Metallic targets (such as drums, tanks, and rebar) typically exhibit the strongest response in the inphase component at frequencies between 5 kHz and 25 kHz when the inductive limit of the response is achieved. The inphase component is displayed in parts per thousand (ppt). Non-metallic man-made targets (such as concrete without rebar, landfills, and backfills) often produce strong responses at frequencies greater than 10 kHz in the quadrature component. The quadrature component is displayed as apparent conductivity and is measured in millisiemens per meter (mS/m). Generally, the lower the frequency, the greater the depth of penetration.

Data was collected with the instrument inline with the direction of travel in vertical dipole configuration. The instrument was carried at a height of 6 to 12 inches depending on terrain. The data was collected on the data logger and transferred to a laptop PC for data processing and interpretation.

The location data was first reviewed for faults and erroneous readings were removed. Color graphic maps were created using a kriging grid method. The gridding method can display anomalous artifacts in areas with poor coverage and large variations in measurements. These color graphic maps allow for the interpretation of detected metallic and conductive anomalies, as discussed above.

PHYSICAL SETTINGS

NOVA observed the following physical conditions at the time of the survey.

Weather: March Survey - Rain, Clear; April Survey - Clear

Temperature: 50-65° F

Surface: Asphalt, Gravel, Forest Duff, Marsh, Stream, Vegetation

Survey Parameters: An FDEM survey was conducted throughout the two areas of concern (AOC 2 and AOC 3). Data was collected outside of AOC 2 to establish a background inphase ppt level in apparent conductivity for the area. An approximate line spacing of 10 feet was used, where feasible. The location of collected data is shown in the coverage map.

Limitations: Portions of the areas of concern were inaccessible due to thick vegetation and excessively steep slopes. Wider than normal survey transects were collected and the carry height of the instrument varied due to the nature of the site conditions. Additionally, precipitation during a portion of the March survey may have led to an increased apparent conductivity measurement as the moisture content of the soil increased. This may impact the apparent conductivity readings on the transects in most of AOC 2. Small, dispersed metallic objects may not have been identified due to the line spacing.

RESULTS

The apparent conductivity and inphase data from the FDEM survey are presented in the geophysical data. Site features and interpretations are overlaid on the displayed data in the geophysical data. The data has also been provided in digital form, a .kml file, and can be viewed in Google Earth.

The figures showing the apparent conductivity values are presented in the geophysical data. The observed values ranged from below 0 mS/m to over 33 mS/m. Apparent conductivity measurements can be affected by the following site factors:

- Buried or surface metallic objects.
- A change in soil type, such as fill material or a change in soil clay content.
- A change in the relative moisture content of the soil, such as in areas where the water table is closer to the ground surface (like a marsh or stream) or after recent precipitation.
- An increase in the pore fluid conductance due to an increase in dissolved solids in the pore fluid (such as leachate or salt water).

The inphase data is presented in the geophysical data. Large alternating positive and negative readings within a spatially dense area are generally indicative of buried or surface metal.

Large portions of the two areas of concern (AOC 2 & 3) show responses consistent with buried conductive waste and buried metallic objects. There is some evidence of trenching visible in the inphase data (light green lines), but the data generally agrees with a previous geophysical survey (Geomatrix, 2005) of the area that suggests a widespread burial of waste. NOVA's interpretation of the metallic fill boundary is shown

in solid pink and light blue lines in the attached geophysical data. The light blue line shows the demarcation of a separate anomaly area, not previously identified and apparently unconnected to the main burial area. Metallic fill interpretations from the previous geophysical survey (Geomatrix, 2005) are shown in dashed pink lines in the geophysical data. Anomalies outside of these lines are suspected to be related to scattered minor metallic debris, surface metallic objects or buried utility lines.

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

NOVA Geophysical Services



Levent Eskicakit, P.G., E.P.

Project Engineer

Attachments:

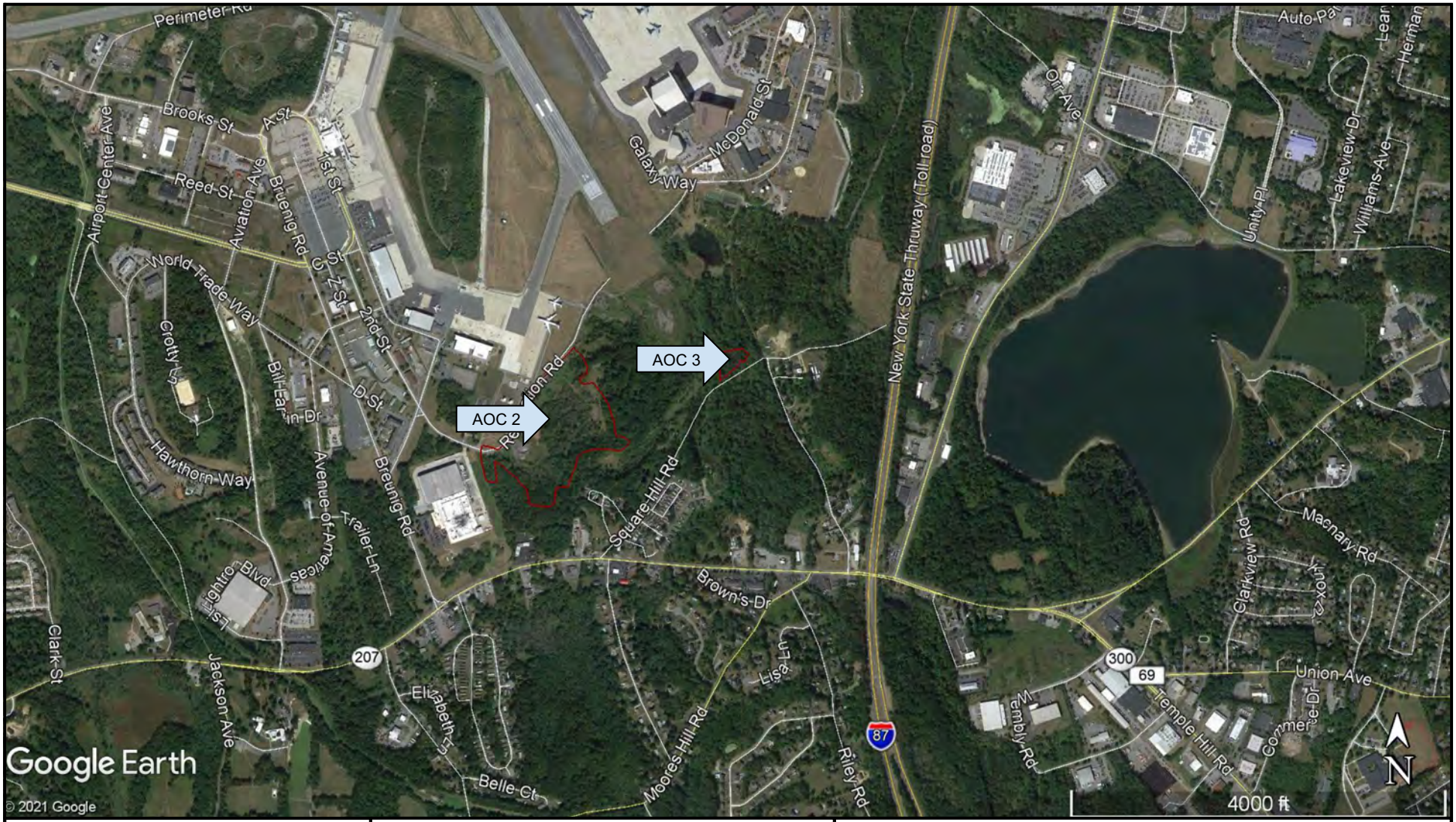
Location Map

Coverage Map

Geophysical Data

Survey Plan

Geophysical Images



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Location Map

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
AUTH:	Chris Steinley

LEGEND

AOC



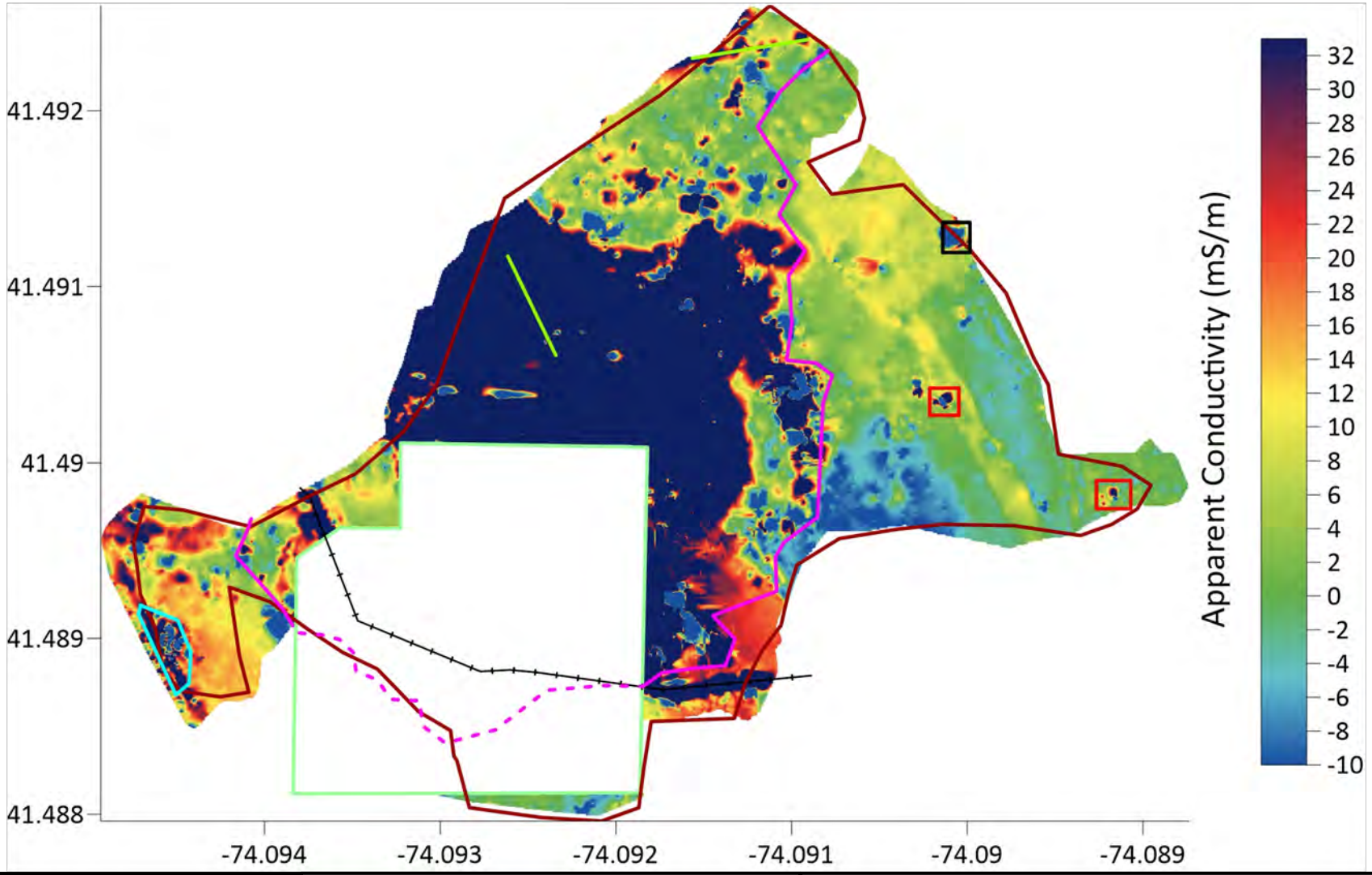
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Coverage Map

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
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LEGEND

- AOC
- 2005 Geophysical
- Collected Data



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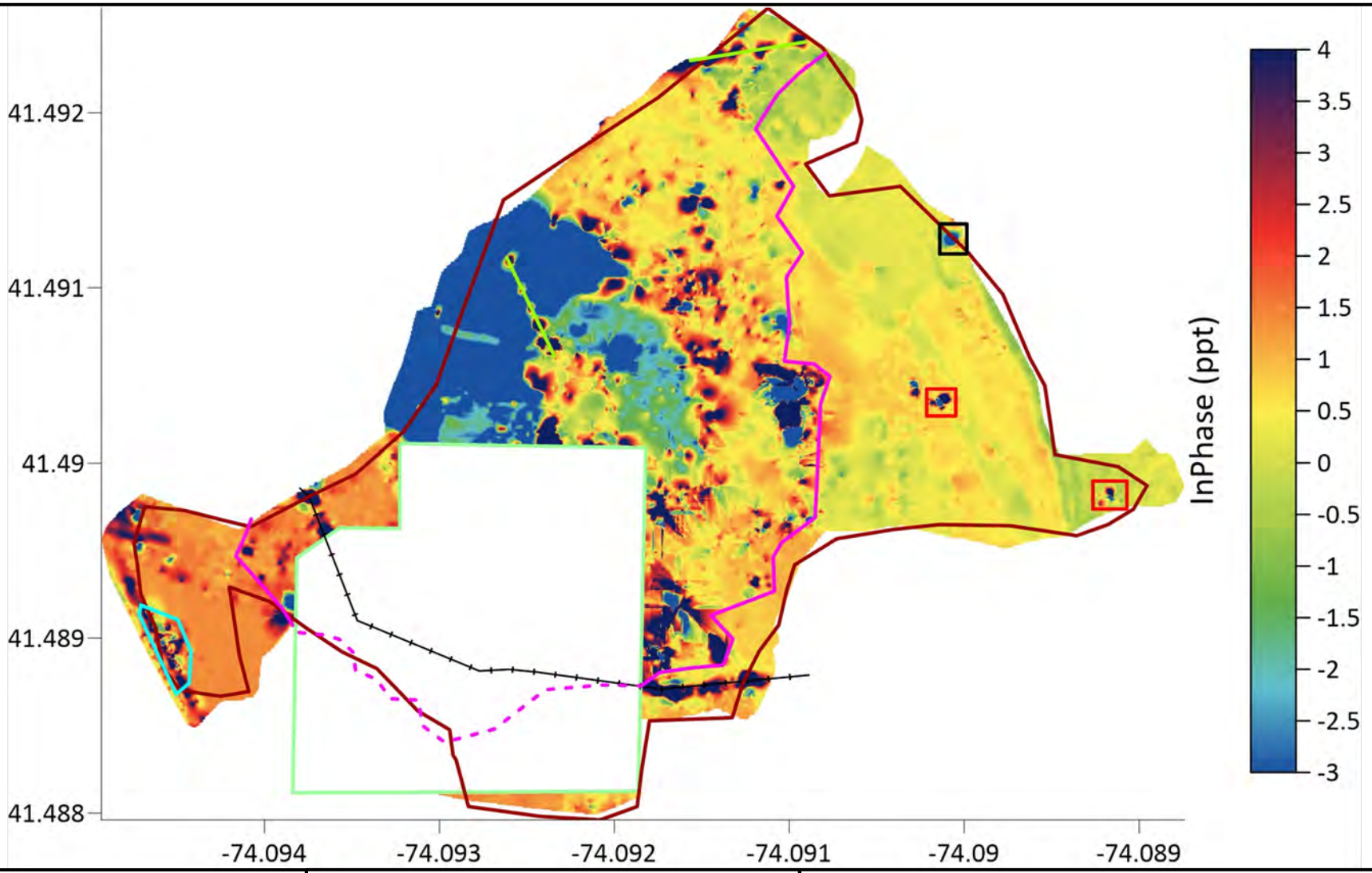
Geophysical Data (AOC 2)

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
AUTH:	Chris Steinley

LEGEND

- AOC 2
- Anomaly Area
- Secondary Anomaly Area
- Trench Anomaly
- Concrete Foundation
- 2005 Geophysical
- Fence
- Surface Metal

*Dashed lines from previous survey



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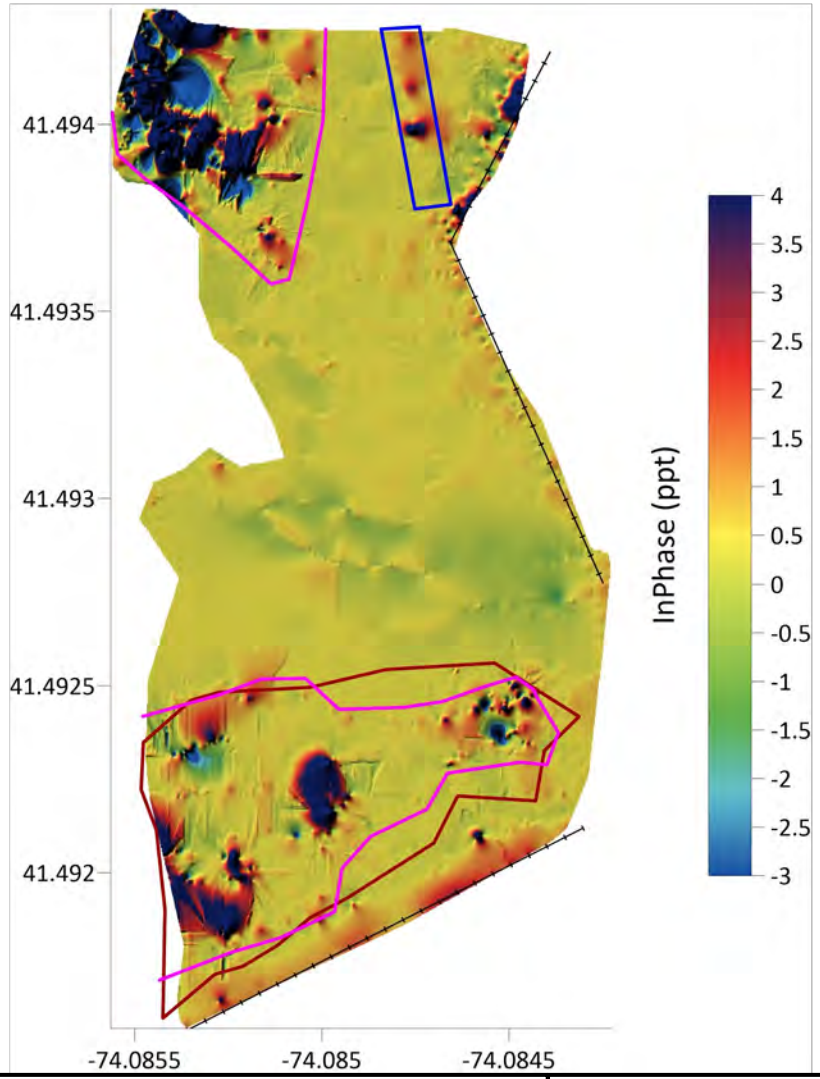
Geophysical Data (AOC 2)

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
AUTH:	Chris Steinley

LEGEND

- AOC 2
- Anomaly Area
- Secondary Anomaly Area
- Trench Anomaly
- Concrete Foundation
- 2005 Geophysical
- Fence
- Surface Metal

*Dashed lines from previous survey



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Phone (347) 556-7787 * Fax (718) 261-1527
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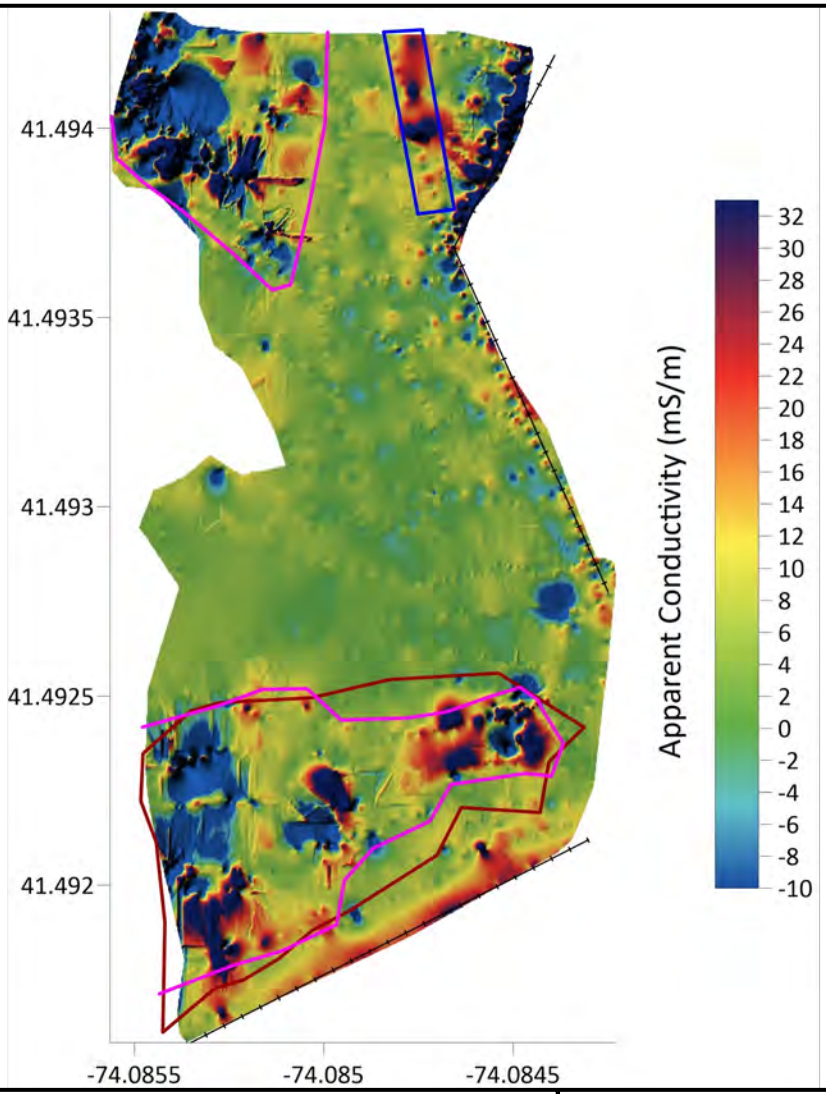
Geophysical Data (AOC 3)

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
AUTH:	Chris Steinley

LEGEND

- AOC 3
- Anomaly Area
- Fence
- Subsurface Utilities

*Dashed lines from previous survey



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Geophysical Services
Subsurface Mapping Solutions
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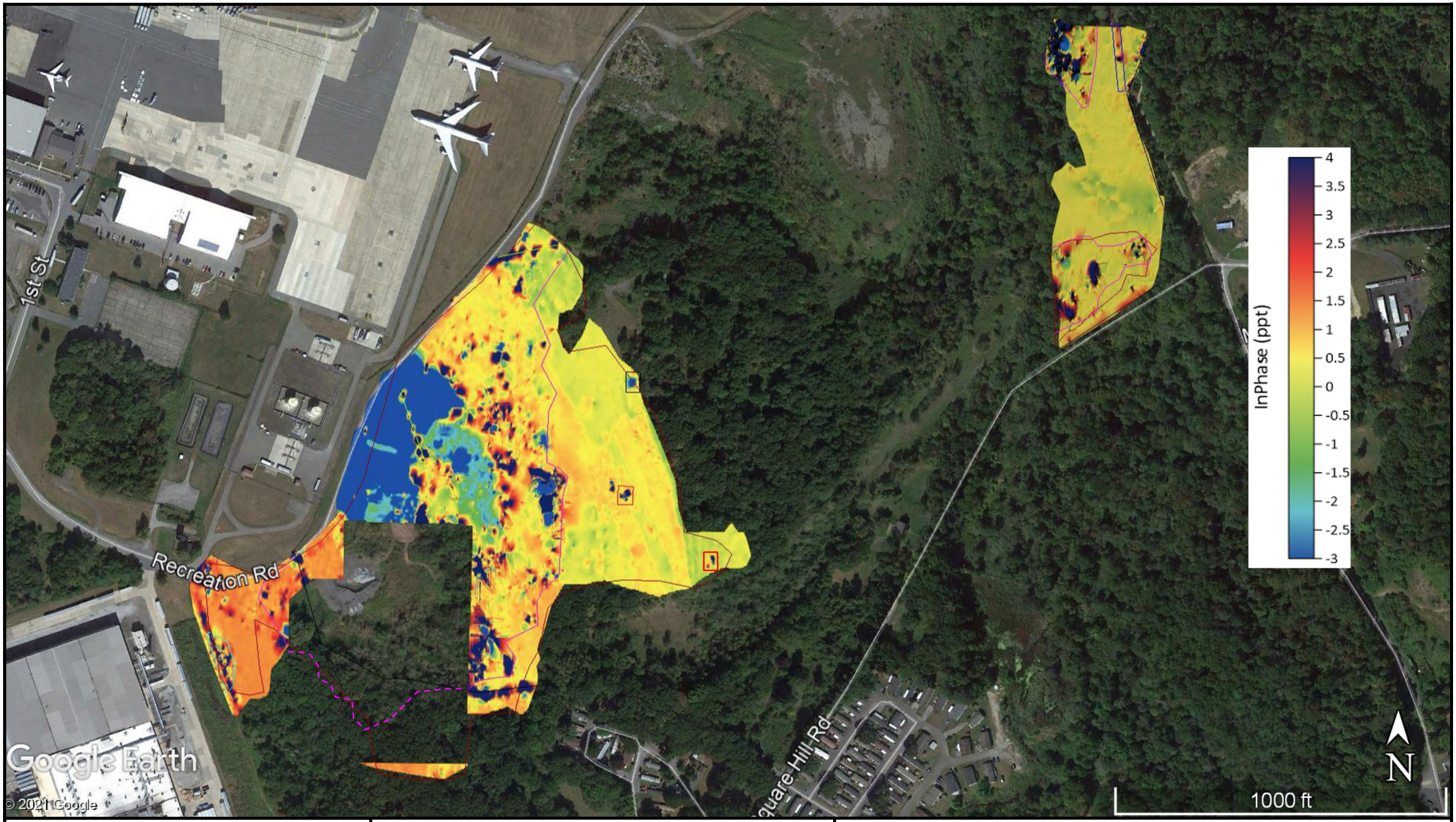
Geophysical Data (AOC 3)

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
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LEGEND

- AOC 3
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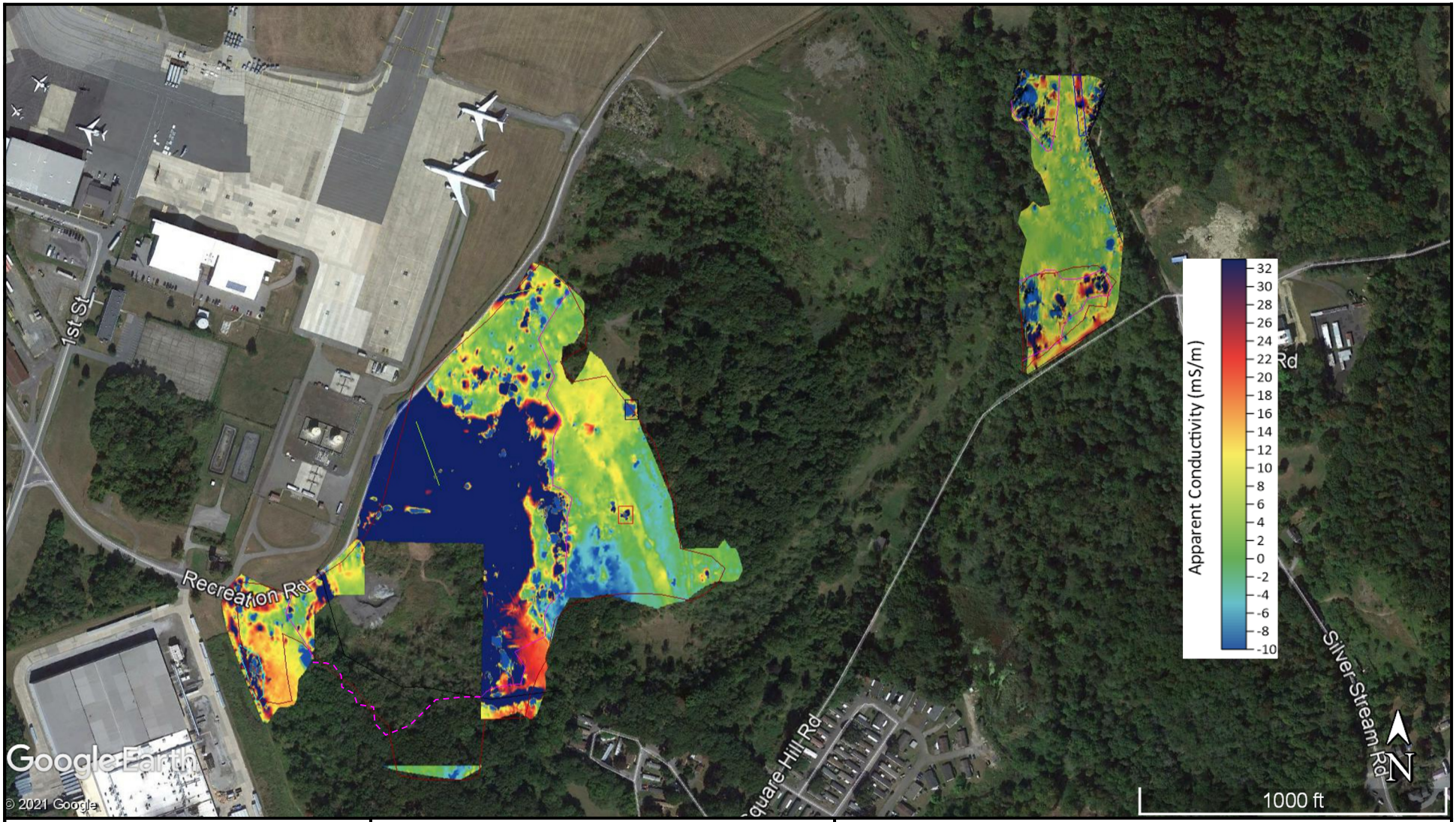
Survey Plan (InPhase)

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
AUTH:	Chris Steinley

LEGEND

- AOC
- Anomaly Area
- Secondary Anomaly Area
- Trench Anomaly
- Concrete Foundation
- 2005 Geophysical
- Fence
- Surface Metal
- Subsurface Utilities

*Dashed lines from previous survey



NOVA Geophysical Services

Subsurface Mapping Solutions
56-01 Marathon Parkway, # 765
Douglaston, New York 11362
Phone (347) 556-7787 * Fax (718) 261-1527
www.novagsi.com

Survey Plan (Apparent Conductivity)

SITE:	**Stewart Airport** Recreation Road, New Windsor, New York 12553
CLIENT:	Tidewater
DATE:	March 24th-25th & April 26th, 2021
AUTH:	Chris Steinley

LEGEND

- AOC
- Anomaly Area
- Secondary Anomaly Area
- Trench Anomaly
- Concrete Foundation
- 2005 Geophysical
- Fence
- Surface Metal

*Dashed lines from previous survey

GEOPHYSICAL IMAGES

Stewart Airport
Recreation Road
New Windsor, New York 12553
March 24th-25th & April 26th, 2021





GEOPHYSICAL IMAGES

Stewart Airport
Recreation Road
New Windsor, New York 12553
March 24th-25th & April 26th, 2021





GEOPHYSICAL IMAGES

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GEOPHYSICAL IMAGES

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March 24th-25th & April 26th, 2021









GEOPHYSICAL IMAGES

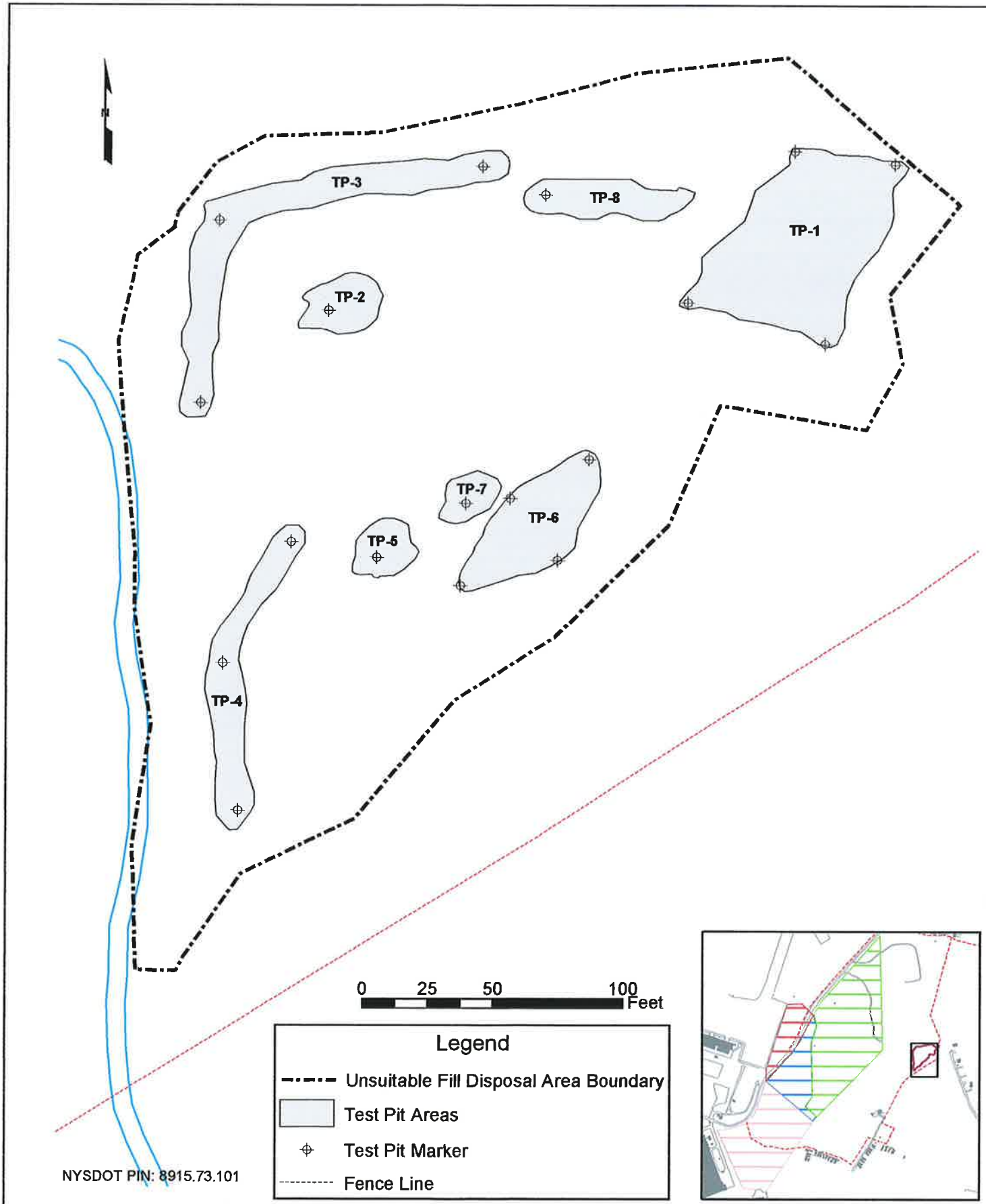
Stewart Airport
Recreation Road
New Windsor, New York 12553
March 24th-25th & April 26th, 2021





APPENDIX D

AOC 3 - FIGURE 2.6 AND TEST PIT BORING LOGS



Lawler, Matusky & Skelly Engineers LLP
One Blue Hill Plaza Pearl River, New York 10965
ENVIRONMENTAL SCIENCE & ENGINEERING CONSULTANTS

NYSDOT Stewart International Airport
Southern Landfill Area - Preliminary Site Assessment
Unsuitable Disposal Area Test Pit Locations

Figure 2-6

lms-srv1\Data\04xx-xxx\0446_NYSDOT\0446-500 Stewart Standby Contract\GIS\SL_Report_Figure_2-6.mdx

LMS — Test Pit Log

Crew: SGE		**TP-1**	
Sheet 1	**of** 1		
Project Name: SIA Unsuitable Fill Deposition Area	**Project No.:**	446-500	
Client: NYSDOT	**Date:** Start	4/8/2002	
Excavator Type: Komatsu track excavator	Finish	4/8/2002	
Operator: Parratt-Wolff Inc.	**Final Depth**	~ 6 ft	
Test Pit Location: UFDA	**Depth to Water:**	n/a	
Coordinates:	**Surf. Elevation**	~ 360' MSL	
Logged By: SGE	**Perc Hole Depth (bgs):**	none	

Monitoring Instrument: PID / CGI / Radiation meter

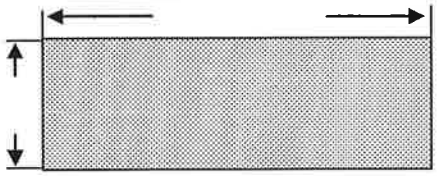
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading			Description
	PID	CGI	RAD meter	
0 - 2	background	background	background	assorted pieces of scrap metal
				degraded pieces of drums (drums & lids very rusted)
				old tires; piece of concrete sewer pipe
2 -4	background	background	background	assorted household waste; slug of solid concrete
				pieces of old carpeting; solidified roofing tar
4 - 6	background	background	background	green mesh bag filled with asphalt - bag labeled American Airlines
				this excavation area occurred along the east side of the UFDA area, close to the old access road
				excavated area dimensions ~ 40' x 60'

Additional Notes

depths above referenced to top of debris mound; excavation continued to surrounding ground level unless otherwise noted

Test Pit Plan



LMS Test Pit Log

Project Name: SIA Unsuitable Fill Deposition Area		**Crew:** SGE	**TP-2**
		Sheet 1	**of** 1
Client: NYSDOT		**Project No.:**	446-500
Excavator Type: Komatsu track excavator		**Date:** Start	4/8/2002
		Finish	4/8/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 5 ft
Test Pit Location: UFDA		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 355' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none

Monitoring Instrument: PID / CGI / Radiation meter

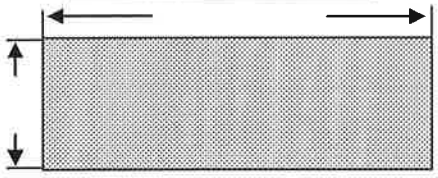
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	disturbed native soil
				light brown and dark brown
				dry to moist
2 - 4	background	background	background	silt, sand, and cobbles (typical till composition)
				no debris noted in excavated area
4 - 6	background	background	background	
				TP-2 area consisted of a large mound confined to north and west by TP-3 ridge
				excavation of TP-2 occurred to ~ 5 ft below top of the mound and did not reach level of surrounding land
				dimension of excavated area ~ 15' x 15'

Additional Notes

native soil excavated from TP-2 is suspected of being consolidated from areas dug out to allow dumping of debris

Test Pit Plan



LMS Test Pit Log

Project Name: SIA Unsuitable Fill Deposition Area		**Crew:** SGE	**TP-3**
Client: NYSDOT		**Sheet** 1	**of** 1
Excavator Type: Komatsu track excavator		**Project No.:**	446-500
Operator: Parratt-Wolff Inc.		**Date:** Start	4/9/2002
Test Pit Location: UFDA		Finish	4/9/2002
Coordinates:		**Final Depth**	~ 5 ft bgs
Logged By: SGE		**Depth to Water:**	n/a
		Surf. Elevation	~ 350' MSL
		Perc Hole Depth (bgs):	none

Monitoring Instrument: PID / CGI / Radiation meter

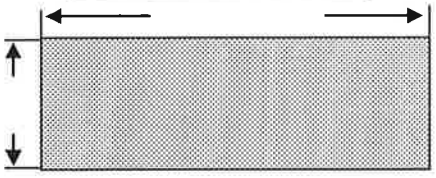
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	debris recovered along entire length of E - W and N - S trending sections of excavation; pipes (well casing ?) at W end of E - W trending section uncover large amount of debris including old tarps, buckets, buckets with solidified roofing tar, plastic bags, used oil filter, tires, unidentifiable metal pieces, plywood, tree stumps, remnants of an electric motor; at W end of this section, just before mound turns sharply to the south, uncover a thin layer of household trash items (bottles, bags, jars etc.) at ~ 2 ft below top of mound
2 - 4	background	background	background	
4 - 6	background	background	background	majority of debris found in area where trend of mound abruptly changes from E-W to N-S
				As TP-3 continued S amount of debris decreased; uncovered some sheet/scrap metal and a stack of rusted buckets containing remnants of roofing tar (liquified when exposed to sunlight)
				E - W trending section of excavation ~ 100 ft long N - S trending section of excavation ~ 70 ft long

Additional Notes

TP-3 consisted of an elongated mound trending E-W that turned abruptly S near the on-site stream;
In some places along TP-3 excavation consisted of scraping mound to level of surrounding land surface;
At some points of interest test pits were excavated as deep as 5 ft bgs

Test Pit Plan



LMS Test Pit Log

Project Name: SIA Unsuitable Fill Deposition Area		**Crew:** SGE	**TP-4**
		Sheet 1	**of** 1
Client: NYSDOT		**Project No.:**	446-500
Excavator Type: Komatsu track excavator		**Date:** Start	4/9/2002
		Finish	4/9/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 5 ft bgs
Test Pit Location: UFDA		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 350' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none

Monitoring Instrument: PID / CGI / Radiation meter

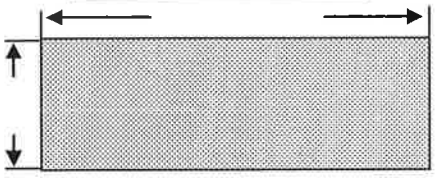
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading			Description
	PID	CGI	RAD meter	
0 - 2	background	background	background	In northern portion of TP-4 mound encountered scrap and sheet metal; crushed and very degraded drums, crushed drum cover, solidified roofing tar, old tires, and scraps of clothing
2 - 4	background	background	background	thin layer of grey material (ash or organic layer ?) @ ~ 4 ft bgs
4 - 6	background	background	background	In southern portion of TP-4 most debris consisted of scrap metal, very crushed up drums, one fairly intact drum containing dried roofing tar, portion of radio antenna, and several drum covers; in southern 20 - 30 ft of mound, almost no debris were uncovered - appears to be mostly displaced native soil.
				length of excavated area ~ 120 ft.
				some areas of mound excavated to level of surrounding ground surface; some discrete pits to 5 ft bgs

Additional Notes

TP-4 consisted of a long N - S trending mound of partially buried debris; the mound appears to be a southward continuation of the mound where TP-3 was excavated.

Test Pit Plan



LMS Test Pit Log

Crew: SGE			**TP-5**
Sheet 1		**of**	1
Project Name: SIA Unsuitable Fill Deposition Area		**Project No.:**	446-500
Client: NYSDOT		**Date:** Start	4/9/2002
Excavator Type: Komatsu track excavator		Finish	4/9/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 5 ft
Test Pit Location:		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 350' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none

Monitoring Instrument: PID / CGI / Radiation meter

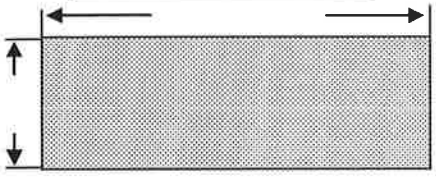
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	Composition very similar to that in mound at TP-2
				light brown and dark brown soil
				dry to moist silt, gravel, and cobbles
2 - 4	background	background	background	some wood chips near bottom of mound
4 - 6	background	background	background	
				dimensions of excavated area ~ 5' x 5'

Additional Notes

native soil excavated from TP-5 is suspected of being consolidated from areas dug out to allow dumping of debris

Test Pit Plan



LMS Test Pit Log

Crew: SGE		**TP-6**	
Sheet 1	**of** 1		
Project Name: SIA Unsuitable Fill Deposition Area		**Project No.:**	446-500
Client: NYSDOT		**Date:** Start	4/9/2002
Excavator Type: Komatsu track excavator		Finish	4/9/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 4 ft
Test Pit Location: UFDA		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 345' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none

Monitoring Instrument: PID / CGI / Radiation meter

Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter
0 - 2	background	background	background
2 - 4	background	background	background
4 - 6	background	background	background

Description

Material excavated from TP-6 appeared to be displaced native soil (gravel & cobbles in silt matrix) with the exception of far western extent of mound where some debris were unearthed, including:
broken bottles, broken panes of glass, various hoses, small compressor motor

Otherwise dug down into heart of mound to level of surrounding land surface and found only native soil

Due to findings on west side of mound, extended excavation to southwest - dug a couple pits and found some remnants of bricks and an area of large cobbles but very few additional debris (some burnt and sawed wood at ~ 3-4 ft bgs)

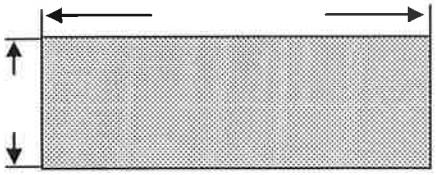
Dug an additional test pit area (TP-7) between TP-5 and TP-6 to look for more debris W of TP-6.

TP-6 total excavated area ~ 40' x 30'

Additional Notes

TP-6 excavated in area E of TP-5 and SW of TP-1
Bulk of excavated area was in large mound and area to SW of mound.
Mound was in very overgrown area and was barely visible from overgrown access road.

Test Pit Plan



LMS Test Pit Log

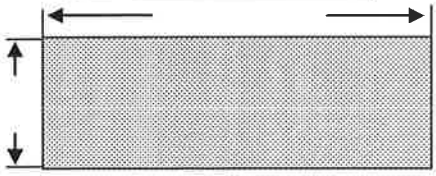
Project Name: SIA Unsuitable Fill Deposition Area		**Crew:** SGE	**TP-7**
Client: NYSDOT		**Sheet** 1	**of** 1
Excavator Type: Komatsu track excavator		**Project No.:**	446-500
Operator: Parratt-Wolff Inc.		**Date:** Start	4/9/2002
Test Pit Location: UFDA		Finish	4/10/2002
Coordinates:		**Final Depth**	~ 4 ft bgs
Logged By: SGE		**Depth to Water:**	n/a
Monitoring Instrument: PID / CGI / Radiation meter		**Surf. Elevation**	~ 345' MSL
Photograph Disk #	**Photo #(s)**	**Perc Hole Depth (bgs):**	none

Depth (Ft)	Instrument(s) Reading			Description
	PID	CGI	RAD meter	
0 - 2	background	background	background	Mostly gravel and cobbles in silty matrix with some debris at and just below surface
2 - 4	background	background	background	Debris unearthed include rotted plywood and scrap (unidentifiable) metal pieces
				layer of burnt sawed wood @ ~ 3 - 4 ft bgs
				TP-7 dimensions ~ 10' x 10'

Additional Notes

TP-7 excavated to further investigate debris uncovered on W side of TP-6

Test Pit Plan



LMS Test Pit Log

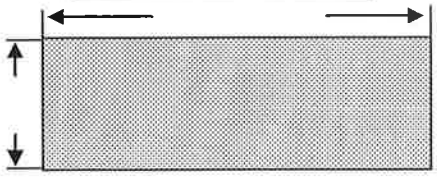
Project Name: SIA Unsuitable Fill Deposition Area		**Crew:** SGE	**TP-8**
		Sheet 1	**of** 1
Client: NYSDOT		**Project No.:**	446-500
Excavator Type: Komatsu track excavator		**Date:** Start	4/10/2002
		Finish	4/10/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 5 ft
Test Pit Location: UFDA		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 355' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none
Monitoring Instrument: PID / CGI / Radiation meter			
Photograph Disk #	**Photo #(s)**		

Depth (Ft)	Instrument(s) Reading			Description
	PID	CGI	RAD meter	
0 - 2	background	background	background	Dug 7 separate pits in TP-8 area into and S of long mound (~ 60 ft length) between E end of TP-3 and NW corner of TP-1 Two pits into SW corner of mound revealed disturbed native soil with no debris. Pit adjacent to E end of TP-3 contained native soil with a layer of chipped wood. Four pits excavated in line trending E-W in low area just south of mound; pit furthest to W contained disturbed native soil and then pits revealed increasing amount of debris as excavation proceeded E. Debris unearthed included: a layer of burnt wood and grey soil (ash ?) underlying layer of household (?) waste. May represent two periods of dumping with later period containing trash bags, beer cans, bottles, tires etc. Pit nearest TP-1 area contained intact pieces of brick and mortar, solidified roofing tar, and compressor motor; less scrap metal here than in many other locations where debris was encountered. Dimensions of excavated area ~ 60' x 15'
2 - 4	background	background	background	
4 - 6	background	background	background	

Additional Notes

Elongated mound at this location was suspected of containing debris but after excavation was observed to consist of native soil; probably displaced to allow dumping of debris as is suspected for TP-1, TP-2, and TP-6 area mounds.

Test Pit Plan



LMS Test Pit Log

Crew: SGE		**TP-1**	
Sheet 1		**of** 1	
Project Name: SIA Unsuitable Fill Deposition Area	**Project No.:**	446-500	
Client: NYSDOT	**Date:** Start	4/8/2002	
Excavator Type: Komatsu track excavator	Finish	4/8/2002	
Operator: Parratt-Wolff Inc.	**Final Depth**	~ 6 ft	
Test Pit Location: UFDA	**Depth to Water:**	n/a	
Coordinates:	**Surf. Elevation**	~ 360' MSL	
Logged By: SGE	**Perc Hole Depth (bgs):**	none	

Monitoring Instrument: PID / CGI / Radiation meter

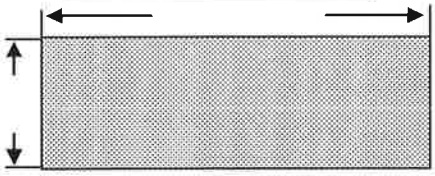
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	assorted pieces of scrap metal
				degraded pieces of drums (drums & lids very rusted)
				old tires; piece of concrete sewer pipe
2 -4	background	background	background	assorted household waste; slug of solid concrete
				pieces of old carpeting; solidified roofing tar
4 - 6	background	background	background	green mesh bag filled with asphalt - bag labeled American Airlines
				this excavation area occurred along the east side of the UFDA area, close to the old access road
				excavated area dimensions ~ 40' x 60'

Additional Notes

depths above referenced to top of debris mound; excavation continued to surrounding ground level unless otherwise noted

Test Pit Plan



LMS Test Pit Log

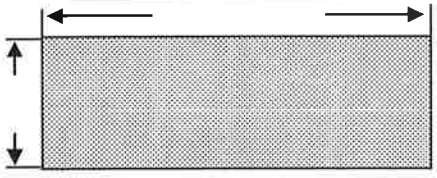
Crew: SGE		**TP-2**	
Sheet 1	**of** 1		
Project Name: SIA Unsuitable Fill Deposition Area	**Project No.:**	446-500	
Client: NYSDOT	**Date:** Start	4/8/2002	
Excavator Type: Komatsu track excavator	Finish	4/8/2002	
Operator: Parratt-Wolff Inc.	**Final Depth**	~ 5 ft	
Test Pit Location: UFDA	**Depth to Water:**	n/a	
Coordinates:	**Surf. Elevation**	~ 355' MSL	
Logged By: SGE	**Perc Hole Depth (bgs):**	none	
Monitoring Instrument: PID / CGI / Radiation meter			
Photograph Disk #	**Photo #(s)**		

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	disturbed native soil
				light brown and dark brown
				dry to moist
2 - 4	background	background	background	silt, sand, and cobbles (typical till composition)
				no debris noted in excavated area
4 - 6	background	background	background	
				TP-2 area consisted of a large mound confined to north and west by TP-3 ridge
				excavation of TP-2 occurred to ~ 5 ft below top of the mound and did not reach level of surrounding land
				dimension of excavated area ~ 15' x 15'

Additional Notes

native soil excavated from TP-2 is suspected of being consolidated from areas dug out to allow dumping of debris

Test Pit Plan



LMS Test Pit Log

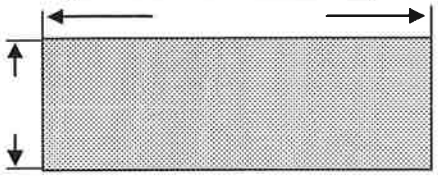
Crew: SGE		**TP-3**	
Sheet 1		**of** 1	
Project Name: SIA Unsuitable Fill Deposition Area	**Project No.:**	446-500	
Client: NYSDOT	**Date:** Start	4/9/2002	
Excavator Type: Komatsu track excavator	Finish	4/9/2002	
Operator: Parratt-Wolff Inc.	**Final Depth**	~ 5 ft bgs	
Test Pit Location: UFDA	**Depth to Water:**	n/a	
Coordinates:	**Surf. Elevation**	~ 350' MSL	
Logged By: SGE	**Perc Hole Depth (bgs):**	none	
Monitoring Instrument: PID / CGI / Radiation meter			
Photograph Disk #	**Photo #(s)**		

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	debris recovered along entire length of E - W and N - S trending sections of excavation; pipes (well casing ?) at W end of E - W trending section uncover large amount of debris including old tarps, buckets, buckets with solidified roofing tar, plastic bags, used oil filter, tires, unidentifiable metal pieces, plywood, tree stumps, remnants of an electric motor; at W end of this section, just before mound turns sharply to the south, uncover a thin layer of household trash items (bottles, bags, jars etc.) at ~ 2 ft below top of mound
2 - 4	background	background	background	
4 - 6	background	background	background	majority of debris found in area where trend of mound abruptly changes from E-W to N-S
				As TP-3 continued S amount of debris decreased; uncovered some sheet/scrap metal and a stack of rusted buckets containing remnants of roofing tar (liquified when exposed to sunlight)
				E - W trending section of excavation ~ 100 ft long N - S trending section of excavation ~ 70 ft long

Additional Notes

TP-3 consisted of an elongated mound trending E-W that turned abruptly S near the on-site stream;
In some places along TP-3 excavation consisted of scraping mound to level of surrounding land surface;
At some points of interest test pits were excavated as deep as 5 ft bgs

Test Pit Plan



LMS Test Pit Log

Crew: SGE		**TP-4**	
Sheet 1	**of** 1		
Project Name: SIA Unsuitable Fill Deposition Area	**Project No.:**	446-500	
Client: NYSDOT	**Date:** Start	4/9/2002	
Excavator Type: Komatsu track excavator	Finish	4/9/2002	
Operator: Parratt-Wolff Inc.	**Final Depth**	~ 5 ft bgs	
Test Pit Location: UFDA	**Depth to Water:**	n/a	
Coordinates:	**Surf. Elevation**	~ 350' MSL	
Logged By: SGE	**Perc Hole Depth (bgs):**	none	

Monitoring Instrument: PID / CGI / Radiation meter

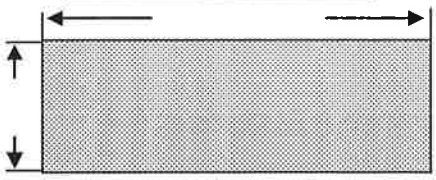
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	In northern portion of TP-4 mound encountered scrap and sheet metal; crushed and very degraded drums, crushed drum cover, solidified roofing tar, old tires, and scraps of clothing
2 - 4	background	background	background	thin layer of grey material (ash or organic layer ?) @ ~ 4 ft bgs
4 - 6	background	background	background	In southern portion of TP-4 most debris consisted of scrap metal, very crushed up drums, one fairly intact drum containing dried roofing tar, portion of radio antenna, and several drum covers; in southern 20 - 30 ft of mound, almost no debris were uncovered - appears to be mostly displaced native soil.
				length of excavated area ~ 120 ft.
				some areas of mound excavated to level of surrounding ground surface; some discrete pits to 5 ft bgs

Additional Notes

TP-4 consisted of a long N - S trending mound of partially buried debris; the mound appears to be a southward continuation of the mound where TP-3 was excavated.

Test Pit Plan



LMS Test Pit Log

Crew: SGE			**TP-5**
Sheet 1		**of**	1
Project Name: SIA Unsuitable Fill Deposition Area		**Project No.:**	446-500
Client: NYSDOT		**Date:** Start	4/9/2002
Excavator Type: Komatsu track excavator		Finish	4/9/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 5 ft
Test Pit Location:		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 350' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none

Monitoring Instrument: PID / CGI / Radiation meter

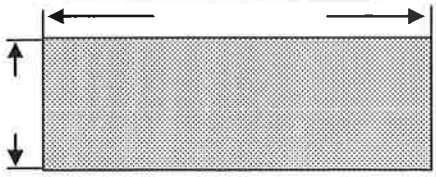
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	Composition very similar to that in mound at TP-2
				light brown and dark brown soil
				dry to moist silt, gravel, and cobbles
2 - 4	background	background	background	some wood chips near bottom of mound
4 - 6	background	background	background	
				dimensions of excavated area ~ 5' x 5'

Additional Notes

native soil excavated from TP-5
is suspected of being consolidated
from areas dug out to allow dumping
of debris

Test Pit Plan



LMS Test Pit Log

Project Name: SIA Unsuitable Fill Deposition Area		**Crew:** SGE	**TP-6**
		Sheet 1	**of** 1
Client: NYSDOT		**Project No.:**	446-500
Excavator Type: Komatsu track excavator		**Date:** Start	4/9/2002
		Finish	4/9/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 4 ft
Test Pit Location: UFDA		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 345' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none
Monitoring Instrument: PID / CGI / Radiation meter			
Photograph Disk #	**Photo #(s)**		

Depth (Ft)	Instrument(s) Reading		
	PID	CGI	RAD meter
0 - 2	background	background	background
2 - 4	background	background	background
4 - 6	background	background	background

Description

Material excavated from TP-6 appeared to be displaced native soil (gravel & cobbles in silt matrix) with the exception of far western extent of mound where some debris were unearthed, including:
broken bottles, broken panes of glass, various hoses, small compressor motor

Otherwise dug down into heart of mound to level of surrounding land surface and found only native soil

Due to findings on west side of mound, extended excavation to southwest - dug a couple pits and found some remnants of bricks and an area of large cobbles but very few additional debris (some burnt and sawed wood at ~ 3-4 ft bgs)

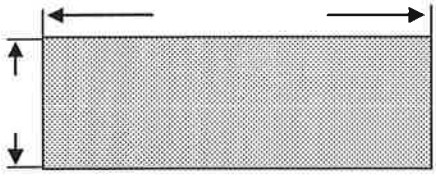
Dug an additional test pit area (TP-7) between TP-5 and TP-6 to look for more debris W of TP-6.

TP-6 total excavated area ~ 40' x 30'

Additional Notes

TP-6 excavated in area E of TP-5 and SW of TP-1
Bulk of excavated area was in large mound and area to SW of mound.
Mound was in very overgrown area and was barely visible from overgrown access road.

Test Pit Plan



LMS Test Pit Log

Crew: SGE			**TP-7**
Sheet 1		**of**	1
Project Name: SIA Unsuitable Fill Deposition Area		**Project No.:**	446-500
Client: NYSDOT		**Date:** Start	4/9/2002
Excavator Type: Komatsu track excavator		Finish	4/10/2002
Operator: Parratt-Wolff Inc.		**Final Depth**	~ 4 ft bgs
Test Pit Location: UFDA		**Depth to Water:**	n/a
Coordinates:		**Surf. Elevation**	~ 345' MSL
Logged By: SGE		**Perc Hole Depth (bgs):**	none

Monitoring Instrument: PID / CGI / Radiation meter

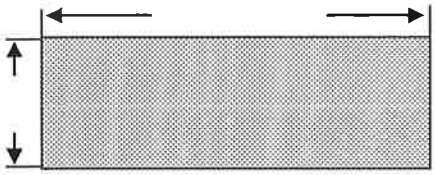
Photograph Disk # **Photo #(s)**

Depth (Ft)	Instrument(s) Reading PID	CGI	RAD meter	Description
0 - 2	background	background	background	Mostly gravel and cobbles in silty matrix with some debris at and just below surface
2 - 4	background	background	background	Debris unearthed include rotted plywood and scrap (unidentifiable) metal pieces
				layer of burnt sawed wood @ ~ 3 - 4 ft bgs
				TP-7 dimensions ~ 10' x 10'

Additional Notes

TP-7 excavated to further investigate debris uncovered on W side of TP-6

Test Pit Plan



LMS Test Pit Log

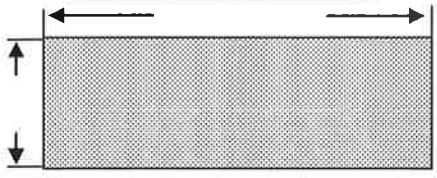
Crew: SGE		**TP-8**	
Sheet 1	**of** 1		
Project Name: SIA Unsuitable Fill Deposition Area	**Project No.:**	446-500	
Client: NYSDOT	**Date:** Start	4/10/2002	
Excavator Type: Komatsu track excavator	Finish	4/10/2002	
Operator: Parratt-Wolff Inc.	**Final Depth**	~ 5 ft	
Test Pit Location: UFDA	**Depth to Water:**	n/a	
Coordinates:	**Surf. Elevation**	~ 355' MSL	
Logged By: SGE	**Perc Hole Depth (bgs):**	none	
Monitoring Instrument: PID / CGI / Radiation meter			
Photograph Disk #	**Photo #(s)**		

Depth (Ft)	Instrument(s) Reading			Description
	PID	CGI	RAD meter	
0 - 2	background	background	background	Dug 7 separate pits in TP-8 area into and S of long mound (~ 60 ft length) between E end of TP-3 and NW corner of TP-1 Two pits into SW corner of mound revealed disturbed native soil with no debris. Pit adjacent to E end of TP-3 contained native soil with a layer of chipped wood. Four pits excavated in line trending E-W in low area just south of mound; pit furthest to W contained disturbed native soil and then pits revealed increasing amount of debris as excavation proceeded E. Debris unearthed included: a layer of burnt wood and grey soil (ash ?) underlying layer of household (?) waste. May represent two periods of dumping with later period containing trash bags, beer cans, bottles, tires etc. Pit nearest TP-1 area contained intact pieces of brick and mortar, solidified roofing tar, and compressor motor; less scrap metal here than in many other locations where debris was encountered. Dimensions of excavated area ~ 60' x 15'
2 - 4	background	background	background	
4 - 6	background	background	background	

Additional Notes

Elongated mound at this location was suspected of containing debris but after excavation was observed to consist of native soil; probably displaced to allow dumping of debris as is suspected for TP-1, TP-2, and TP-6 area mounds.

Test Pit Plan



APPENDIX E

LABORATORY CERTIFICATIONS

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL LLC
2425 New Holland Pike
Lancaster, PA 17601
Dorothy M. Love Phone: 717-556-7327

ENVIRONMENTAL

Valid To: November 30, 2022 Certificate Number: 0001.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.3 of the DoD/DOE Quality Systems Manual for Environmental Laboratories, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP-MS Spectrometry, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.-Electronic Probes (pH, F^-, O_2), Oxygen Demand, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, TCLP, Total Organic Carbon, Turbidity, Liquid Chromatography/Mass Spectrometry/Mass Spectrometry, High Resolution Gas Chromatography/Mass Spectrometry

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Demands				
COD	----------	EPA 410.4	----------	----------
Total Organic Carbon	----------	EPA 9060A SM 5310C-2011	EPA 9060A SM 5310C-2011	EPA 9060A SM 5310 B-2011
Anions				
Ammonia	----------	EPA 350.1	EPA 350.1	SM 4500-NH3 B/C-2011
Fluoride	----------	EPA 300.0 EPA 9056A	EPA 9056A	EPA 9056A EPA 300.0
Nitrate (as N)	----------	EPA 300.0 EPA 9056A	EPA 9056A	EPA 9056A EPA 300.0
Nitrite (as N)	----------	EPA 300.0 EPA 9056A	EPA 9056A	EPA 9056A EPA 300.0

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Bromide	----------	EPA 300.0 EPA 9056A	EPA 9056A	EPA 9056A EPA 300.0
Chloride	----------	EPA 300.0 EPA 9056A	EPA 9056A	EPA 9056A EPA 300.0
Sulfate	----------	EPA 300.0 EPA 9056A	EPA 9056A	EPA 9056A EPA 300.0
Wet Chemistry				
Alkalinity	----------	SM 2320B-2011	----------	----------
Corrosivity	----------	----------	SW-846 Chapter 7	SW-846 Chapter 7
Cyanide	----------	EPA 9012B	EPA 9012B	EPA 9012B
Filterable Residue (TDS)	----------	SM 2540C-2011	----------	----------
Flashpoint	----------	----------	EPA1010A	EPA 1010A
Grain Size	----------	----------	----------	ASTM D422
Hexavalent Chromium Digestion	----------	----------	----------	EPA 3060A
Hexavalent Chromium	----------	EPA 7196A EPA 7199	EPA 7196A EPA 7199	EPA 7196A EPA 7199
Ignitability	----------	----------	40 CFR 261.21	40 CFR 261.21
Nitrate/Nitrite	----------	----------	EPA 353.2	----------
Non-filterable Residue (TSS)	----------	SM 2540D-2011	----------	----------
pH	----------	SM 4500 H+B-2011 EPA 9040B EPA 9040C	EPA 9040B EPA 9040C	EPA 9045C EPA 9045D
Phenol	----------	EPA 9066	EPA 9066	----------
Reactivity	----------	----------	SW-846 Chapter 7.3	SW-846 Chapter 7.3
Sulfide	----------	EPA 376.1 EPA 376.2 SM 4500 S2D-2011 SM 4500 S2F-2011	----------	----------
Total Residue	----------	SM 2540B-2011	----------	SM 2540G-2011
Metals				
Metals Digestion	----------	EPA 3005A EPA 3010A EPA 3020A	EPA 3010A EPA 3020A	EPA 3050B
Aluminum	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Antimony	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Arsenic	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Barium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Beryllium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Boron	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Cadmium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Calcium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Chromium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Cobalt	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Copper	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Iron	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Lead	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Lithium	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Molybdenum	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Magnesium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Manganese	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Mercury	----------	EPA 7470A	EPA 7470A	EPA 7471A EPA 7471B
Nickel	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Potassium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Selenium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Silicon	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Silver	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Sodium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Strontium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Sulfur	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Thallium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Thorium	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Tin	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Titanium	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Tungsten	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Uranium	----------	EPA 6020A EPA 6020B	EPA 6020A EPA 6020B	EPA 6020A EPA 6020B
Vanadium	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Zinc	----------	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B	EPA 6010C EPA 6010D EPA 6020A EPA 6020B
Zirconium	----------	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D	EPA 6010C EPA 6010D
Purgeable Organics (Volatiles)				
Volatile Preparation	----------	EPA 5030C	EPA 5030C	EPA 5035A
Acetone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Acetonitrile	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Acrolein	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Acrylonitrile	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Allyl chloride	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Amyl Alcohol	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Amyl Methyl Ether	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Butyl Alcohol	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Butyl Formate	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Benzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromochloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromodichloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromoform	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Bromomethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Butanone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
n-Butylbenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
sec-Butylbenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
tert-Butylbenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Carbon disulfide	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Carbon tetrachloride	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Chloro-1,3-butadiene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloroacetonitrile	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1-Chlorobutane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chlorodifluoromethane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Chloroethyl Vinyl Ether	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloroform	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D

Parameter/Analyte	Drinking Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
1-Chlorohexane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Chloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Chlorotoluene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
4-Chlorotoluene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Cyclohexane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Cyclohexanone	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Di-Isopropyl ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Dibromochloromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Dibromo-3-chloropropane	EPA 524.2	EPA 8260C/D EPA 8011	EPA 8260C/D EPA 8011	EPA 8260C/D
Dibromomethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Dibromoethane (EDB)	----------	EPA 8260C/D EPA 8011	EPA 8260C/D EPA 8011	EPA 8260C/D
1,2-Dichlorobenzene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3-Dichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,4-Dichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
trans-1,4-dichloro-2-butene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Dichlorodi-fluoromethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1-Dichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Dichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1-Dichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
cis-1,2-Dichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
trans-1,2-Dichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Dichlorofluoromethane	EPA 524.2	----------	----------	----------
1,2-Dichloropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3-Dichloropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2,2-Dichloropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1-Dichloropropene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
cis-1,3-Dichloropropene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
trans-1,3-Dichloropropene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,4-Dioxane	----------	EPA 8260C/D EPA 8260C/D SIM	EPA 8260C/D EPA 8260C/D SIM	EPA 8260C/D EPA 8260C/D SIM
Ethanol	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethylbenzene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethyl ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethyl Methacrylate	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Ethyl Tert-Butyl Ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Freon-113	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Gasoline Range Organics (GRO) [Volatile Petroleum Hydrocarbons (VPH)]	----------	EPA 8015C EPA 8015D EPA 8260C/D NW TPH-Gx MA VPH AK101	EPA 8015C EPA 8015D EPA 8260C/D NW TPH-Gx MA VPH AK101	EPA 8015C EPA 8015D EPA 8260C/D NW TPH-Gx MA VPH AK101
Heptane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Hexane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Hexanone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Hexachlorobutadiene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Hexachloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Isobutyl Alcohol	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Isopropyl Alcohol	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Isopropylbenzene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,4-Isopropyltoluene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methylacrylonitrile	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Acetate		EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Acrylate	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Iodide	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Ethyl ketone	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methylene Chloride	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Isobutyl Ketone	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Methacrylate	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methyl Tert-Butyl Ether	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
4-Methyl-2-pentanone	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Methylcyclohexane		EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
2-Nitropropane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Naphthalene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Pentachloroethane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Propionitrile	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
n-Propylbenzene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Styrene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Tert-Amyl Ethyl Ether		EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,1,2-Tetrachloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,2,2-Tetrachloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Tetrachloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Tetrahydrofuran	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Toluene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,3-Trichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,4-Trichlorobenzene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,1-Trichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,1,2-Trichloroethane	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Trichloroethene	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Trichlorofluoromethane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,3-Trichloropropane	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2,4-Trimethylbenzene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3,5-Trimethylbenzene	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Vinyl Acetate	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Vinyl Chloride	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
Xylenes, Total	----------	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,2-Xylene (o-Xylene)	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D
1,3+1,4-Xylene (m+p Xylene)	EPA 524.2	EPA 8260C/D	EPA 8260C/D	EPA 8260C/D

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Extractable Organics (Semivolatiles)				
Acenaphthene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Acenaphthylene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Acetophenone	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Acetylaminofluorene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Alkylated PAHs	----------	EPA 8270D/E SIM	EPA 8270D/E SIM	EPA 8270D/E SIM
4-Aminobiphenyl	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Amino-4,6-dinitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
4-Amino-2,6-dinitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
Aniline	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Anthracene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Atrazine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzaldehyde	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzoic acid	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Benzo (a) anthracene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (b) fluoranthene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (k) fluoranthene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (ghi) perylene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (a) pyrene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Benzo (e) pyrene	----------	EPA 8270D/E SIM	EPA 8270D/E SIM	EPA 8270D/E SIM
Benzyl Alcohol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Biphenyl	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
bis (2-Chloroethoxy) Methane	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
bis (2-Chloroethyl) Ether	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
bis (2-Chloroisopropyl) Ether	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
bis (2-Ethylhexyl) Phthalate	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
4-Bromophenylphenyl Ether	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Butyl benzyl Phthalate	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Caprolactam	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Carbazole	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Carbon Range Organics C8-C44 (including subsets of this range i.e. HRO, MRO, ORO, RRO)	----------	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D
4-Chloroaniline	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Chloro-3-methylphenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Chlorobenzilate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1-Chloronaphthalene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Chloronaphthalene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Chlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Chlorophenyl phenyl ether	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Chrysene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Cresols (Methyl phenols)	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
cis-/trans-Diallate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Diamino-6-nitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
2,6-Diamino-4-nitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
Dibenzo (a,h) acridine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Dibenzo (a,h) anthracene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Dibenzofuran	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
1,2-Dichlorobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,3-Dichlorobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,4-Dichlorobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3,3-Dichlorobenzidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Diesel Range Organics (DRO) [Extractable Petroleum Hydrocarbons (EPH)]	----------	EPA 8015C EPA 8015D NWTPH DX MA EPH TX1005/1006 AK102/103 AK102/103-SV	EPA 8015C EPA 8015D NWTPH DX MA EPH TX1005/1006 AK102/103 AK102/103-SV	EPA 8015C EPA 8015D NWTPH DX MA EPH TX1005/1006 AK102/103
2,4-Dichlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,6-Dichlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Diethyl Phthalate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Dimethoate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
p-Dimethylaminoazobenze	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
7,12-Dimethylbenz (a) anthracene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Dimethylphenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Dimethyl Phthalate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3,3'-Dimethylbenzidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Di-n-butyl Phthalate	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Di-n-octyl phthalate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3,5-Dinitroaniline	----------	EPA 8330B	EPA 8330B	EPA 8330B
1,3-Dinitrobenzene	----------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B
1,4-Dinitrobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Dinitrophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4-Dinitrotoluene	----------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B
2,6-Dinitrotoluene	----------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B
1,4-Dioxane	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Diphenylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Diphenyl ether	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,2-Diphenylhydrazine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Ethyl Methane Sulfonate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Fluoroanthene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Fluorene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Hexachlorobenzene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Hexachlorobutadiene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexachlorocyclo-pentadiene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexachloroethane	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexachloropropene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	----------	EPA 8330B	EPA 8330B	EPA 8330B
Indeno (1,2,3-cd) Pyrene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Isodrin	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Isophorone	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Isosafrole	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3-Methycholanthrene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Methyl-4,6-dinitrophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Methyl methane sulfonate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1-Methylnaphthalene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
2-Methylnaphthalene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
2-Methylphenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Methylphenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Naphthalene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
1,4-Naphthoquinone	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1-Naphthylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Naphthylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Nitroquinoline-1-oxide	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Nitroaniline	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
3-Nitroaniline	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Nitroaniline	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Nitrobenzene	----------	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B	EPA 8270D/E EPA 8330B
Nitroglycerin	----------	EPA 8330B	EPA 8330B	EPA 8330B
2-Nitrophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
4-Nitrophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Nitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
3-Nitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
4-Nitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
5-Nitro-o-toluidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitroso-di-n-butylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodiethylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodimethylamine	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
n-Nitrosodimethylethylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosomorpholine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodi-n-propylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosodiphenylamine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosopiperidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
n-Nitrosopyrrolidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	----------	EPA 8330B	EPA 8330B	EPA 8330B

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
2,2-Oxybis (1-chloropropane)	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentachlorobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentachloronitrobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentachlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pentaerythritol Tetranitrate (PETN)	----------	EPA 8330B	EPA 8330B	EPA 8330B
Perylene	----------	EPA 8270D/E SIM	EPA 8270D/E SIM	EPA 8270D/E SIM
Phenacetin	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Phenanthrene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Phenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2-Picoline	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pronamide	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Pyrene	----------	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM	EPA 8270D/E EPA 8270D/E SIM
Pyridine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Safrole	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,2,4,5- Tetrachlorobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,3,4,6-Tetrachlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Tetraethyl dithiopyrophosphate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Tetraethy lead	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Tetryl	----------	EPA 8330B	EPA 8330B	EPA 8330B
Thionazin	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
o-Toluidine	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,2,4-Trichlorobenzene	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
1,3,5-Trinitrobenzene	----------	EPA 8330B	EPA 8330B	EPA 8330B
2,4,5-Trichlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4,6-Trichlorophenol	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
O,O,O-Tri-ethylphosphorothioate	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
2,4,6-Trinitrotoluene	----------	EPA 8330B	EPA 8330B	EPA 8330B
Organochlorine Pesticides				
Aldrin	----------	EPA 8081B	EPA 8081B	EPA 8081B
alpha-BHC	----------	EPA 8081B	EPA 8081B	EPA 8081B
beta-BHC	----------	EPA 8081B	EPA 8081B	EPA 8081B
delta-BHC	----------	EPA 8081B	EPA 8081B	EPA 8081B
gamma-BHC (Lindane)	----------	EPA 8081B	EPA 8081B	EPA 8081B

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
alpha-Chlordane	----------	EPA 8081B	EPA 8081B	EPA 8081B
Chlordane (Technical)	----------	EPA 8081B	EPA 8081B	EPA 8081B
Chlorobenzilate	----------	EPA 8081B	EPA 8081B	EPA 8081B
2,4'-DDD	----------	EPA 8081B	EPA 8081B	EPA 8081B
2,4'-DDE	----------	EPA 8081B	EPA 8081B	EPA 8081B
2,4'-DDT	----------	EPA 8081B	EPA 8081B	EPA 8081B
4,4'-DDD	----------	EPA 8081B	EPA 8081B	EPA 8081B
4,4'-DDE	----------	EPA 8081B	EPA 8081B	EPA 8081B
4,4'-DDT	----------	EPA 8081B	EPA 8081B	EPA 8081B
Diallate	----------	EPA 8081B	EPA 8081B	EPA 8081B
1.2-Dibromo-3-chloropropane (DBCP)	----------	EPA 8081B	EPA 8081B	EPA 8081B
Dieldrin	----------	EPA 8081B	EPA 8081B	EPA 8081B
Dinoseb	----------	EPA 8270D/E	EPA 8270D/E	EPA 8270D/E
Endosulfan I (alpha)	----------	EPA 8081B	EPA 8081B	EPA 8081B
Endosulfan II (beta)	----------	EPA 8081B	EPA 8081B	EPA 8081B
Endosulfan Sulfate	----------	EPA 8081B	EPA 8081B	EPA 8081B
Endrin	----------	EPA 8081B	EPA 8081B	EPA 8081B
Endrin Aldehyde	----------	EPA 8081B	EPA 8081B	EPA 8081B
Endrin Ketone	----------	EPA 8081B	EPA 8081B	EPA 8081B
gamma-Chlordane	----------	EPA 8081B	EPA 8081B	EPA 8081B
Heptachlor	----------	EPA 8081B	EPA 8081B	EPA 8081B
Heptachlor Epoxide	----------	EPA 8081B	EPA 8081B	EPA 8081B
Hexachlorobenzene	----------	EPA 8081B	EPA 8081B	EPA 8081B
Hexachlorocyclopentadiene	----------	EPA 8081B	EPA 8081B	EPA 8081B
Isodrin	----------	EPA 8081B	EPA 8081B	EPA 8081B
Methoxychlor	----------	EPA 8081B	EPA 8081B	EPA 8081B
Mirex	----------	EPA 8081B	EPA 8081B	EPA 8081B
Toxaphene	----------	EPA 8081B	EPA 8081B	EPA 8081B
PCBs (Aroclors)				
PCB-1016 (Arochlor)	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1221	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1232	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1242	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1248	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1254	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1260	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1262	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB-1268	----------	EPA 8082A	EPA 8082A	EPA 8082A
PCB congeners (209)	----------	EPA 1668A EPA 1668C	EPA 1668A EPA 1668C	EPA 1668A EPA 1668C

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Herbicides				
2,4,5-T	----------	EPA 8151A	EPA 8151A	EPA 8151A
2,4,5-TP (Silvex)	----------	EPA 8151A	EPA 8151A	EPA 8151A
2,4-D	----------	EPA 8151A	EPA 8151A	EPA 8151A
2,4-DB	----------	EPA 8151A	EPA 8151A	EPA 8151A
Dalapon	----------	EPA 8151A	EPA 8151A	EPA 8151A
Dicamba	----------	EPA 8151A	EPA 8151A	EPA 8151A
Dichlorprop	----------	EPA 8151A	EPA 8151A	EPA 8151A
Dinoseb	----------	EPA 8151A	EPA 8151A	EPA 8151A
MCPA	----------	EPA 8151A	EPA 8151A	EPA 8151A
MCPP	----------	EPA 8151A	EPA 8151A	EPA 8151A
Pentachlorophenol	----------	EPA 8151A	EPA 8151A	EPA 8151A
PCB Homologues				
Monochlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Dichlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Trichlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Tetrachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Pentachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Hexachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Heptachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Octachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Nonachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Decachlorobiphenyls	----------	EPA 680	EPA 680	EPA 680
Dioxins/Furans				
2,3,7,8-TCDD	EPA 1613B	EPA 8290A	EPA 8290A	EPA 8290A
2,3,7,8-TCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8-PeCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
2,3,4,7,8-PeCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8-PeCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,7,8-HxCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,6,7,8-HxCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
2,3,4,6,7,8-HxCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8,9-HxCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,7,8,-HxCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,6,7,8-HxCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,7,8,9-HxCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,6,7,8-HpCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,7,8,9-HpCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
1,2,3,4,6,7,8-HpCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
OCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
OCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total HpCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total HpCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total HxCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total HxCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total PeCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A

Parameter/Analyte	Potable Water	Non-Potable Water	Solid Hazardous Waste	
			Aqueous	Solid
Total PeCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total TCDD	----------	EPA 8290A	EPA 8290A	EPA 8290A
Total TCDF	----------	EPA 8290A	EPA 8290A	EPA 8290A
Misc. Headspace Analysis				
Carbon dioxide	----------	RSK-175	RSK-175	----------
Ethane	----------	RSK-175	RSK-175	----------
Ethene	----------	RSK-175	RSK-175	----------
Methane	----------	RSK-175	RSK-175	----------
Hazardous Waste Characteristics				
Toxicity Characteristic Leaching Procedure	----------	----------	EPA 1311	EPA 1311
Synthetic Precipitation Leaching Procedure	----------	----------	EPA 1312	EPA 1312
ASTM Leaching Procedure	----------	----------	ASTM D3987-85	ASTM D3987-85
Other				
Perchlorate	----------	EPA 6850	EPA 6850	EPA 6850
Hydrazine	----------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Formaldehyde	----------	----------	EPA 8315A	EPA 8315A
Methylhydrazine	----------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
1,1-Dimethylhydrazine	----------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Volatile Preparation	----------	EPA 5030A EPA 5030C	EPA 5030A EPA 5030C	EPA 5035 EPA 5035A
Organic Extraction/Cleanup	----------	EPA 3510C EPA 3511 EPA 3660B, 3620C, 3665A	EPA 3510C EPA 3511 EPA 3660B, 3620C, 3665A	EPA 3546 EPA 3550C EPA 3660B, 3620C, 3665A, 3640A

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
Per and Polyfluoroalkyl Substances (PFAS)			
N-ethyl Perfluorooctane-Sulfonamidoacetic Acid (NetFOSAA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
N-methyl Perfluorooctane-Sulfonamidoacetic Acid (NMeFOSAA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorobutanesulfonic Acid (PFBS)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorodecanoic Acid (PFDA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
Perfluorododecanoic Acid (PFDoDA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluoroheptanoic Acid (PFHpA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorohexanesulfonic Acid (PFHxS)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorohexanoic Acid (PFHxA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorononanoic Acid (PFNA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorooctanesulfonic Acid (PFOS)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorooctanoic Acid (PFOA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorotetradecanoic Acid (PFTeDA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorotridecanoic Acid (PFTrDA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluoroundecanoic Acid (PFUnDA)	EPA 537 EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (HFPODA)	EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
4,8-Dioxa-3H-perfluorononanoic acid (DONA)	EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	EPA 537.1	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluoro-n-butanoic Acid (PFBA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluoro-n-pentanoic Acid (PFPeA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
8:2 Fluorotelomersulfonic Acid (8:2FTS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
4:2 Fluorotelomersulfonic Acid (4:2-FTS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluoropentanesulfonic Acid (PFPeS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
6:2 Fluorotelomersulfonic Acid (6:2-FTS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluoroheptanesulfonic Acid (PFHpS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorononanesulfonic Acid (PFNS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorodecanesulfonic Acid (PFDS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
10:2 Fluorotelomersulfonic Acid (10:2-FTS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorododecanesulfonic Acid (PFDoDS)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorohexadecanoic Acid (PFHxDA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorooctadecanoic Acid (PFODA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
Perfluorooctanesulfonamide (PFOSA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol (NMePFOSAE)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
N-methylperfluoro-1-octanesulfonamide (NMePFOSA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15
(N-ethylperfluoro-1-octanesulfonamido)-ethanol (NEtPFOSAE)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
N-ethylperfluoro-1-octanesulfonamide (NEtPFOSA)	----------	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15

End of DoD ELAP section of scope

Start of KY, WY, and ISO 17025 section of scope

In addition, in recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with ISO IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and for the test methods applicable to Kentucky Statute KRS 224.60-130(2)(a), and for the test methods applicable to the Wyoming Storage Tank Remediation Laboratory Accreditation Program), accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP-MS Spectrometry, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.-Electronic Probes (pH, F^-, O_2), Oxygen Demand, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, TCLP, Total Organic Carbon, Turbidity, Liquid Chromatography/Mass Spectrometry/Mass Spectrometry, High Resolution Gas Chromatography/Mass Spectrometry

Parameter/Analyte	Tissue	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Other				
Perchlorate	Food & Food Products EPA 6850	EPA 6850	EPA 6850	EPA 6850
Hydrazine	----------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Methylhydrazine	----------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
1,1-Dimethylhydrazine	----------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Volatile Preparation	----------	EPA 5030A EPA 5030C	EPA 5030A EPA 5030C	EPA 5035 EPA 5035A
Organic Extraction/ Cleanup	EPA 3546 EPA 3550C EPA 3660B EPA 3620C EPA 3665A EPA 3640A	EPA 3510C EPA 3511 EPA 3660B EPA 3620C EPA 3665A	EPA 3510C EPA 3511 EPA 3660B EPA 3620C EPA 3665A	EPA 3546 EPA 3550C EPA 3660B EPA 3620C EPA 3665A EPA 3640A
Kentucky UST Program				
Metals				
Arsenic	----------	----------	EPA 6010B	EPA 6010B
Barium	----------	----------	EPA 6010B	EPA 6010B

Parameter/Analyte	Tissue	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Cadmium	----------	----------	EPA 6010B	EPA 6010B
Chromium	----------	----------	EPA 6010B	EPA 6010B
Lead	----------	----------	EPA 6010B	EPA 6010B
Mercury	----------	----------	EPA 7470A	EPA 7471A
Selenium	----------	----------	EPA 6010B	EPA 6010B
Silver	----------	----------	EPA 6010B	EPA 6010B

Parameter/Analyte	Tissue	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Purgeable Organics (Volatiles)				
Diesel Range Organics (DRO)	----------	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D
Gasoline Range Organics (GRO)	----------	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D	EPA 8015C EPA 8015D
Wyoming Storage Tank Program				
Metals				
Cadmium	----------	----------	EPA 6010C	EPA 6010C
Chromium	----------	----------	EPA 6010C	EPA 6010C
Chromium (Total, hexavalent)	----------	----------	EPA 7196A	EPA 7196A
Lead	----------	----------	EPA 6010C	EPA 6010C
Purgeable Organics (Volatiles)				
Volatile Preparation	----------	----------	EPA 5030C EPA 5030C	EPA 5035 EPA 5035A
Benzene	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
1,2-Dichloroethane	----------	----------	EPA 8260D	EPA 8260D
Diisopropyl Ether	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Ethyl Benzene	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Ethyl tert-butyl Ether	----------	----------	EPA 8260D	EPA 8260D
Methyl tert-butyl Ether	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Naphthalene	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Toluene	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Tert-amyl Methyl Ether	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Tert-butyl Alcohol	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Xylenes, total	----------	----------	EPA 5030C EPA 8260D	EPA 8260D

Parameter/Analyte	Tissue	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid
Gasoline Range Organics (GRO C6-C10)	----------	----------	EPA 5030C EPA 8260D	EPA 8260D
Extractable Organics (Semivolatiles)				
Diesel Range Organics (DRO C10-C32)	----------	----------	EPA 8015C w/ EPA 3630 cleanup	EPA 8015C w/ EPA 3630 cleanup

Food and Feed (WHO 29)	**Food/Feed**			
2,3,7,8-TCDD	EPA 1613B	----------	----------	----------
2,3,7,8-TCDF	EPA 1613B	----------	----------	----------
1,2,3,7,8-PeCDF	EPA 1613B	----------	----------	----------
2,3,4,7,8-PeCDF	EPA 1613B	----------	----------	----------
1,2,3,7,8-PeCDD	EPA 1613B	----------	----------	----------
1,2,3,4,7,8-HxCDF	EPA 1613B	----------	----------	----------
1,2,3,6,7,8-HxCDF	EPA 1613B	----------	----------	----------
2,3,4,6,7,8-HxCDF	EPA 1613B	----------	----------	----------
1,2,3,7,8,9-HxCDF	EPA 1613B	----------	----------	----------
1,2,3,4,7,8-HxCDD	EPA 1613B	----------	----------	----------
1,2,3,6,7,8-HxCDD	EPA 1613B	----------	----------	----------
1,2,3,7,8,9-HxCDD	EPA 1613B	----------	----------	----------
1,2,3,4,6,7,8-HpCDF	EPA 1613B	----------	----------	----------
1,2,3,4,7,8,9-HpCDF	EPA 1613B	----------	----------	----------
1,2,3,4,6,7,8-HpCDD	EPA 1613B	----------	----------	----------
OCDF	EPA 1613B	----------	----------	----------
OCDD	EPA 1613B	----------	----------	----------
Total HpCDD	EPA 1613B	----------	----------	----------
Total HpCDF	EPA 1613B	----------	----------	----------
Total HxCDD	EPA 1613B	----------	----------	----------
Total HxCDF	EPA 1613B	----------	----------	----------
Total PeCDD	EPA 1613B	----------	----------	----------
Total PeCDF	EPA 1613B	----------	----------	----------
Total TCDD	EPA 1613B	----------	----------	----------
Total TCDF	EPA 1613B	----------	----------	----------
6 marker PCBs (PCB28, PCB52, PCB101, PCB138, PCB153, and PCB180)	EPA 1668A EPA 1668C	----------	----------	----------

Parameter/Analyte	Tissue	Nonpotable Water	Solid Hazardous Waste	
			Aqueous	Solid

12 Dioxin-like PCBs (dl-PCBs)/coplanar PCBs (PCB77, PCB81, PCB105, PCB114, PCB118, PCB123, PCB126, PCB156, PCB157, PCB167, PCB169, and PCB189)	EPA 1668A EPA 1668C	----------	----------	----------

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
Per and Polyfluoroalkyl Substances (PFAS)			
N-ethyl perfluorooctane-sulfonamidoacetic acid (NetFOSAA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
N-methyl perfluoroctane-sulfonamidoacetic acid (NMeFOSAA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorobutanesulfonic acid (PFBS)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorodecanoic acid (PFDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorododecanoic acid (PFDoDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoroheptanoic acid (PFHpA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorohexanesulfonic acid (PFHxS)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorohexanoic acid (PFHxA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorononanoic acid (PFNA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctanesulfonic acid (PFOS)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctanoic acid (PFOA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorotetradecanoic acid (PFTeDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorotridecanoic acid (PFTrDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoroundecanoic acid (PFUnDA)	EPA 537 Ver. 1.1 EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (HFPODA)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
4,8-Dioxa-3H-perfluorononanoic acid (DONA)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	EPA 537.1	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoro-n-butanoic acid (PFBA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoro-n-pentanoic acid (PFPeA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
8:2 Fluorotelomersulfonic acid (8:2FTS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod

Parameter/Analyte	Drinking Water	Nonpotable Water	Solid Haz.Waste
4:2 Fluorotelomersulfonic acid (4:2-FTS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoropentanesulfonic acid (PFPeS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
6:2 Fluorotelomersulfonic acid (6:2-FTS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluoroheptanesulfonic acid (PFHpS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorononanesulfonic acid (PFNS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorodecanesulfonic acid (PFDS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
10:2 Fluorotelomersulfonic acid (10:2-FTS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorododecanesulfonic acid (PFDoDS)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorohexadecanoic acid (PFHxDA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctadecanoic acid (PFODA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
Perfluorooctanesulfonamide (PFOSA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol (NMePFOSAE)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
N-methylperfluoro-1-octanesulfonamide (NMePFOSA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol (NEtPFOSAE)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod
N-ethylperfluoro-1-octanesulfonamide (NEtPFOSA)	----------	EPA 537 Ver.1.1 Mod	EPA 537 Ver.1.1 Mod

End of KY, WY, and ISO 17025 section of scope

Accredited Laboratory

A2LA has accredited

EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL, LLC

Lancaster, PA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.3 of the DoD/DOE Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated *April 2017*).

Presented this 28th day of January 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1.01
Valid to November 30, 2022

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Eurofins Seattle
5755 8th Street East
Tacoma, WA 98424

Fulfills the requirements of

ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.4)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 19 January 2025
Certificate Number: L2236

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.4)

Eurofins Seattle

5755 8th Street East
Tacoma, WA 98424
Terri Torres
253-922-2310

TESTING

Valid to: **January 19, 2025** Certificate Number: **L2236**

Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010D/200.7	Silver
ICP-AES	EPA 6010B/6010D/200.7	Aluminum
ICP-AES	EPA 6010B/6010D/200.7	Arsenic
ICP-AES	EPA 6010B/6010D/200.7	Boron
ICP-AES	EPA 6010B/6010D/200.7	Barium
ICP-AES	EPA 6010B/6010D/200.7	Beryllium
ICP-AES	EPA 6010B/6010D/200.7	Calcium
ICP-AES	EPA 6010B/6010D/200.7	Cadmium
ICP-AES	EPA 6010B/6010D/200.7	Cobalt
ICP-AES	EPA 6010B/6010D/200.7	Chromium
ICP-AES	EPA 6010B/6010D/200.7	Copper
ICP-AES	EPA 6010B/6010D/200.7	Iron
ICP-AES	EPA 6010B/6010D/200.7	Potassium
ICP-AES	EPA 6010B/6010D/200.7	Magnesium
ICP-AES	EPA 6010B/6010D/200.7	Manganese

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010D/200.7	Molybdenum
ICP-AES	EPA 6010B/6010D/200.7	Sodium
ICP-AES	EPA 6010B/6010D/200.7	Nickel
ICP-AES	EPA 6010B/6010D/200.7	Lead
ICP-AES	EPA 6010B/6010D/200.7	Antimony
ICP-AES	EPA 6010B/6010D/200.7	Selenium
ICP-AES	EPA 6010B/6010D/200.7	Silicon
ICP-AES	EPA 6010B/6010D/200.7	Tin
ICP-AES	EPA 6010B/6010D/200.7	Titanium
ICP-AES	EPA 6010B/6010D/200.7	Strontium
ICP-AES	EPA 6010B/6010D/200.7	Thallium
ICP-AES	EPA 6010B/6010D/200.7	Vanadium
ICP-AES	EPA 6010B/6010D/200.7	Zinc
ICP-MS	EPA 6020/6020B/200.8	Silver
ICP-MS	EPA 6020/6020B/200.8	Aluminum
ICP-MS	EPA 6020/6020B/200.8	Arsenic
ICP-MS	EPA 6020/6020B/200.8	Barium
ICP-MS	EPA 6020/6020B/200.8	Beryllium
ICP-MS	EPA 6020/6020B/200.8	Cadmium
ICP-MS	EPA 6020/6020B/200.8	Cobalt
ICP-MS	EPA 6020/6020B/200.8	Chromium
ICP-MS	EPA 6020/6020B/200.8	Copper
ICP-MS	EPA 6020/6020B/200.8	Iron
ICP-MS	EPA 6020/6020B/200.8	Manganese
ICP-MS	EPA 6020/6020B/200.8	Molybdenum
ICP-MS	EPA 6020/6020B/200.8	Nickel
ICP-MS	EPA 6020/6020B/200.8	Lead
ICP-MS	EPA 6020/6020B/200.8	Antimony
ICP-MS	EPA 6020/6020B/200.8	Selenium
ICP-MS	EPA 6020/6020B/200.8	Thallium
ICP-MS	EPA 6020/6020B/200.8	Uranium
ICP-MS	EPA 6020/6020B/200.8	Vanadium
ICP-MS	EPA 6020/6020B/200.8	Zinc
CVAAS	EPA 7470A/245.1	Mercury
GC/MS	EPA 8260B/8260D/624.1	1,1,1,2-Tetrachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260D/624.1	1,1,1-Trichloroethane
GC/MS	EPA 8260B/8260D/624.1	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/8260D/624.1	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/8260D/624.1	1,1,2-Trichloroethane
GC/MS	EPA 8260B/8260D/624.1	1,1-Dichloroethane
GC/MS	EPA 8260B/8260D/624.1	1,1-Dichloroethene
GC/MS	EPA 8260B/8260D/624.1	1,1-Dichloropropene
GC/MS	EPA 8260B/8260D/624.1	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/8260D/624.1	1,2,3-Trichloropropane
GC/MS	EPA 8260B/8260D/624.1	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/8260D/624.1	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/8260D/624.1	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/8260D/624.1	1,2-Dibromo-3-Chloropropane
GC/MS	EPA 8260B/8260D/624.1	1,2-Dichlorobenzene
GC/MS	EPA 8260B/8260D/624.1	1,2-Dichloroethane
GC/MS	EPA 8260B/8260D/624.1	1,2-Dichloropropane
GC/MS	EPA 8260B/8260D/624.1	1,3-Dichloropropene, Total
GC/MS	EPA 8260B/8260D/624.1	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/8260D/624.1	1,3-Dichlorobenzene
GC/MS	EPA 8260B/8260D/624.1	1,3-Dichloropropane
GC/MS	EPA 8260B/8260D/624.1	1,4-Dichlorobenzene
GC/MS	EPA 8260B/8260D/624.1	2,2-Dichloropropane
GC/MS	EPA 8260B/8260D/624.1	2-Chloroethylvinylether
GC/MS	EPA 8260B/8260D/624.1	2-Chlorotoluene
GC/MS	EPA 8260B/8260D/624.1	2-Hexanone
GC/MS	EPA 8260B/8260D/624.1	2-Methyl-2-Propanol
GC/MS	EPA 8260B/8260D/624.1	4-Chlorotoluene
GC/MS	EPA 8260B/8260D/624.1	4-Isopropyltoluene
GC/MS	EPA 8260B/8260D/624.1	Acetone
GC/MS	EPA 8260B/8260D/624.1	Acetonitrile
GC/MS	EPA 8260B/8260D/624.1	Acrolein
GC/MS	EPA 8260B/8260D/624.1	Acrylonitrile
GC/MS	EPA 8260B/8260D/624.1	Benzene
GC/MS	EPA 8260B/8260D/624.1	Bromobenzene
GC/MS	EPA 8260B/8260D/624.1	Bromodichloromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260D/624.1	Bromoform
GC/MS	EPA 8260B/8260D/624.1	Bromomethane
GC/MS	EPA 8260B/8260D/624.1	Carbon disulfide
GC/MS	EPA 8260B/8260D/624.1	Carbon tetrachloride
GC/MS	EPA 8260B/8260D/624.1	Chlorobenzene
GC/MS	EPA 8260B/8260D/624.1	Chlorobromomethane
GC/MS	EPA 8260B/8260D/624.1	Chlorodibromomethane
GC/MS	EPA 8260B/8260D/624.1	Chloroethane
GC/MS	EPA 8260B/8260D/624.1	Chloroform
GC/MS	EPA 8260B/8260D/624.1	Chloromethane
GC/MS	EPA 8260B/8260D/624.1	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/8260D/624.1	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/8260D/624.1	Cyclohexane
GC/MS	EPA 8260B/8260D/624.1	Dibromomethane
GC/MS	EPA 8260B/8260D/624.1	Dichlorodifluoromethane
GC/MS	EPA 8260B/8260D/624.1	Ethylbenzene
GC/MS	EPA 8260B/8260D/624.1	Ethylene Dibromide
GC/MS	EPA 8260B/8260D/624.1	Ethyl ether
GC/MS	EPA 8260B/8260D/624.1	Hexachlorobutadiene
GC/MS	EPA 8260B/8260D/624.1	Isopropylbenzene
GC/MS	EPA 8260B/8260D/624.1	Iodomethane
GC/MS	EPA 8260B/8260D/624.1	Isopropyl ether
GC/MS	EPA 8260B/8260D/624.1	Methacrylonitrile
GC/MS	EPA 8260B/8260D/624.1	Methyl acetate
GC/MS	EPA 8260B/8260D/624.1	Methyl Ethyl Ketone
GC/MS	EPA 8260B/8260D/624.1	Methyl Isobutyl Ketone
GC/MS	EPA 8260B/8260D/624.1	Methyl tert-butyl ether
GC/MS	EPA 8260B/8260D/624.1	Methylcyclohexane
GC/MS	EPA 8260B/8260D/624.1	Methylene Chloride
GC/MS	EPA 8260B/8260D/624.1	m-Xylene & p-Xylene
GC/MS	EPA 8260B/8260D/624.1	Naphthalene
GC/MS	EPA 8260B/8260D/624.1	n-Butanol
GC/MS	EPA 8260B/8260D/624.1	n-Butylbenzene
GC/MS	EPA 8260B/8260D/624.1	n-Hexane
GC/MS	EPA 8260B/8260D/624.1	N-Propylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260D/624.1	o-Xylene
GC/MS	EPA 8260B/8260D/624.1	sec-Butylbenzene
GC/MS	EPA 8260B/8260D/624.1	Styrene
GC/MS	EPA 8260B/8260D/624.1	tert-Butylbenzene
GC/MS	EPA 8260B/8260D/624.1	Tert-amyl methyl ether
GC/MS	EPA 8260B/8260D/624.1	Tert-butyl ethyl ether
GC/MS	EPA 8260B/8260D/624.1	Tetrachloroethene
GC/MS	EPA 8260B/8260D/624.1	Tetrahydrofuran
GC/MS	EPA 8260B/8260D/624.1	Toluene
GC/MS	EPA 8260B/8260D/624.1	Total Xylenes
GC/MS	EPA 8260B/8260D/624.1	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/8260D/624.1	trans-1,3-Dichloropropene
GC/MS	EPA 8260B/8260D/624.1	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/8260D/624.1	Trichloroethene
GC/MS	EPA 8260B/8260D/624.1	Trichlorofluoromethane
GC/MS	EPA 8260B/8260D/624.1	Vinyl Acetate
GC/MS	EPA 8260B/8260D/624.1	Vinyl chloride
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1,1,2-Tetrachloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1,2,2-Tetrachloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1,2-Trichloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1-Dichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,2,4-Trimethylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,2-Dichloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,3,5-Trimethylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,4-Dichlorobenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	2-Hexanone
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Benzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Bromoform
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Bromomethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Butadiene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Chlorodibromomethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Chloroform
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	cis-1,2-Dichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	cis-1,3-Dichloropropene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Ethylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Dibromomethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Bromodichloromethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Ethylene Dibromide
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Hexachlorobutadiene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Isopropylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Isopropyl alcohol
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	m&p-Xylene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Methyl tert-Butyl Ether
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Naphthalene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	n-Butylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	o-Xylene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Sec-Butylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Tert-Butylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Tetrachloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Toluene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	trans-1,3-Dichloropropene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Trichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Vinyl chloride
GC/MS	EPA 8270C/8270E/625.1	1-Methylnaphthalene
GC/MS	EPA 8270C/8270E/625.1	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/8270E/625.1	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/8270E/625.1	1,2-Dichlorobenzene
GC/MS	EPA 8270C/8270E/625.1	1,3-Dichlorobenzene
GC/MS	EPA 8270C/8270E/625.1	1,4-Dichlorobenzene
GC/MS	EPA 8270C/8270E/625.1	bis(2-chloroisopropyl)ether
GC/MS	EPA 8270C/8270E/625.1	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/8270E/625.1	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/8270E/625.1	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/8270E/625.1	2,4-Dichlorophenol
GC/MS	EPA 8270C/8270E/625.1	2,4-Dimethylphenol
GC/MS	EPA 8270C/8270E/625.1	2,4-Dinitrophenol
GC/MS	EPA 8270C/8270E/625.1	2,4-Dinitrotoluene
GC/MS	EPA 8270C/8270E/625.1	2,6-Dinitrotoluene
GC/MS	EPA 8270C/8270E/625.1	2-Chloronaphthalene
GC/MS	EPA 8270C/8270E/625.1	2-Chlorophenol
GC/MS	EPA 8270C/8270E/625.1	2-Methylnaphthalene
GC/MS	EPA 8270C/8270E/625.1	2-Methylphenol
GC/MS	EPA 8270C/8270E/625.1	2-Nitroaniline
GC/MS	EPA 8270C/8270E/625.1	2-Nitrophenol
GC/MS	EPA 8270C/8270E/625.1	3 & 4 Methylphenol
GC/MS	EPA 8270C/8270E/625.1	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/8270E/625.1	3-Nitroaniline
GC/MS	EPA 8270C/8270E/625.1	4,6-Dinitro-2-methylphenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/8270E/625.1	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/8270E/625.1	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/8270E/625.1	4-Chloroaniline
GC/MS	EPA 8270C/8270E/625.1	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/8270E/625.1	4-Nitroaniline
GC/MS	EPA 8270C/8270E/625.1	4-Nitrophenol
GC/MS	EPA 8270C/8270E/625.1	Acenaphthene
GC/MS	EPA 8270C/8270E/625.1	Acenaphthylene
GC/MS	EPA 8270C/8270E/625.1	Aniline
GC/MS	EPA 8270C/8270E/625.1	Anthracene
GC/MS	EPA 8270C/8270E/625.1	1,2-Diphenylhydrazine as Azobenzene
GC/MS	EPA 8270C/8270E/625.1	Benzo[a]anthracene
GC/MS	EPA 8270C/8270E/625.1	Benzo[a]pyrene
GC/MS	EPA 8270C/8270E/625.1	Benzo[b]fluoranthene
GC/MS	EPA 8270C/8270E/625.1	Benzo[g,h,i]perylene
GC/MS	EPA 8270C/8270E/625.1	Benzo[k]fluoranthene
GC/MS	EPA 8270C/8270E/625.1	Benzoic acid
GC/MS	EPA 8270C/8270E/625.1	Benzyl alcohol
GC/MS	EPA 8270C/8270E/625.1	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/8270E/625.1	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/8270E/625.1	Bis(2-ethylhexyl) phthalate
GC/MS	EPA 8270C/8270E/625.1	Butyl benzyl phthalate
GC/MS	EPA 8270C/8270E/625.1	Carbazole
GC/MS	EPA 8270C/8270E/625.1	Chrysene
GC/MS	EPA 8270C/8270E/625.1	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/8270E/625.1	Dibenzofuran
GC/MS	EPA 8270C/8270E/625.1	Diethyl phthalate
GC/MS	EPA 8270C/8270E/625.1	Dimethyl phthalate
GC/MS	EPA 8270C/8270E/625.1	Di-n-butyl phthalate
GC/MS	EPA 8270C/8270E/625.1	Di-n-octyl phthalate
GC/MS	EPA 8270C/8270E/625.1	Fluoranthene
GC/MS	EPA 8270C/8270E/625.1	Fluorene
GC/MS	EPA 8270C/8270E/625.1	Hexachlorobenzene
GC/MS	EPA 8270C/8270E/625.1	Hexachlorobutadiene
GC/MS	EPA 8270C/8270E/625.1	Hexachlorocyclopentadiene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/8270E/625.1	Hexachloroethane
GC/MS	EPA 8270C/8270E/625.1	Indeno[1,2,3-cd]pyrene
GC/MS	EPA 8270C/8270E/625.1	Isophorone
GC/MS	EPA 8270C/8270E/625.1	Naphthalene
GC/MS	EPA 8270C/8270E/625.1	Nitrobenzene
GC/MS	EPA 8270C/8270E/625.1	N-Nitrosodimethylamine
GC/MS	EPA 8270C/8270E/625.1	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270C/8270E/625.1	N-Nitrosodiphenylamine
GC/MS	EPA 8270C/8270E/625.1	Pentachlorophenol
GC/MS	EPA 8270C/8270E/625.1	Phenanthrene
GC/MS	EPA 8270C/8270E/625.1	Phenol
GC/MS	EPA 8270C/8270E/625.1	Pyrene
GC/MS	EPA 8270C/8270E/625.1	Pyridine
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	1-Methylnaphthalene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	1,4-Dioxane
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	2-Methylnaphthalene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Acenaphthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Acenaphthylene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Anthracene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[a]anthracene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[a]pyrene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[b]fluoranthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[g,h,i]perylene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[k]fluoranthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Bis(2-ethylhexyl) phthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Chrysene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Dibenz(a,h)anthracene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Fluoranthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Fluorene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Indeno[1,2,3-cd]pyrene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Naphthalene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Pentachlorophenol
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Phenanthrene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Pyrene
GC-ECD	EPA 8011/504.1	1,2-Dibromoethane
GC-ECD	EPA 8011/504.1	1,2-Dibromo-3-Chloropropane
GC-ECD	EPA 8011/504.1	1,2,3-Trichloropropane
GC-ECD	EPA 8081A/8081B/608.3	2,4'-DDD
GC-ECD	EPA 8081A/8081B/608.3	2,4'-DDE
GC-ECD	EPA 8081A/8081B/608.3	2,4'-DDT
GC-ECD	EPA 8081A/8081B/608.3	Aldrin
GC-ECD	EPA 8081A/8081B/608.3	alpha-BHC
GC-ECD	EPA 8081A/8081B/608.3	beta-BHC
GC-ECD	EPA 8081A/8081B/608.3	Cis-Nonachlor
GC-ECD	EPA 8081A/8081B/608.3	delta-BHC
GC-ECD	EPA 8081A/8081B/608.3	Dieldrin
GC-ECD	EPA 8081A/8081B/608.3	Endosulfan I
GC-ECD	EPA 8081A/8081B/608.3	Endosulfan II
GC-ECD	EPA 8081A/8081B/608.3	Endosulfan sulfate
GC-ECD	EPA 8081A/8081B/608.3	Endrin
GC-ECD	EPA 8081A/8081B/608.3	Endrin aldehyde
GC-ECD	EPA 8081A/8081B/608.3	Endrin ketone
GC-ECD	EPA 8081A/8081B/608.3	gamma-BHC (Lindane)
GC-ECD	EPA 8081A/8081B/608.3	Heptachlor

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081A/8081B/608.3	Hexachlorobenzene
GC-ECD	EPA 8081A/8081B/608.3	Hexachlorobutadiene
GC-ECD	EPA 8081A/8081B/608.3	Methoxychlor
GC-ECD	EPA 8081A/8081B/608.3	Mirex
GC-ECD	EPA 8081A/8081B/608.3	Oxy-Chlordane
GC-ECD	EPA 8081A/8081B/608.3	Technical Chlordane
GC-ECD	EPA 8081A/8081B/608.3	Toxaphene
GC-ECD	EPA 8081A/8081B/608.3	Trans-Nonachlor
GC-ECD	EPA 8081A/8081B/608.3	4,4'-DDD
GC-ECD	EPA 8081A/8081B/608.3	4,4'-DDE
GC-ECD	EPA 8081A/8081B/608.3	4,4'-DDT
GC-ECD	EPA 8081A/8081B/608.3	alpha-Chlordane
GC-ECD	EPA 8081A/8081B/608.3	gamma-Chlordane
GC-ECD	EPA 8081A/8081B/608.3	Heptachlor epoxide
GC-ECD	EPA 8082/8082A/608.3	PCB-1016
GC-ECD	EPA 8082/8082A/608.3	PCB-1221
GC-ECD	EPA 8082/8082A/608.3	PCB-1232
GC-ECD	EPA 8082/8082A/608.3	PCB-1242
GC-ECD	EPA 8082/8082A/608.3	PCB-1248
GC-ECD	EPA 8082/8082A/608.3	PCB-1254
GC-ECD	EPA 8082/8082A/608.3	PCB-1260
GC-ECD	EPA 8082/8082A/608.3	PCB-1262
GC-ECD	EPA 8082/8082A/608.3	PCB-1268
GC-FID	EPA 8015B/8015D	Gasoline
GC/MS	EPA 8260B	Gasoline
GC-FID	AK101	Gasoline
GC/MS	AK101	Gasoline
GC-FID	NWTPH-Gx	Gasoline
GC/MS	NWTPH-Gx	Gasoline
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C5-C6)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C6-C8)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C8-C10)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C10-C12)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aromatic HCs >C8-C10)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aromatic HCs >C10-C12)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aromatic HCs >C12-C13)
GC-FID	EPA 8015B/8015D	Diesel
GC-FID	AK102	Diesel
GC-FID	NWTPH-Dx	Diesel
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic C8-C10)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C10-C12)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C12-C16)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C16-C21)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C21-C34)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic C8-C10)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C10-C12)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C12-C16)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C16-C21)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C21-C34)
GC-FID	EPA 8015B/8015D	Motor Oil
GC-FID	AK103	Motor Oil
GC-FID	NWTPH-Dx	Motor Oil
GC/MS	Organotins	Dibutyltin
GC/MS	Organotins	Monobutyltin
GC/MS	Organotins	Tetra-n-butyltin
GC/MS	Organotins	Tributyltin

Non-Potable Water		
Technology	**Method**	**Analyte**
Titration	EPA 310.1 / SM 2320B	Alkalinity
Titration	EPA 310.1 / SM 2320B	Carbonate Alkalinity
Titration	EPA 310.1 / SM 2320B	Bicarbonate Alkalinity
Colorimetric/ RFA	EPA 350.1/ SM 4500-NH3-G	Ammonia
Colorimetric / RFA	EPA 353.2	Nitrate + Nitrite
Probe	EPA 405.1 / SM 5210B	BOD
Titration	EPA 410.2 SM 5220C	COD
Colorimetric / RFA	SM 5220D 22nd Ed	COD
Gravimetric	EPA 1664A	Oil & Grease
Colorimetric/RFA	EPA 9012A	Total Cyanides
Colorimetric/RFA	EPA 9012B	Total Cyanides
Ion Chromatography	EPA 300.0/9056A	Bromide
Ion Chromatography	EPA 300.0/9056A	Chloride
Ion Chromatography	EPA 300.0/9056A	Fluoride
Ion Chromatography	EPA 300.0/9056A	Sulfate
Ion Chromatography	EPA 300.0/9056A	Nitrate
Ion Chromatography	EPA 300.0/9056A	Nitrite
TOC Analyzer (Combustion)	EPA 415.1/9060/9060A SM 5310B	TOC
TOC Analyzer (Combustion)	EPA 415.1/9060/9060A SM 5310B	DOC
Probe	EPA 9040B/9045C/150.1	pH
Gravimetric	EPA 160.1 SM 2540C	Total Dissolved Solids
Gravimetric	EPA 160.2 SM 2540D	Total Suspended Solids
Conductivity meter	EPA 120.1 SM 2510B	Specific Conductance
Setaflash	EPA 1020A	Flashpoint
CVGCAFS	EPA 1630	Methyl Mercury
CVAFS	EPA 1631E	Mercury
CVGCAA	EPA 1632A	Arsenite
CVGCAA	EPA 1632A	Inorganic Arsenic

Non-Potable Water		
Preparation	**Method**	**Type**
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	Semivolatile and Nonvolatile Organics
Purge and Trap	EPA 5030B	Volatile Organic Compounds
Acid Digestion (Aqueous)	EPA 3005A/3010A	Inorganics
TCLP Extraction	EPA 1311	Toxicity Characteristic Leaching Procedure
Florisil Cleanup	EPA 3620B	Cleanup of pesticide residues and other chlorinated hydrocarbons
Silica Gel Cleanup	EPA 3630C	Column Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup Reagent
Sulfuric Acid Cleanup	EPA 3665A	Cleanup for Quantization of PCBs

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010D	Silver
ICP-AES	EPA 6010B/6010D	Aluminum
ICP-AES	EPA 6010B/6010D	Arsenic
ICP-AES	EPA 6010B/6010D	Boron
ICP-AES	EPA 6010B/6010D	Barium
ICP-AES	EPA 6010B/6010D	Beryllium
ICP-AES	EPA 6010B/6010D	Calcium
ICP-AES	EPA 6010B/6010D	Cadmium
ICP-AES	EPA 6010B/6010D	Cobalt
ICP-AES	EPA 6010B/6010D	Chromium
ICP-AES	EPA 6010B/6010D	Copper
ICP-AES	EPA 6010B/6010D	Iron
ICP-AES	EPA 6010B/6010D	Potassium
ICP-AES	EPA 6010B/6010D	Magnesium
ICP-AES	EPA 6010B/6010D	Manganese
ICP-AES	EPA 6010B/6010D	Molybdenum
ICP-AES	EPA 6010B/6010D	Sodium
ICP-AES	EPA 6010B/6010D	Nickel
ICP-AES	EPA 6010B/6010D	Lead
ICP-AES	EPA 6010B/6010D	Antimony
ICP-AES	EPA 6010B/6010D	Selenium
ICP-AES	EPA 6010B/6010D	Silicon

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010B/6010D	Tin
ICP-AES	EPA 6010B/6010D	Titanium
ICP-AES	EPA 6010B/6010D	Strontium
ICP-AES	EPA 6010B/6010D	Thallium
ICP-AES	EPA 6010B/6010D	Vanadium
ICP-AES	EPA 6010B/6010D	Zinc
ICP-MS	EPA 6020/6020B	Silver
ICP-MS	EPA 6020/6020B	Aluminum
ICP-MS	EPA 6020/6020B	Arsenic
ICP-MS	EPA 6020/6020B	Barium
ICP-MS	EPA 6020/6020B	Beryllium
ICP-MS	EPA 6020/6020B	Cadmium
ICP-MS	EPA 6020/6020B	Cobalt
ICP-MS	EPA 6020/6020B	Chromium
ICP-MS	EPA 6020/6020B	Copper
ICP-MS	EPA 6020/6020B	Iron
ICP-MS	EPA 6020/6020B	Manganese
ICP-MS	EPA 6020/6020B	Molybdenum
ICP-MS	EPA 6020/6020B	Nickel
ICP-MS	EPA 6020/6020B	Lead
ICP-MS	EPA 6020/6020B	Antimony
ICP-MS	EPA 6020/6020B	Selenium
ICP-MS	EPA 6020/6020B	Thallium
ICP-MS	EPA 6020/6020B	Uranium
ICP-MS	EPA 6020/6020B	Vanadium
ICP-MS	EPA 6020/6020B	Zinc
CVAAS	EPA 7471A/7471B	Mercury
GC/MS	EPA 8260B/8260D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/8260D	1,1,1-Trichloroethane
GC/MS	EPA 8260B/8260D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/8260D	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/8260D	1,1,2-Trichloroethane
GC/MS	EPA 8260B/8260D	1,1-Dichloroethane
GC/MS	EPA 8260B/8260D	1,1-Dichloroethene
GC/MS	EPA 8260B/8260D	1,1-Dichloropropene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260D	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/8260D	1,2,3-Trichloropropane
GC/MS	EPA 8260B/8260D	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/8260D	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/8260D	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/8260D	1,2-Dibromo-3-Chloropropane
GC/MS	EPA 8260B/8260D	1,2-Dichlorobenzene
GC/MS	EPA 8260B/8260D	1,2-Dichloroethane
GC/MS	EPA 8260B/8260D	1,2-Dichloropropane
GC/MS	EPA 8260B/8260D	1,3-Dichloropropene, Total
GC/MS	EPA 8260B/8260D	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/8260D	1,3-Dichlorobenzene
GC/MS	EPA 8260B/8260D	1,3-Dichloropropane
GC/MS	EPA 8260B/8260D	1,4-Dichlorobenzene
GC/MS	EPA 8260B/8260D	2,2-Dichloropropane
GC/MS	EPA 8260B/8260D	2-Chloroethylvinylether
GC/MS	EPA 8260B/8260D	2-Chlorotoluene
GC/MS	EPA 8260B/8260D	2-Hexanone
GC/MS	EPA 8260B/8260D	2-Methyl-2-Propanol
GC/MS	EPA 8260B/8260D	4-Chlorotoluene
GC/MS	EPA 8260B/8260D	4-Isopropyltoluene
GC/MS	EPA 8260B/8260D	Acetone
GC/MS	EPA 8260B/8260D	Acetonitrile
GC/MS	EPA 8260B/8260D	Acrolein
GC/MS	EPA 8260B/8260D	Acrylonitrile
GC/MS	EPA 8260B/8260D	Benzene
GC/MS	EPA 8260B/8260D	Bromobenzene
GC/MS	EPA 8260B/8260D	Bromodichloromethane
GC/MS	EPA 8260B/8260D	Bromoform
GC/MS	EPA 8260B/8260D	Bromomethane
GC/MS	EPA 8260B/8260D	Carbon disulfide
GC/MS	EPA 8260B/8260D	Carbon tetrachloride
GC/MS	EPA 8260B/8260D	Chlorobenzene
GC/MS	EPA 8260B/8260D	Chlorobromomethane
GC/MS	EPA 8260B/8260D	Chlorodibromomethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260D	Chloroethane
GC/MS	EPA 8260B/8260D	Chloroform
GC/MS	EPA 8260B/8260D	Chloromethane
GC/MS	EPA 8260B/8260D	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/8260D	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/8260D	Cyclohexane
GC/MS	EPA 8260B/8260D	Dibromomethane
GC/MS	EPA 8260B/8260D	Dichlorodifluoromethane
GC/MS	EPA 8260B/8260D	Ethylbenzene
GC/MS	EPA 8260B/8260D	Ethylene Dibromide
GC/MS	EPA 8260B/8260D	Ethyl ether
GC/MS	EPA 8260B/8260D	Hexachlorobutadiene
GC/MS	EPA 8260B/8260D	Isopropylbenzene
GC/MS	EPA 8260B/8260D	Iodomethane
GC/MS	EPA 8260B/8260D	Isopropyl ether
GC/MS	EPA 8260B/8260D	Methacrylonitrile
GC/MS	EPA 8260B/8260D	Methyl acetate
GC/MS	EPA 8260B/8260D	Methyl Ethyl Ketone
GC/MS	EPA 8260B/8260D	Methyl Isobutyl Ketone
GC/MS	EPA 8260B/8260D	Methyl tert-butyl ether
GC/MS	EPA 8260B/8260D	Methylcyclohexane
GC/MS	EPA 8260B/8260D	Methylene Chloride
GC/MS	EPA 8260B/8260D	m-Xylene & p-Xylene
GC/MS	EPA 8260B/8260D	Naphthalene
GC/MS	EPA 8260B/8260D	n-Butanol
GC/MS	EPA 8260B/8260D	n-Butylbenzene
GC/MS	EPA 8260B/8260D	n-Hexane
GC/MS	EPA 8260B/8260D	N-Propylbenzene
GC/MS	EPA 8260B/8260D	o-Xylene
GC/MS	EPA 8260B/8260D	sec-Butylbenzene
GC/MS	EPA 8260B/8260D	Styrene
GC/MS	EPA 8260B/8260D	tert-Butylbenzene
GC/MS	EPA 8260B/8260D	Tert-amyl methyl ether
GC/MS	EPA 8260B/8260D	Tert-butyl ethyl ether
GC/MS	EPA 8260B/8260D	Tetrachloroethene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/8260D	Tetrahydrofuran
GC/MS	EPA 8260B/8260D	Toluene
GC/MS	EPA 8260B/8260D	Total Xylenes
GC/MS	EPA 8260B/8260D	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/8260D	trans-1,3-Dichloropropene
GC/MS	EPA 8260B/8260D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/8260D	Trichloroethene
GC/MS	EPA 8260B/8260D	Trichlorofluoromethane
GC/MS	EPA 8260B/8260D	Vinyl Acetate
GC/MS	EPA 8260B/8260D	Vinyl chloride
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1,1,2-Tetrachloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1,2,2-Tetrachloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1,2-Trichloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,2,4-Trimethylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1, 2-Dibromoethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,1-Dichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,2-Dichloroethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,3,5-Trimethylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	1,4-Dichlorobenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	2-Hexanone
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Benzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Bromoform
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Bromomethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Butadiene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Chlorodibromomethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Chloroform
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	cis-1,2-Dichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	cis-1,3-Dichloropropene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Dibromomethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Ethylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Bromodichloromethane
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Ethylene Dibromide
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Hexachlorobutadiene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Isopropylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Isopropyl alcohol
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	m&p-Xylene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Methyl tert-Butyl Ether
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Naphthalene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	n-Butylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	o-Xylene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Sec-Butylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Tert-Butylbenzene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Tetrachloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Toluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Trans-1,2-Dichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	trans-1,3-Dichloropropene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Trichloroethene
GC/MS SIM	EPA 8260B SIM EPA 8260D SIM	Vinyl chloride
GC/MS	EPA 8270C/8270E	1-Methylnaphthalene
GC/MS	EPA 8270C/8270E	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/8270E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/8270E	1,2-Dichlorobenzene
GC/MS	EPA 8270C/8270E	1,3-Dichlorobenzene
GC/MS	EPA 8270C/8270E	1,4-Dichlorobenzene
GC/MS	EPA 8270C/8270E	bis(2-chloroisopropyl)ether
GC/MS	EPA 8270C/8270E	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/8270E	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/8270E	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/8270E	2,4-Dichlorophenol
GC/MS	EPA 8270C/8270E	2,4-Dimethylphenol
GC/MS	EPA 8270C/8270E	2,4-Dinitrophenol
GC/MS	EPA 8270C/8270E	2,4-Dinitrotoluene
GC/MS	EPA 8270C/8270E	2,6-Dinitrotoluene
GC/MS	EPA 8270C/8270E	2-Chloronaphthalene
GC/MS	EPA 8270C/8270E	2-Chlorophenol
GC/MS	EPA 8270C/8270E	2-Methylnaphthalene
GC/MS	EPA 8270C/8270E	2-Methylphenol
GC/MS	EPA 8270C/8270E	2-Nitroaniline
GC/MS	EPA 8270C/8270E	2-Nitrophenol
GC/MS	EPA 8270C/8270E	3 & 4 Methylphenol
GC/MS	EPA 8270C/8270E	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/8270E	3-Nitroaniline
GC/MS	EPA 8270C/8270E	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/8270E	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/8270E	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/8270E	4-Chloroaniline

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/8270E	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/8270E	4-Nitroaniline
GC/MS	EPA 8270C/8270E	4-Nitrophenol
GC/MS	EPA 8270C/8270E	Acenaphthene
GC/MS	EPA 8270C/8270E	Acenaphthylene
GC/MS	EPA 8270C/8270E	Aniline
GC/MS	EPA 8270C/8270E	Anthracene
GC/MS	EPA 8270C/8270E	1,2-Diphenylhydrazine as Azobenzene
GC/MS	EPA 8270C/8270E	Benzo[a]anthracene
GC/MS	EPA 8270C/8270E	Benzo[a]pyrene
GC/MS	EPA 8270C/8270E	Benzo[b]fluoranthene
GC/MS	EPA 8270C/8270E	Benzo[g,h,i]perylene
GC/MS	EPA 8270C/8270E	Benzo[k]fluoranthene
GC/MS	EPA 8270C/8270E	Benzoic acid
GC/MS	EPA 8270C/8270E	Benzyl alcohol
GC/MS	EPA 8270C/8270E	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/8270E	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/8270E	Bis(2-ethylhexyl) phthalate
GC/MS	EPA 8270C/8270E	Butyl benzyl phthalate
GC/MS	EPA 8270C/8270E	Carbazole
GC/MS	EPA 8270C/8270E	Chrysene
GC/MS	EPA 8270C/8270E	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/8270E	Dibenzofuran
GC/MS	EPA 8270C/8270E	Diethyl phthalate
GC/MS	EPA 8270C/8270E	Dimethyl phthalate
GC/MS	EPA 8270C/8270E	Di-n-butyl phthalate
GC/MS	EPA 8270C/8270E	Di-n-octyl phthalate
GC/MS	EPA 8270C/8270E	Fluoranthene
GC/MS	EPA 8270C/8270E	Fluorene
GC/MS	EPA 8270C/8270E	Hexachlorobenzene
GC/MS	EPA 8270C/8270E	Hexachlorobutadiene
GC/MS	EPA 8270C/8270E	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/8270E	Hexachloroethane
GC/MS	EPA 8270C/8270E	Indeno[1,2,3-cd]pyrene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/8270E	Isophorone
GC/MS	EPA 8270C/8270E	Naphthalene
GC/MS	EPA 8270C/8270E	Nitrobenzene
GC/MS	EPA 8270C/8270E	N-Nitrosodimethylamine
GC/MS	EPA 8270C/8270E	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270C/8270E	N-Nitrosodiphenylamine
GC/MS	EPA 8270C/8270E	Pentachlorophenol
GC/MS	EPA 8270C/8270E	Phenanthrene
GC/MS	EPA 8270C/8270E	Phenol
GC/MS	EPA 8270C/8270E	Pyrene
GC/MS	EPA 8270C/8270E	Pyridine
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	1-Methylnaphthalene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	1,4-Dioxane
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	2-Methylnaphthalene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Acenaphthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Acenaphthylene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Anthracene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[a]anthracene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[a]pyrene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[b]fluoranthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[g,h,i]perylene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Benzo[k]fluoranthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Bis(2-ethylhexyl) phthalate
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Chrysene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Dibenz(a,h)anthracene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Fluoranthene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Fluorene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Indeno[1,2,3-cd]pyrene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Naphthalene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Pentachlorophenol
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Phenanthrene
GC/MS SIM	EPA 8270C SIM EPA 8270E SIM	Pyrene
GC-ECD	EPA 8011	1,2-Dibromoethane
GC-ECD	EPA 8011	1,2-Dibromo-3-Chloropropane
GC-ECD	EPA 8011	1,2,3-Trichloropropane
GC-ECD	EPA 8081A/8081B	2,4'-DDD
GC-ECD	EPA 8081A/8081B	2,4'-DDE
GC-ECD	EPA 8081A/8081B	2,4'-DDT
GC-ECD	EPA 8081A/8081B	4,4'-DDD
GC-ECD	EPA 8081A/8081B	4,4'-DDE
GC-ECD	EPA 8081A/8081B	4,4'-DDT
GC-ECD	EPA 8081A/8081B	Aldrin
GC-ECD	EPA 8081A/8081B	alpha-BHC
GC-ECD	EPA 8081A/8081B	alpha-Chlordane
GC-ECD	EPA 8081A/8081B	beta-BHC
GC-ECD	EPA 8081A/8081B	delta-BHC
GC-ECD	EPA 8081A/8081B	Cis-Nonchlor
GC-ECD	EPA 8081A/8081B	Dieldrin
GC-ECD	EPA 8081A/8081B	Endosulfan I
GC-ECD	EPA 8081A/8081B	Endosulfan II
GC-ECD	EPA 8081A/8081B	Endosulfan sulfate
GC-ECD	EPA 8081A/8081B	Endrin

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081A/8081B	Endrin aldehyde
GC-ECD	EPA 8081A/8081B	Endrin ketone
GC-ECD	EPA 8081A/8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081A/8081B	gamma-Chlordane
GC-ECD	EPA 8081A/8081B	Heptachlor
GC-ECD	EPA 8081A/8081B	Heptachlor epoxide
GC-ECD	EPA 8081A/8081B	Hexachlorobenzene
GC-ECD	EPA 8081A/8081B	Hexachlorobutadiene
GC-ECD	EPA 8081A/8081B	Methoxychlor
GC-ECD	EPA 8081A/8081B	Mirex
GC-ECD	EPA 8081A/8081B	Oxy-Chlordane
GC-ECD	EPA 8081A/8081B	Technical Chlordane
GC-ECD	EPA 8081A/8081B	Toxaphene
GC-ECD	EPA 8081A/8081B	Trans-Nonachlor
GC-ECD	EPA 8082/8082A	PCB-1016
GC-ECD	EPA 8082/8082A	PCB-1221
GC-ECD	EPA 8082/8082A	PCB-1232
GC-ECD	EPA 8082/8082A	PCB-1242
GC-ECD	EPA 8082/8082A	PCB-1248
GC-ECD	EPA 8082/8082A	PCB-1254
GC-ECD	EPA 8082/8082A	PCB-1260
GC-ECD	EPA 8082/8082A	PCB-1262
GC-ECD	EPA 8082/8082A	PCB-1268
GC-FID	EPA 8015B/8015D	Gasoline
GC/MS	EPA 8260B	Gasoline
GC-FID	AK101	Gasoline
GC/MS	AK101	Gasoline
GC-FID	NWTPH-Gx	Gasoline
GC/MS	NWTPH-Gx	Gasoline
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C5-C6)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C6-C8)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C8-C10)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aliphatic HCs >C10-C12)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aromatic HCs >C8-C10)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aromatic HCs >C10-C12)
GC-FID	NWVPH	Volatile Petroleum Hydrocarbons (aromatic HCs >C12-C13)
GC-FID	EPA 8015B/8015D	Diesel
GC-FID	AK102	Diesel
GC-FID	NWTPH-Dx	Diesel
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic C8-C10)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C10-C12)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C12-C16)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C16-C21)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aliphatic >C21-C34)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic 8-C10)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C10-C12)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C12-C16)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C16-C21)
GC-FID	NWEPH	Extractable Petroleum Hydrocarbons (aromatic >C21-C34)
GC-FID	EPA 8015B/8015D	Motor Oil
GC-FID	AK103	Motor Oil
GC-FID	NWTPH-Dx	Motor Oil
GC/MS	Organotins	Dibutyltin
GC/MS	Organotins	Monobutyltin
GC/MS	Organotins	Tetra-n-butyltin

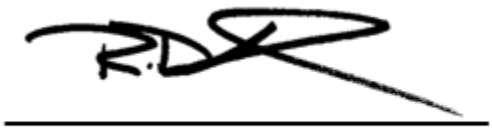
Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	Organotins	Tributyltin
Gravimetric	ASTM D422-63/D7928/D6913	Grain Size
Colorimetric/RFA	EPA 9012A	Total Cyanides
Colorimetric/RFA	EPA 9012B	Total Cyanides
Colorimetric/RFA	EPA 350.1	Ammonia
Ion Chromatography	EPA 300.0/9056A	Bromide
Ion Chromatography	EPA 300.0/9056A	Chloride
Ion Chromatography	EPA 300.0/9056A	Fluoride
Ion Chromatography	EPA 300.0/9056A	Sulfate
Ion Chromatography	EPA 300.0/9056A	Nitrate
Ion Chromatography	EPA 300.0/9056A	Nitrite
CVGCAFS	EPA 1630 MOD/SOP 2808	Methyl Mercury
CVAFS	EPA 1631B	Mercury
CVGCAA	EPA 1632A MOD	Arsenite
CVGCAA	EPA 1632A MOD	Inorganic Arsenic
TOC Analyzer (Combustion)	EPA 9060/9060A	TOC
Probe	EPA 9040B/9045C	pH/Corrosivity
Setaflash	EPA 1020A	Flashpoint
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	Semivolatile and Nonvolatile Organics in leachates
Microwave Extraction	EPA 3546	Semivolatile and Nonvolatile Organics
Solvent Dilution	EPA 3580A	Semivolatile and Nonvolatile Organics
Waste Dilution	EPA 3585	Volatile Organic Compounds
Purge and Trap	EPA 5030B	Volatile Organic Compounds
Purge and Trap	EPA 5035A	Volatile Organic Compounds
Acid Digestion (Aqueous)	EPA 3005A/3010A	Inorganics in leachates
Acid Digestion (Sediments, Sludges, Soils)	EPA 3050B	Inorganics
TCLP Extraction	EPA 1311	Toxicity Characteristic Leaching Procedure
Florisil Cleanup	EPA 3620B	Cleanup of pesticide residues and other chlorinated hydrocarbons
Silica Gel Cleanup	EPA 3630C	Column Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup Reagent
Sulfuric Acid Cleanup	EPA 3665A	Cleanup for Quantitation of PCBs

Air and Emissions		
Technology	**Method**	**Analyte**
CVAFS	EPA 30B EPA 12B SOP5143	Total Gaseous Mercury

Biological Tissue		
Technology	**Method**	**Analyte**
CVGCAFS	EPA 1630 MOD/SOP2808	Methyl Mercury
CVAFS	EPA 1631B	Mercury
CVGCAA	EPA 1632A	Arsenite
CVGCAA	EPA 1632A	Inorganic Arsenic

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2236.



R. Douglas Leonard Jr., VP, PILR SBU

Texas Commission on Environmental Quality

NELAP-Recognized Laboratory Accreditation is hereby awarded to

Eurofins Xenco Corpus Christi

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329

in accordance with Texas Water Code Chapter 5, Subchapter R, Title 30 Texas Administrative Code Chapter 25, and the National Environmental Laboratory Accreditation Program.

The laboratory's scope of accreditation includes the fields of accreditation that accompany this certificate. Continued accreditation depends upon successful ongoing participation in the program. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current location(s) and accreditation status for particular methods and analyses (www.tceq.texas.gov/goto/lab). Accreditation does not imply that a product, process, system or person is approved by the Texas Commission on Environmental Quality.

Certificate Number: T104704210-21-28
Effective Date: 7/15/2021
Expiration Date: 3/31/2022

Executive Director Texas Commission on Environmental Quality

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

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These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Non-Potable Water***

Method EPA 1010

Analyte	AB	Analyte ID	Method ID
Ignitability	TX	1780	10116606

Method EPA 110.2

Analyte	AB	Analyte ID	Method ID
Color	TX	1605	10005604

Method EPA 1110

Analyte	AB	Analyte ID	Method ID
Corrosivity	TX	1615	10118000

Method EPA 120.1

Analyte	AB	Analyte ID	Method ID
Conductivity	TX	1610	10006403

Method EPA 1311

Analyte	AB	Analyte ID	Method ID
TCLP	TX	849	10118806

Method EPA 1312

Analyte	AB	Analyte ID	Method ID
SPLP	TX	850	10119003

Method EPA 160.2

Analyte	AB	Analyte ID	Method ID
Residue-nonfilterable (TSS)	TX	1960	10009606

Method EPA 160.3

Analyte	AB	Analyte ID	Method ID
Residue-total (total solids)	TX	1950	10010001

Method EPA 1664

Analyte	AB	Analyte ID	Method ID
n-Hexane Extractable Material (HEM) (O&G)	TX	1803	10127807
Silica Gel Treated n-Hexane Extractable Material (SGT-HEM)	TX	10220	10127807

Method EPA 200.7

Analyte	AB	Analyte ID	Method ID
Aluminum	TX	1000	10013806
Antimony	TX	1005	10013806

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Matrix: ***Non-Potable Water***

Arsenic	TX	1010	10013806
Barium	TX	1015	10013806
Beryllium	TX	1020	10013806
Boron	TX	1025	10013806
Cadmium	TX	1030	10013806
Calcium	TX	1035	10013806
Chromium	TX	1040	10013806
Cobalt	TX	1050	10013806
Copper	TX	1055	10013806
Iron	TX	1070	10013806
Lead	TX	1075	10013806
Lithium	TX	1080	10013806
Magnesium	TX	1085	10013806
Manganese	TX	1090	10013806
Molybdenum	TX	1100	10013806
Nickel	TX	1105	10013806
Phosphorus	TX	1910	10013806
Potassium	TX	1125	10013806
Selenium	TX	1140	10013806
Silica as SiO2	TX	1990	10013806
Silver	TX	1150	10013806
Sodium	TX	1155	10013806
Strontium	TX	1160	10013806
Thallium	TX	1165	10013806
Tin	TX	1175	10013806
Titanium	TX	1180	10013806
Vanadium	TX	1185	10013806
Zinc	TX	1190	10013806

Method EPA 245.2

Analyte	**AB**	**Analyte ID**	**Method ID**

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Matrix: ***Non-Potable Water***

Mercury	TX	1095	10271406

Method EPA 300.0

Analyte	**AB**	**Analyte ID**	**Method ID**
Bromide	TX	1540	10053200
Chloride	TX	1575	10053200
Nitrate as N	TX	1810	10053200
Nitrate-nitrite	TX	1820	10053200
Nitrite as N	TX	1840	10053200
Sulfate	TX	2000	10053200

Method EPA 310.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Alkalinity as CaCO3	TX	1505	10054805

Method EPA 330.4

Analyte	**AB**	**Analyte ID**	**Method ID**
Total residual chlorine	TX	1940	10059208

Method EPA 340.2

Analyte	**AB**	**Analyte ID**	**Method ID**
Fluoride	TX	1730	10062201

Method EPA 350.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Ammonia as N	TX	1515	10063408

Method EPA 365.3

Analyte	**AB**	**Analyte ID**	**Method ID**
Orthophosphate as P	TX	1870	10070801

Method EPA 376.2

Analyte	**AB**	**Analyte ID**	**Method ID**
Sulfide	TX	2005	10074609

Method EPA 415.1

Analyte	**AB**	**Analyte ID**	**Method ID**
Total Organic Carbon (TOC)	TX	2040	10078407

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Matrix: ***Non-Potable Water***

Method EPA 6010

Analyte	AB	Analyte ID	Method ID
Aluminum	TX	1000	10155609
Antimony	TX	1005	10155609
Arsenic	TX	1010	10155609
Barium	TX	1015	10155609
Beryllium	TX	1020	10155609
Boron	TX	1025	10155609
Cadmium	TX	1030	10155609
Calcium	TX	1035	10155609
Chromium	TX	1040	10155609
Cobalt	TX	1050	10155609
Copper	TX	1055	10155609
Iron	TX	1070	10155609
Lead	TX	1075	10155609
Lithium	TX	1080	10155609
Magnesium	TX	1085	10155609
Manganese	TX	1090	10155609
Molybdenum	TX	1100	10155609
Nickel	TX	1105	10155609
Phosphorus	TX	1910	10155609
Potassium	TX	1125	10155609
Selenium	TX	1140	10155609
Silica as SiO2	TX	1990	10155609
Silver	TX	1150	10155609
Sodium	TX	1155	10155609
Strontium	TX	1160	10155609
Thallium	TX	1165	10155609
Tin	TX	1175	10155609
Titanium	TX	1180	10155609

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Matrix: ***Non-Potable Water***

Vanadium	TX	1185	10155609
Zinc	TX	1190	10155609

Method EPA 624

Analyte	AB	Analyte ID	Method ID
1,1,1-Trichloroethane	TX	5160	10107207
1,1,2,2-Tetrachloroethane	TX	5110	10107207
1,1,2-Trichloroethane	TX	5165	10107207
1,1-Dichloroethane	TX	4630	10107207
1,1-Dichloroethylene	TX	4640	10107207
1,2-Dibromoethane (EDB, Ethylene dibromide)	TX	4585	10107207
1,2-Dichlorobenzene	TX	4610	10107207
1,2-Dichloroethane (Ethylene dichloride)	TX	4635	10107207
1,2-Dichloropropane	TX	4655	10107207
1,3-Dichlorobenzene	TX	4615	10107207
1,4-Dichlorobenzene	TX	4620	10107207
2-Butanone (Methyl ethyl ketone, MEK)	TX	4410	10107207
2-Chloroethyl vinyl ether	TX	4500	10107207
Acetone (2-Propanone)	TX	4315	10107207
Acrolein (Propenal)	TX	4325	10107207
Acrylonitrile	TX	4340	10107207
Benzene	TX	4375	10107207
Bromodichloromethane	TX	4395	10107207
Bromoform	TX	4400	10107207
Carbon tetrachloride	TX	4455	10107207
Chlorobenzene	TX	4475	10107207
Chlorodibromomethane	TX	4575	10107207
Chloroethane (Ethyl chloride)	TX	4485	10107207
Chloroform	TX	4505	10107207
cis-1,2-Dichloroethylene	TX	4645	10107207
cis-1,3-Dichloropropene	TX	4680	10107207

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Matrix: ***Non-Potable Water***

Ethylbenzene	TX	4765	10107207
m+p-xylene	TX	5240	10107207
Methyl bromide (Bromomethane)	TX	4950	10107207
Methyl chloride (Chloromethane)	TX	4960	10107207
Methyl tert-butyl ether (MTBE)	TX	5000	10107207
Methylene chloride (Dichloromethane)	TX	4975	10107207
Naphthalene	TX	5005	10107207
o-Xylene	TX	5250	10107207
Tetrachloroethylene (Perchloroethylene)	TX	5115	10107207
Toluene	TX	5140	10107207
Total trihalomethanes	TX	5205	10107207
trans-1,2-Dichloroethylene	TX	4700	10107207
trans-1,3-Dichloropropylene	TX	4685	10107207
Trichloroethene (Trichloroethylene)	TX	5170	10107207
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	TX	5175	10107207
Vinyl chloride	TX	5235	10107207
Xylene (total)	TX	5260	10107207

Method EPA 624.1

Analyte	AB	Analyte ID	Method ID
1,1,1-Trichloroethane	TX	5160	10298121
1,1,2,2-Tetrachloroethane	TX	5110	10298121
1,1,2-Trichloroethane	TX	5165	10298121
1,1-Dichloroethane	TX	4630	10298121
1,1-Dichloroethylene	TX	4640	10298121
1,2-Dibromoethane (EDB, Ethylene dibromide)	TX	4585	10298121
1,2-Dichlorobenzene	TX	4610	10298121
1,2-Dichloroethane (Ethylene dichloride)	TX	4635	10298121
1,2-Dichloropropane	TX	4655	10298121
1,3-Dichlorobenzene	TX	4615	10298121
1,4-Dichlorobenzene	TX	4620	10298121

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

Eurofins Xenco Corpus Christi
Expiration Date: 3/31/2022

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
Issue Date: 7/15/2021

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Matrix: ***Non-Potable Water***

2-Butanone (Methyl ethyl ketone, MEK)	TX	4410	10298121
2-Chloroethyl vinyl ether	TX	4500	10298121
Acetone (2-Propanone)	TX	4315	10298121
Acrolein (Propenal)	TX	4325	10298121
Acrylonitrile	TX	4340	10298121
Benzene	TX	4375	10298121
Bromodichloromethane	TX	4395	10298121
Bromoform	TX	4400	10298121
Carbon tetrachloride	TX	4455	10298121
Chlorobenzene	TX	4475	10298121
Chlorodibromomethane	TX	4575	10298121
Chloroethane (Ethyl chloride)	TX	4485	10298121
Chloroform	TX	4505	10298121
cis-1,2-Dichloroethylene	TX	4645	10298121
cis-1,3-Dichloropropene	TX	4680	10298121
Ethylbenzene	TX	4765	10298121
m+p-xylene	TX	5240	10298121
Methyl bromide (Bromomethane)	TX	4950	10298121
Methyl chloride (Chloromethane)	TX	4960	10298121
Methyl tert-butyl ether (MTBE)	TX	5000	10298121
Methylene chloride (Dichloromethane)	TX	4975	10298121
Naphthalene	TX	5005	10298121
o-Xylene	TX	5250	10298121
Tetrachloroethylene (Perchloroethylene)	TX	5115	10298121
Toluene	TX	5140	10298121
Total trihalomethanes	TX	5205	10298121
trans-1,2-Dichloroethylene	TX	4700	10298121
trans-1,3-Dichloropropylene	TX	4685	10298121
Trichloroethene (Trichloroethylene)	TX	5170	10298121
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	TX	5175	10298121

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28
Expiration Date: 3/31/2022
Issue Date: 7/15/2021

Eurofins Xenco Corpus Christi

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329

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Matrix: ***Non-Potable Water***

Vinyl chloride	TX	5235	10298121
Xylene (total)	TX	5260	10298121

Method EPA 625

Analyte	AB	Analyte ID	Method ID
1,2,4,5-Tetrachlorobenzene	TX	6715	10107401
1,2,4-Trichlorobenzene	TX	5155	10107401
1,2-Dichlorobenzene	TX	4610	10107401
1,2-Diphenylhydrazine	TX	6220	10107401
1,3-Dichlorobenzene	TX	4615	10107401
1,4-Dichlorobenzene	TX	4620	10107401
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	TX	4659	10107401
2,3,4,6-Tetrachlorophenol	TX	6735	10107401
2,4,5-Trichlorophenol	TX	6835	10107401
2,4,6-Trichlorophenol	TX	6840	10107401
2,4-Dichlorophenol	TX	6000	10107401
2,4-Dimethylphenol	TX	6130	10107401
2,4-Dinitrophenol	TX	6175	10107401
2,4-Dinitrotoluene (2,4-DNT)	TX	6185	10107401
2,6-Dinitrotoluene (2,6-DNT)	TX	6190	10107401
2-Chloronaphthalene	TX	5795	10107401
2-Chlorophenol	TX	5800	10107401
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	TX	6360	10107401
2-Methylphenol (o-Cresol)	TX	6400	10107401
2-Nitrophenol	TX	6490	10107401
3,3'-Dichlorobenzidine	TX	5945	10107401
4-Bromophenyl phenyl ether (BDE-3)	TX	5660	10107401
4-Chloro-3-methylphenol	TX	5700	10107401
4-Chlorophenyl phenylether	TX	5825	10107401
4-Methylphenol (p-Cresol)	TX	6410	10107401
4-Nitrophenol	TX	6500	10107401

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

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Expiration Date: 3/31/2022

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
Issue Date: 7/15/2021

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Matrix: ***Non-Potable Water***

Acenaphthene	TX	5500	10107401
Acenaphthylene	TX	5505	10107401
Anthracene	TX	5555	10107401
Benzidine	TX	5595	10107401
Benzo(a)anthracene	TX	5575	10107401
Benzo(a)pyrene	TX	5580	10107401
Benzo(b)fluoranthene	TX	5585	10107401
Benzo(g,h,i)perylene	TX	5590	10107401
Benzo(k)fluoranthene	TX	5600	10107401
bis(2-Chloroethoxy)methane	TX	5760	10107401
bis(2-Chloroethyl) ether	TX	5765	10107401
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	TX	6065	10107401
Butyl benzyl phthalate	TX	5670	10107401
Chrysene	TX	5855	10107401
Dibenz(a,h) anthracene	TX	5895	10107401
Diethyl phthalate	TX	6070	10107401
Dimethyl phthalate	TX	6135	10107401
Di-n-butyl phthalate	TX	5925	10107401
Di-n-octyl phthalate	TX	6200	10107401
Fluoranthene	TX	6265	10107401
Fluorene	TX	6270	10107401
Hexachlorobenzene	TX	6275	10107401
Hexachlorobutadiene	TX	4835	10107401
Hexachlorocyclopentadiene	TX	6285	10107401
Hexachloroethane	TX	4840	10107401
Indeno(1,2,3-cd) pyrene	TX	6315	10107401
Isophorone	TX	6320	10107401
Naphthalene	TX	5005	10107401
Nitrobenzene	TX	5015	10107401
n-Nitrosodiethylamine	TX	6525	10107401

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

Eurofins Xenco Corpus Christi
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1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
Issue Date: 7/15/2021

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Matrix: ***Non-Potable Water***

n-Nitrosodimethylamine	TX	6530	10107401
n-Nitrosodi-n-butylamine	TX	5025	10107401
n-Nitrosodi-n-propylamine	TX	6545	10107401
n-Nitrosodiphenylamine	TX	6535	10107401
Pentachlorobenzene	TX	6590	10107401
Pentachlorophenol	TX	6605	10107401
Phenanthrene	TX	6615	10107401
Phenol	TX	6625	10107401
Pyrene	TX	6665	10107401
Pyridine	TX	5095	10107401

Method EPA 625.1

Analyte	AB	Analyte ID	Method ID
1,2,4,5-Tetrachlorobenzene	TX	6715	10300024
1,2,4-Trichlorobenzene	TX	5155	10300024
1,2-Dichlorobenzene	TX	4610	10300024
1,2-Diphenylhydrazine	TX	6221	10300024
1,3-Dichlorobenzene	TX	4615	10300024
1,4-Dichlorobenzene	TX	4620	10300024
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	TX	4659	10300024
2,3,4,6-Tetrachlorophenol	TX	6735	10300024
2,4,5-Trichlorophenol	TX	6835	10300024
2,4,6-Trichlorophenol	TX	6840	10300024
2,4-Dichlorophenol	TX	6000	10300024
2,4-Dimethylphenol	TX	6130	10300024
2,4-Dinitrophenol	TX	6175	10300024
2,4-Dinitrotoluene (2,4-DNT)	TX	6185	10300024
2,6-Dinitrotoluene (2,6-DNT)	TX	6190	10300024
2-Chloronaphthalene	TX	5795	10300024
2-Chlorophenol	TX	5800	10300024
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	TX	6360	10300024

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

Eurofins Xenco Corpus Christi
Expiration Date: 3/31/2022

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
Issue Date: 7/15/2021

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Matrix: ***Non-Potable Water***

2-Methylphenol (o-Cresol)	TX	6400	10300024
2-Nitrophenol	TX	6490	10300024
3,3'-Dichlorobenzidine	TX	5945	10300024
4-Bromophenyl phenyl ether (BDE-3)	TX	5660	10300024
4-Chloro-3-methylphenol	TX	5700	10300024
4-Chlorophenyl phenylether	TX	5825	10300024
4-Methylphenol (p-Cresol)	TX	6410	10300024
4-Nitrophenol	TX	6500	10300024
Acenaphthene	TX	5500	10300024
Acenaphthylene	TX	5505	10300024
Anthracene	TX	5555	10300024
Benzidine	TX	5595	10300024
Benzo(a)anthracene	TX	5575	10300024
Benzo(a)pyrene	TX	5580	10300024
Benzo(b)fluoranthene	TX	5585	10300024
Benzo(g,h,i)perylene	TX	5590	10300024
Benzo(k)fluoranthene	TX	5600	10300024
bis(2-Chloroethoxy)methane	TX	5760	10300024
bis(2-Chloroethyl) ether	TX	5765	10300024
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	TX	6065	10300024
Butyl benzyl phthalate	TX	5670	10300024
Chrysene	TX	5855	10300024
Dibenz(a,h) anthracene	TX	5895	10300024
Diethyl phthalate	TX	6070	10300024
Dimethyl phthalate	TX	6135	10300024
Di-n-butyl phthalate	TX	5925	10300024
Di-n-octyl phthalate	TX	6200	10300024
Fluoranthene	TX	6265	10300024
Fluorene	TX	6270	10300024
Hexachlorobenzene	TX	6275	10300024

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28
Expiration Date: 3/31/2022
Issue Date: 7/15/2021

Eurofins Xenco Corpus Christi
1733 North Padre Island Drive
Corpus Christi, TX 78408-2329

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Matrix: ***Non-Potable Water***

Hexachlorobutadiene	TX	4835	10300024
Hexachlorocyclopentadiene	TX	6285	10300024
Hexachloroethane	TX	4840	10300024
Indeno(1,2,3-cd) pyrene	TX	6315	10300024
Isophorone	TX	6320	10300024
Naphthalene	TX	5005	10300024
Nitrobenzene	TX	5015	10300024
n-Nitrosodiethylamine	TX	6525	10300024
n-Nitrosodimethylamine	TX	6530	10300024
n-Nitrosodi-n-butylamine	TX	5025	10300024
n-Nitrosodi-n-propylamine	TX	6545	10300024
n-Nitrosodiphenylamine	TX	6535	10300024
Pentachlorobenzene	TX	6590	10300024
Pentachlorophenol	TX	6605	10300024
Phenanthrene	TX	6615	10300024
Phenol	TX	6625	10300024
Pyrene	TX	6665	10300024
Pyridine	TX	5095	10300024

Method EPA 7196

Analyte	**AB**	**Analyte ID**	**Method ID**
Chromium (VI)	TX	1045	10162400

Method EPA 7470

Analyte	**AB**	**Analyte ID**	**Method ID**
Mercury	TX	1095	10165807

Method EPA 7471

Analyte	**AB**	**Analyte ID**	**Method ID**
Mercury	TX	1095	10166208

Method EPA 8082

Analyte	**AB**	**Analyte ID**	**Method ID**
Aroclor-1016 (PCB-1016)	TX	8880	10179007
Aroclor-1221 (PCB-1221)	TX	8885	10179007

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

Eurofins Xenco Corpus Christi
Expiration Date: 3/31/2022

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
Issue Date: 7/15/2021

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Matrix: ***Non-Potable Water***

Aroclor-1232 (PCB-1232)	TX	8890	10179007
Aroclor-1242 (PCB-1242)	TX	8895	10179007
Aroclor-1248 (PCB-1248)	TX	8900	10179007
Aroclor-1254 (PCB-1254)	TX	8905	10179007
Aroclor-1260 (PCB-1260)	TX	8910	10179007

Method EPA 8260

Analyte	**AB**	**Analyte ID**	**Method ID**
1,1,1,2-Tetrachloroethane	TX	5105	10184802
1,1,1-Trichloroethane	TX	5160	10184802
1,1,2,2-Tetrachloroethane	TX	5110	10184802
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	TX	5195	10184802
1,1,2-Trichloroethane	TX	5165	10184802
1,1-Dichloroethane	TX	4630	10184802
1,1-Dichloroethylene	TX	4640	10184802
1,1-Dichloropropene	TX	4670	10184802
1,2,3-Trichlorobenzene	TX	5150	10184802
1,2,3-Trichloropropane	TX	5180	10184802
1,2,4-Trichlorobenzene	TX	5155	10184802
1,2,4-Trimethylbenzene	TX	5210	10184802
1,2-Dibromo-3-chloropropane (DBCP)	TX	4570	10184802
1,2-Dibromoethane (EDB, Ethylene dibromide)	TX	4585	10184802
1,2-Dichlorobenzene	TX	4610	10184802
1,2-Dichloroethane (Ethylene dichloride)	TX	4635	10184802
1,2-Dichloropropane	TX	4655	10184802
1,3,5-Trimethylbenzene	TX	5215	10184802
1,3-Dichlorobenzene	TX	4615	10184802
1,3-Dichloropropane	TX	4660	10184802
1,4-Dichlorobenzene	TX	4620	10184802
1,4-Dioxane (1,4-Diethyleneoxide)	TX	4735	10184802
1-Chlorohexane	TX	4510	10184802

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

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Eurofins Xenco Corpus Christi
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1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
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Matrix: ***Non-Potable Water***

2,2-Dichloropropane	TX	4665	10184802
2-Butanone (Methyl ethyl ketone, MEK)	TX	4410	10184802
2-Chloroethyl vinyl ether	TX	4500	10184802
2-Chlorotoluene	TX	4535	10184802
2-Hexanone (MBK)	TX	4860	10184802
2-Nitropropane	TX	5020	10184802
4-Chlorotoluene	TX	4540	10184802
4-Isopropyltoluene (p-Cymene)	TX	4915	10184802
4-Methyl-2-pentanone (MIBK)	TX	4995	10184802
Acetone (2-Propanone)	TX	4315	10184802
Acetonitrile	TX	4320	10184802
Acrolein (Propenal)	TX	4325	10184802
Acrylonitrile	TX	4340	10184802
Allyl chloride (3-Chloropropene)	TX	4355	10184802
Benzene	TX	4375	10184802
Benzyl chloride	TX	5635	10184802
Bromobenzene	TX	4385	10184802
Bromochloromethane	TX	4390	10184802
Bromodichloromethane	TX	4395	10184802
Bromoform	TX	4400	10184802
Carbon disulfide	TX	4450	10184802
Carbon tetrachloride	TX	4455	10184802
Chlorobenzene	TX	4475	10184802
Chlorodibromomethane	TX	4575	10184802
Chloroethane (Ethyl chloride)	TX	4485	10184802
Chloroform	TX	4505	10184802
Chloroprene (2-Chloro-1,3-butadiene)	TX	4525	10184802
cis-1,2-Dichloroethylene	TX	4645	10184802
cis-1,3-Dichloropropene	TX	4680	10184802
cis-1,4-Dichloro-2-butene	TX	4600	10184802

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

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1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
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Matrix: ***Non-Potable Water***

Dibromofluoromethane	TX	4590	10184802
Dibromomethane (Methylene bromide)	TX	4595	10184802
Dichlorodifluoromethane (Freon-12)	TX	4625	10184802
Diethyl ether	TX	4725	10184802
Ethyl acetate	TX	4755	10184802
Ethyl methacrylate	TX	4810	10184802
Ethylbenzene	TX	4765	10184802
Ethylene oxide	TX	4795	10184802
Hexachlorobutadiene	TX	4835	10184802
Iodomethane (Methyl iodide)	TX	4870	10184802
Isobutyl alcohol (2-Methyl-1-propanol)	TX	4875	10184802
Isopropylbenzene (Cumene)	TX	4900	10184802
m+p-xylene	TX	5240	10184802
Methacrylonitrile	TX	4925	10184802
Methyl bromide (Bromomethane)	TX	4950	10184802
Methyl chloride (Chloromethane)	TX	4960	10184802
Methyl methacrylate	TX	4990	10184802
Methyl tert-butyl ether (MTBE)	TX	5000	10184802
Methylene chloride (Dichloromethane)	TX	4975	10184802
Naphthalene	TX	5005	10184802
n-Butylbenzene	TX	4435	10184802
n-Propylbenzene	TX	5090	10184802
o-Xylene	TX	5250	10184802
Pentachloroethane	TX	5035	10184802
Propionitrile (Ethyl cyanide)	TX	5080	10184802
sec-Butylbenzene	TX	4440	10184802
Styrene	TX	5100	10184802
tert-Butylbenzene	TX	4445	10184802
Tetrachloroethylene (Perchloroethylene)	TX	5115	10184802
Toluene	TX	5140	10184802

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28
Expiration Date: 3/31/2022
Issue Date: 7/15/2021

Eurofins Xenco Corpus Christi

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329

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Matrix: ***Non-Potable Water***

Total trihalomethanes	TX	5205	10184802
trans-1,2-Dichloroethylene	TX	4700	10184802
trans-1,3-Dichloropropylene	TX	4685	10184802
trans-1,4-Dichloro-2-butene	TX	4605	10184802
Trichloroethene (Trichloroethylene)	TX	5170	10184802
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	TX	5175	10184802
Vinyl acetate	TX	5225	10184802
Vinyl chloride	TX	5235	10184802
Xylene (total)	TX	5260	10184802

Method EPA 8270

Analyte	**AB**	**Analyte ID**	**Method ID**
1,2,4,5-Tetrachlorobenzene	TX	6715	10185805
1,2,4-Trichlorobenzene	TX	5155	10185805
1,2-Dichlorobenzene	TX	4610	10185805
1,2-Diphenylhydrazine	TX	6220	10185805
1,3-Dichlorobenzene	TX	4615	10185805
1,4-Dichlorobenzene	TX	4620	10185805
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	TX	4659	10185805
2,3,4,6-Tetrachlorophenol	TX	6735	10185805
2,4,5-Trichlorophenol	TX	6835	10185805
2,4,6-Trichlorophenol	TX	6840	10185805
2,4-Dichlorophenol	TX	6000	10185805
2,4-Dimethylphenol	TX	6130	10185805
2,4-Dinitrophenol	TX	6175	10185805
2,4-Dinitrotoluene (2,4-DNT)	TX	6185	10185805
2,6-Dichlorophenol	TX	6005	10185805
2,6-Dinitrotoluene (2,6-DNT)	TX	6190	10185805
2-Acetylaminofluorene	TX	5515	10185805
2-Chloronaphthalene	TX	5795	10185805
2-Chlorophenol	TX	5800	10185805

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

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Matrix: ***Non-Potable Water***

2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	TX	6360	10185805
2-Methylaniline (o-Toluidine)	TX	5145	10185805
2-Methylnaphthalene	TX	6385	10185805
2-Methylphenol (o-Cresol)	TX	6400	10185805
2-Nitroaniline	TX	6460	10185805
2-Nitrophenol	TX	6490	10185805
3,3'-Dichlorobenzidine	TX	5945	10185805
3-Methylcholanthrene	TX	6355	10185805
3-Methylphenol (m-Cresol)	TX	6405	10185805
3-Nitroaniline	TX	6465	10185805
4-Bromophenyl phenyl ether (BDE-3)	TX	5660	10185805
4-Chloro-3-methylphenol	TX	5700	10185805
4-Chloroaniline	TX	5745	10185805
4-Chlorophenyl phenylether	TX	5825	10185805
4-Methylphenol (p-Cresol)	TX	6410	10185805
4-Nitroaniline	TX	6470	10185805
4-Nitrophenol	TX	6500	10185805
7,12-Dimethylbenz(a) anthracene	TX	6115	10185805
Acenaphthene	TX	5500	10185805
Acenaphthylene	TX	5505	10185805
Acetophenone	TX	5510	10185805
Aniline	TX	5545	10185805
Anthracene	TX	5555	10185805
Azobenzene	TX	5562	10185805
Benzenethiol (Thiophenol)	TX	6750	10185805
Benzidine	TX	5595	10185805
Benzo(a)anthracene	TX	5575	10185805
Benzo(a)pyrene	TX	5580	10185805
Benzo(b)fluoranthene	TX	5585	10185805
Benzo(g,h,i)perylene	TX	5590	10185805

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

Eurofins Xenco Corpus Christi
Expiration Date: 3/31/2022

1733 North Padre Island Drive
Corpus Christi, TX 78408-2329
Issue Date: 7/15/2021

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Matrix: ***Non-Potable Water***

Benzo(k)fluoranthene	TX	5600	10185805
Benzoic acid	TX	5610	10185805
Benzyl alcohol	TX	5630	10185805
Biphenyl	TX	5640	10185805
bis(2-Chloroethoxy)methane	TX	5760	10185805
bis(2-Chloroethyl) ether	TX	5765	10185805
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	TX	6065	10185805
Butyl benzyl phthalate	TX	5670	10185805
Carbazole	TX	5680	10185805
Chrysene	TX	5855	10185805
Dibenz(a,h) anthracene	TX	5895	10185805
Dibenz(a,j) acridine	TX	5900	10185805
Dibenzo(a,e) pyrene	TX	5890	10185805
Dibenzofuran	TX	5905	10185805
Diethyl phthalate	TX	6070	10185805
Dimethyl phthalate	TX	6135	10185805
Di-n-butyl phthalate	TX	5925	10185805
Di-n-octyl phthalate	TX	6200	10185805
Diphenylamine	TX	6205	10185805
Fluoranthene	TX	6265	10185805
Fluorene	TX	6270	10185805
Hexachlorobenzene	TX	6275	10185805
Hexachlorobutadiene	TX	4835	10185805
Hexachlorocyclopentadiene	TX	6285	10185805
Hexachloroethane	TX	4840	10185805
Hexachloropropene	TX	6295	10185805
Indeno(1,2,3-cd) pyrene	TX	6315	10185805
Isophorone	TX	6320	10185805
Naphthalene	TX	5005	10185805
Nitrobenzene	TX	5015	10185805

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Matrix: ***Non-Potable Water***

n-Nitrosodiethylamine	TX	6525	10185805
n-Nitrosodimethylamine	TX	6530	10185805
n-Nitrosodi-n-butylamine	TX	5025	10185805
n-Nitrosodi-n-propylamine	TX	6545	10185805
n-Nitrosodiphenylamine	TX	6535	10185805
n-Nitrosomethylethylamine	TX	6550	10185805
n-Nitrosomorpholine	TX	6555	10185805
n-Nitrosopiperidine	TX	6560	10185805
n-Nitrosopyrrolidine	TX	6565	10185805
Pentachlorobenzene	TX	6590	10185805
Pentachloronitrobenzene (PCNB)	TX	6600	10185805
Pentachlorophenol	TX	6605	10185805
Phenacetin	TX	6610	10185805
Phenanthrene	TX	6615	10185805
Phenol	TX	6625	10185805
Pronamide (Kerb)	TX	6650	10185805
Pyrene	TX	6665	10185805
Pyridine	TX	5095	10185805
Quinoline	TX	6670	10185805

Method EPA 9040

Analyte	**AB**	**Analyte ID**	**Method ID**
pH	TX	1900	10197203

Method EPA 9050

Analyte	**AB**	**Analyte ID**	**Method ID**
Conductivity	TX	1610	10198808

Method EPA 9056

Analyte	**AB**	**Analyte ID**	**Method ID**
Bromide	TX	1540	10199209
Chloride	TX	1575	10199209
Nitrate as N	TX	1810	10199209
Nitrate-nitrite	TX	1820	10199209

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NELAP - Recognized Laboratory Fields of Accreditation

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Matrix: ***Non-Potable Water***

Nitrite as N	TX	1840	10199209
Sulfate	TX	2000	10199209

Method EPA 9060

Analyte	**AB**	**Analyte ID**	**Method ID**
Total Organic Carbon (TOC)	TX	2040	10200201

Method EPA 9251

Analyte	**AB**	**Analyte ID**	**Method ID**
Chloride	TX	1575	10207406

Method HACH 8000

Analyte	**AB**	**Analyte ID**	**Method ID**
Chemical oxygen demand (COD)	TX	1565	60003001

Method SM 2120 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Color	TX	1605	20223807

Method SM 2130 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Turbidity	TX	2055	20042200

Method SM 2320 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Alkalinity as CaCO3	TX	1505	20045005

Method SM 2340 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Total hardness as CaCO3	TX	1755	20046008

Method SM 2510 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Conductivity	TX	1610	20048004

Method SM 2540 B

Analyte	**AB**	**Analyte ID**	**Method ID**
Residue-total (total solids)	TX	1950	20004608

Method SM 2540 C

Analyte	**AB**	**Analyte ID**	**Method ID**
Residue-filterable (TDS)	TX	1955	20049803

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Matrix: ***Non-Potable Water***

Method SM 2540 D

Analyte	AB	Analyte ID	Method ID
Residue-nonfilterable (TSS)	TX	1960	20004802

Method SM 3500-Cr B

Analyte	AB	Analyte ID	Method ID
Chromium (VI)	TX	1045	20065809

Method SM 4500-Cl F

Analyte	AB	Analyte ID	Method ID
Total residual chlorine	TX	1940	20080482

Method SM 4500-Cl^- E

Analyte	AB	Analyte ID	Method ID
Chloride	TX	1575	20019209

Method SM 4500-F^- C

Analyte	AB	Analyte ID	Method ID
Fluoride	TX	1730	20101808

Method SM 4500-H+ B

Analyte	AB	Analyte ID	Method ID
pH	TX	1900	20104603

Method SM 4500-NH3 B

Analyte	AB	Analyte ID	Method ID
Ammonia as N	TX	1515	20022804

Method SM 4500-NH3 G

Analyte	AB	Analyte ID	Method ID
Ammonia as N	TX	1515	20023205

Method SM 4500-O G

Analyte	AB	Analyte ID	Method ID
Oxygen, dissolved	TX	1880	20025405

Method SM 4500-$S2^-$ D

Analyte	AB	Analyte ID	Method ID
Sulfide	TX	2005	20125400

Method SM 4500-$SO3^-$ B

Analyte	AB	Analyte ID	Method ID

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Matrix: ***Non-Potable Water***

Sulfite	TX	2015	20026806

Method SM 5210 B

Analyte	AB	Analyte ID	Method ID
Biochemical oxygen demand (BOD)	TX	1530	20027401
Carbonaceous BOD, CBOD	TX	1555	20027401

Method SM 5310 B

Analyte	AB	Analyte ID	Method ID
Total Organic Carbon (TOC)	TX	2040	20137206

Method SM 5540 C

Analyte	AB	Analyte ID	Method ID
Surfactants - MBAS	TX	2025	20144405

Method TCEQ 1005

Analyte	AB	Analyte ID	Method ID
Total Petroleum Hydrocarbons (TPH)	TX	2050	90019208

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Matrix: ***Solid & Chemical Materials***

Method EPA 1010

Analyte	AB	Analyte ID	Method ID
Ignitability	TX	1780	10116606

Method EPA 1110

Analyte	AB	Analyte ID	Method ID
Corrosivity	TX	1615	10118000

Method EPA 1311

Analyte	AB	Analyte ID	Method ID
TCLP	TX	849	10118806

Method EPA 1312

Analyte	AB	Analyte ID	Method ID
SPLP	TX	850	10119003

Method EPA 350.1

Analyte	AB	Analyte ID	Method ID
Ammonia as N	TX	1515	10063408

Method EPA 6010

Analyte	AB	Analyte ID	Method ID
Aluminum	TX	1000	10155609
Antimony	TX	1005	10155609
Arsenic	TX	1010	10155609
Barium	TX	1015	10155609
Beryllium	TX	1020	10155609
Boron	TX	1025	10155609
Cadmium	TX	1030	10155609
Calcium	TX	1035	10155609
Chromium	TX	1040	10155609
Cobalt	TX	1050	10155609
Copper	TX	1055	10155609
Iron	TX	1070	10155609
Lead	TX	1075	10155609
Lithium	TX	1080	10155609

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Matrix: ***Solid & Chemical Materials***

Magnesium	TX	1085	10155609
Manganese	TX	1090	10155609
Molybdenum	TX	1100	10155609
Nickel	TX	1105	10155609
Phosphorus	TX	1910	10155609
Potassium	TX	1125	10155609
Selenium	TX	1140	10155609
Silica as SiO2	TX	1990	10155609
Silver	TX	1150	10155609
Sodium	TX	1155	10155609
Strontium	TX	1160	10155609
Thallium	TX	1165	10155609
Tin	TX	1175	10155609
Titanium	TX	1180	10155609
Vanadium	TX	1185	10155609
Zinc	TX	1190	10155609

Method EPA 7471

Analyte	**AB**	**Analyte ID**	**Method ID**
Mercury	TX	1095	10166208

Method EPA 8082

Analyte	**AB**	**Analyte ID**	**Method ID**
Aroclor-1016 (PCB-1016)	TX	8880	10179007
Aroclor-1221 (PCB-1221)	TX	8885	10179007
Aroclor-1232 (PCB-1232)	TX	8890	10179007
Aroclor-1242 (PCB-1242)	TX	8895	10179007
Aroclor-1248 (PCB-1248)	TX	8900	10179007
Aroclor-1254 (PCB-1254)	TX	8905	10179007
Aroclor-1260 (PCB-1260)	TX	8910	10179007

Method EPA 8260

Analyte	**AB**	**Analyte ID**	**Method ID**
1,1,1,2-Tetrachloroethane	TX	5105	10184802

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Matrix: ***Solid & Chemical Materials***

1,1,1-Trichloroethane	TX	5160	10184802
1,1,2,2-Tetrachloroethane	TX	5110	10184802
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	TX	5195	10184802
1,1,2-Trichloroethane	TX	5165	10184802
1,1-Dichloroethane	TX	4630	10184802
1,1-Dichloroethylene	TX	4640	10184802
1,1-Dichloropropene	TX	4670	10184802
1,2,3-Trichlorobenzene	TX	5150	10184802
1,2,3-Trichloropropane	TX	5180	10184802
1,2,4-Trichlorobenzene	TX	5155	10184802
1,2,4-Trimethylbenzene	TX	5210	10184802
1,2-Dibromo-3-chloropropane (DBCP)	TX	4570	10184802
1,2-Dibromoethane (EDB, Ethylene dibromide)	TX	4585	10184802
1,2-Dichlorobenzene	TX	4610	10184802
1,2-Dichloroethane (Ethylene dichloride)	TX	4635	10184802
1,2-Dichloropropane	TX	4655	10184802
1,3,5-Trimethylbenzene	TX	5215	10184802
1,3-Dichlorobenzene	TX	4615	10184802
1,3-Dichloropropane	TX	4660	10184802
1,4-Dichlorobenzene	TX	4620	10184802
1,4-Dioxane (1,4-Diethyleneoxide)	TX	4735	10184802
1-Chlorohexane	TX	4510	10184802
2,2-Dichloropropane	TX	4665	10184802
2-Butanone (Methyl ethyl ketone, MEK)	TX	4410	10184802
2-Chloroethyl vinyl ether	TX	4500	10184802
2-Chlorotoluene	TX	4535	10184802
2-Hexanone (MBK)	TX	4860	10184802
2-Nitropropane	TX	5020	10184802
4-Chlorotoluene	TX	4540	10184802
4-Isopropyltoluene (p-Cymene)	TX	4915	10184802

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Matrix: ***Solid & Chemical Materials***

4-Methyl-2-pentanone (MIBK)	TX	4995	10184802
Acetone (2-Propanone)	TX	4315	10184802
Acetonitrile	TX	4320	10184802
Acrolein (Propenal)	TX	4325	10184802
Acrylonitrile	TX	4340	10184802
Allyl chloride (3-Chloropropene)	TX	4355	10184802
Benzene	TX	4375	10184802
Benzyl chloride	TX	5635	10184802
Bromobenzene	TX	4385	10184802
Bromochloromethane	TX	4390	10184802
Bromodichloromethane	TX	4395	10184802
Bromoform	TX	4400	10184802
Carbon disulfide	TX	4450	10184802
Carbon tetrachloride	TX	4455	10184802
Chlorobenzene	TX	4475	10184802
Chlorodibromomethane	TX	4575	10184802
Chloroethane (Ethyl chloride)	TX	4485	10184802
Chloroform	TX	4505	10184802
Chloroprene (2-Chloro-1,3-butadiene)	TX	4525	10184802
cis-1,2-Dichloroethylene	TX	4645	10184802
cis-1,3-Dichloropropene	TX	4680	10184802
cis-1,4-Dichloro-2-butene	TX	4600	10184802
Dibromofluoromethane	TX	4590	10184802
Dibromomethane (Methylene bromide)	TX	4595	10184802
Dichlorodifluoromethane (Freon-12)	TX	4625	10184802
Diethyl ether	TX	4725	10184802
Ethyl acetate	TX	4755	10184802
Ethyl methacrylate	TX	4810	10184802
Ethylbenzene	TX	4765	10184802
Ethylene oxide	TX	4795	10184802

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Matrix: ***Solid & Chemical Materials***

Hexachlorobutadiene	TX	4835	10184802
Iodomethane (Methyl iodide)	TX	4870	10184802
Isobutyl alcohol (2-Methyl-1-propanol)	TX	4875	10184802
Isopropylbenzene (Cumene)	TX	4900	10184802
m+p-xylene	TX	5240	10184802
Methacrylonitrile	TX	4925	10184802
Methyl bromide (Bromomethane)	TX	4950	10184802
Methyl chloride (Chloromethane)	TX	4960	10184802
Methyl methacrylate	TX	4990	10184802
Methyl tert-butyl ether (MTBE)	TX	5000	10184802
Methylene chloride (Dichloromethane)	TX	4975	10184802
Naphthalene	TX	5005	10184802
n-Butylbenzene	TX	4435	10184802
n-Propylbenzene	TX	5090	10184802
o-Xylene	TX	5250	10184802
Pentachloroethane	TX	5035	10184802
Propionitrile (Ethyl cyanide)	TX	5080	10184802
sec-Butylbenzene	TX	4440	10184802
Styrene	TX	5100	10184802
tert-Butylbenzene	TX	4445	10184802
Tetrachloroethylene (Perchloroethylene)	TX	5115	10184802
Toluene	TX	5140	10184802
trans-1,2-Dichloroethylene	TX	4700	10184802
trans-1,3-Dichloropropylene	TX	4685	10184802
trans-1,4-Dichloro-2-butene	TX	4605	10184802
Trichloroethene (Trichloroethylene)	TX	5170	10184802
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	TX	5175	10184802
Vinyl acetate	TX	5225	10184802
Vinyl chloride	TX	5235	10184802
Xylene (total)	TX	5260	10184802

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Matrix: ***Solid & Chemical Materials***

Method EPA 8270

Analyte	AB	Analyte ID	Method ID
1,2,4,5-Tetrachlorobenzene	TX	6715	10185805
1,2,4-Trichlorobenzene	TX	5155	10185805
1,2-Dichlorobenzene	TX	4610	10185805
1,2-Diphenylhydrazine	TX	6220	10185805
1,3-Dichlorobenzene	TX	4615	10185805
1,4-Dichlorobenzene	TX	4620	10185805
2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl)ether)	TX	4659	10185805
2,3,4,6-Tetrachlorophenol	TX	6735	10185805
2,4,5-Trichlorophenol	TX	6835	10185805
2,4,6-Trichlorophenol	TX	6840	10185805
2,4-Dichlorophenol	TX	6000	10185805
2,4-Dimethylphenol	TX	6130	10185805
2,4-Dinitrophenol	TX	6175	10185805
2,4-Dinitrotoluene (2,4-DNT)	TX	6185	10185805
2,6-Dichlorophenol	TX	6005	10185805
2,6-Dinitrotoluene (2,6-DNT)	TX	6190	10185805
2-Chloronaphthalene	TX	5795	10185805
2-Chlorophenol	TX	5800	10185805
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	TX	6360	10185805
2-Methylnaphthalene	TX	6385	10185805
2-Methylphenol (o-Cresol)	TX	6400	10185805
2-Nitroaniline	TX	6460	10185805
2-Nitrophenol	TX	6490	10185805
3,3'-Dichlorobenzidine	TX	5945	10185805
3-Methylcholanthrene	TX	6355	10185805
3-Methylphenol (m-Cresol)	TX	6405	10185805
3-Nitroaniline	TX	6465	10185805
4-Bromophenyl phenyl ether (BDE-3)	TX	5660	10185805

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Matrix: ***Solid & Chemical Materials***

4-Chloro-3-methylphenol	TX	5700	10185805
4-Chloroaniline	TX	5745	10185805
4-Chlorophenyl phenylether	TX	5825	10185805
4-Methylphenol (p-Cresol)	TX	6410	10185805
4-Nitroaniline	TX	6470	10185805
4-Nitrophenol	TX	6500	10185805
7,12-Dimethylbenz(a) anthracene	TX	6115	10185805
Acenaphthene	TX	5500	10185805
Acenaphthylene	TX	5505	10185805
Acetophenone	TX	5510	10185805
Aniline	TX	5545	10185805
Anthracene	TX	5555	10185805
Azobenzene	TX	5562	10185805
Benzenethiol (Thiophenol)	TX	6750	10185805
Benzidine	TX	5595	10185805
Benzo(a)anthracene	TX	5575	10185805
Benzo(a)pyrene	TX	5580	10185805
Benzo(b)fluoranthene	TX	5585	10185805
Benzo(g,h,i)perylene	TX	5590	10185805
Benzo(k)fluoranthene	TX	5600	10185805
Benzoic acid	TX	5610	10185805
Benzyl alcohol	TX	5630	10185805
Biphenyl	TX	5640	10185805
bis(2-Chloroethoxy)methane	TX	5760	10185805
bis(2-Chloroethyl) ether	TX	5765	10185805
bis(2-Ethylhexyl) phthalate (Di(2-Ethylhexyl) phthalate, DEHP)	TX	6065	10185805
Butyl benzyl phthalate	TX	5670	10185805
Carbazole	TX	5680	10185805
Chrysene	TX	5855	10185805
Dibenz(a,h) anthracene	TX	5895	10185805

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Matrix: ***Solid & Chemical Materials***

Dibenz(a,j) acridine	TX	5900	10185805
Dibenzo(a,e) pyrene	TX	5890	10186002
Dibenzofuran	TX	5905	10185805
Diethyl phthalate	TX	6070	10185805
Dimethyl phthalate	TX	6135	10185805
Di-n-butyl phthalate	TX	5925	10185805
Di-n-octyl phthalate	TX	6200	10185805
Diphenylamine	TX	6205	10185805
Fluoranthene	TX	6265	10185805
Fluorene	TX	6270	10185805
Hexachlorobenzene	TX	6275	10185805
Hexachlorobutadiene	TX	4835	10185805
Hexachlorocyclopentadiene	TX	6285	10185805
Hexachloroethane	TX	4840	10185805
Hexachloropropene	TX	6295	10185805
Indeno(1,2,3-cd) pyrene	TX	6315	10185805
Isophorone	TX	6320	10185805
Naphthalene	TX	5005	10185805
Nitrobenzene	TX	5015	10185805
n-Nitrosodiethylamine	TX	6525	10185805
n-Nitrosodimethylamine	TX	6530	10185805
n-Nitrosodi-n-butylamine	TX	5025	10185805
n-Nitrosodi-n-propylamine	TX	6545	10185805
n-Nitrosodiphenylamine	TX	6535	10185805
Pentachlorobenzene	TX	6590	10185805
Pentachlorophenol	TX	6605	10185805
Phenanthrene	TX	6615	10185805
Phenol	TX	6625	10185805
Pyrene	TX	6665	10185805
Pyridine	TX	5095	10185805

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28
Expiration Date: 3/31/2022
Issue Date: 7/15/2021

Eurofins Xenco Corpus Christi
1733 North Padre Island Drive
Corpus Christi, TX 78408-2329

These fields of accreditation supercede all previous fields. The Texas Commission on Environmental Quality urges customers to verify the laboratory's current accreditation status for particular methods and analyses.

Matrix: ***Solid & Chemical Materials***

Quinoline	TX	6670	10185805
Method EPA 9040			
Analyte	**AB**	**Analyte ID**	**Method ID**
pH	TX	1900	10197203
Method EPA 9045			
Analyte	**AB**	**Analyte ID**	**Method ID**
Corrosivity	TX	1615	10198400
pH	TX	1900	10198400
Method EPA 9050			
Analyte	**AB**	**Analyte ID**	**Method ID**
Conductivity	TX	1610	10198808
Method EPA 9056			
Analyte	**AB**	**Analyte ID**	**Method ID**
Bromide	TX	1540	10199209
Chloride	TX	1575	10199209
Nitrate as N	TX	1810	10199209
Nitrate-nitrite	TX	1820	10199209
Nitrite as N	TX	1840	10199209
Sulfate	TX	2000	10199209
Method EPA 9095			
Analyte	**AB**	**Analyte ID**	**Method ID**
Paint Filter Liquids Test	TX	10312	10204203
Method EPA 9251			
Analyte	**AB**	**Analyte ID**	**Method ID**
Chloride	TX	1575	10207406
Method SM 2320 B			
Analyte	**AB**	**Analyte ID**	**Method ID**
Alkalinity as CaCO3	TX	1505	20045005
Method SM 2510 B			
Analyte	**AB**	**Analyte ID**	**Method ID**
Conductivity	TX	1610	20048004

Texas Commission on Environmental Quality

NELAP - Recognized Laboratory Fields of Accreditation

Certificate: T104704210-21-28

Eurofins Xenco Corpus Christi

Expiration Date: 3/31/2022

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Issue Date: 7/15/2021

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Matrix: ***Solid & Chemical Materials***

Method	Analyte	AB	Analyte ID	Method ID
SM 2540 G	Residue-total (total solids)	TX	1950	20005203
SSA/ASA Part 3:34	Carbon, organic (Walkley-Black)	TX	10340	SSA/ASA Pt 3:34
TCEQ 1005	Total Petroleum Hydrocarbons (TPH)	TX	2050	90019208

CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Eurofins Air Toxics
180 Blue Ravine Road, Suite B
Folsom, CA 95630

Fulfills the requirements of

ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.4)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 27 April 2024
Certificate Number: ADE-1451

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V5.4)

Eurofins Air Toxics

180 Blue Ravine Road, Suite B
Folsom, CA 95630
Melanie Levesque
(916) 605-3396

TESTING

Valid to: **April 27, 2024** Certificate Number: **ADE-1451**

Environmental

Air and Emissions		
Technology	**Method**	**Analyte**
GC/FID/dual TCD	ASTM D1945 Mod	Acetylene
GC/FID/dual TCD	ASTM D1945 Mod	Carbon Dioxide
GC/FID/dual TCD	ASTM D1945 Mod	Carbon Monoxide
GC/FID/dual TCD	ASTM D1945 Mod	Ethane
GC/FID/dual TCD	ASTM D1945 Mod	Ethylene
GC/FID/dual TCD	ASTM D1945 Mod	Helium
GC/FID/dual TCD	ASTM D1945 Mod	Hydrogen
GC/FID/dual TCD	ASTM D1945 Mod	Isobutane
GC/FID/dual TCD	ASTM D1945 Mod	Isopentane
GC/FID/dual TCD	ASTM D1945 Mod	Methane

Air and Emissions		
Technology	**Method**	**Analyte**
GC/FID/dual TCD	ASTM D1945 Mod	n-Butane
GC/FID/dual TCD	ASTM D1945 Mod	Neopentane
GC/FID/dual TCD	ASTM D1945 Mod	Nitrogen
GC/FID/dual TCD	ASTM D1945 Mod	n-Pentane
GC/FID/dual TCD	ASTM D1945 Mod	Oxygen
GC/FID/dual TCD	ASTM D1945 Mod	Propane
GC/FID/dual TCD	ASTM D1946 Mod	Carbon Dioxide
GC/FID/dual TCD	ASTM D1946 Mod	Carbon Monoxide
GC/FID/dual TCD	ASTM D1946 Mod	Ethane
GC/FID/dual TCD	ASTM D1946 Mod	Ethylene
GC/FID/dual TCD	ASTM D1946 Mod	Helium
GC/FID/dual TCD	ASTM D1946 Mod	Hydrogen
GC/FID/dual TCD	ASTM D1946 Mod	Methane
GC/FID/dual TCD	ASTM D1946 Mod	Nitrogen
GC/FID/dual TCD	ASTM D1946 Mod	Oxygen
GC/FID/PID	TO-3 Mod	TPH(GRO)
GC/FID/PID	TO-3 Mod	TPH(JP4)
GC/MS	TO-15 (Full Scan/SIM)	1,1,1-Trichloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1,2,2-Tetrachloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1,2-Trichloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1-Dichloroethane
GC/MS	TO-15 (Full Scan/SIM)	1,1-Dichloroethene
GC/MS	TO-15 (Full Scan)	1,2,4-Trichlorobenzene

Air and Emissions		
Technology	**Method**	**Analyte**
GC/MS	TO-15 (Full Scan)	1,2,4-Trimethylbenzene
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dibromoethane (EDB)
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dichlorobenzene
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dichloroethane
GC/MS	TO-15 (Full Scan)	1,2-Dichloropropane
GC/MS	TO-15 (Full Scan/SIM)	1,2-Dichlorotetrafluoroethane (Freon 114)
GC/MS	TO-15 (Full Scan)	1,3,5-Trimethylbenzene
GC/MS	TO-15 (Full Scan)	1,3-Butadiene
GC/MS	TO-15 (Full Scan/SIM)	1,3-Dichlorobenzene
GC/MS	TO-15 (Full Scan/SIM)	1,4-Dichlorobenzene
GC/MS	TO-15 (Full Scan)	1,4-Dioxane
GC/MS	TO-15 (Full Scan)	2,2,4-Trimethylpentane
GC/MS	TO-15 (Full Scan)	2-Butanone (MEK)
GC/MS	TO-15 (Full Scan)	2-Chlorotoluene
GC/MS	TO-15 (Full Scan)	2-Hexanone
GC/MS	TO-15 (Full Scan)	2-Propanol
GC/MS	TO-15 (Full Scan)	3-Chloropropene
GC/MS	TO-15 (Full Scan)	4-Methyl-2-pentanone (MIBK)
GC/MS	TO-15 (Full Scan)	Acetone
GC/MS	TO-15 (Full Scan)	alpha-Chlorotoluene
GC/MS	TO-15 (Full Scan/SIM)	Benzene
GC/MS	TO-15 (Full Scan)	Bromodichloromethane
GC/MS	TO-15 (Full Scan)	Bromoform

Air and Emissions		
Technology	**Method**	**Analyte**
GC/MS	TO-15 (Full Scan)	Bromomethane
GC/MS	TO-15 (Full Scan)	Butane
GC/MS	TO-15 (Full Scan)	Butyl Benzene
GC/MS	TO-15 (Full Scan)	Carbon disulfide
GC/MS	TO-15 (Full Scan/SIM)	Carbon tetrachloride
GC/MS	TO-15 (Full Scan/SIM)	Chlorobenzene
GC/MS	TO-15 (Full Scan)	Chlorodibromomethane
GC/MS	TO-15 (Full Scan/SIM)	Chloroethane
GC/MS	TO-15 (Full Scan/SIM)	Chloroform
GC/MS	TO-15 (Full Scan/SIM)	Chloromethane
GC/MS	TO-15 (Full Scan/SIM)	cis-1,2-Dichloroethene
GC/MS	TO-15 (Full Scan)	cis-1,3-Dichloropropene
GC/MS	TO-15 (Full Scan)	Cyclohexane
GC/MS	TO-15 (Full Scan)	Cumene
GC/MS	TO-15 (Full Scan/SIM)	Dichlorodifluoromethane (Freon 12)
GC/MS	TO-15 (Full Scan)	Ethanol
GC/MS	TO-15 (Full Scan/SIM)	Ethylbenzene
GC/MS	TO-15 (Full Scan)	Hexachlorobutadiene
GC/MS	TO-15 (Full Scan)	Methylene Chloride
GC/MS	TO-15 (Full Scan/SIM)	m,p-Xylene
GC/MS	TO-15 (Full Scan/SIM)	Naphthalene
GC/MS	TO-15 (Full Scan)	n-Butanol (1-Butanol)
GC/MS	TO-15 (Full Scan)	n-Heptane

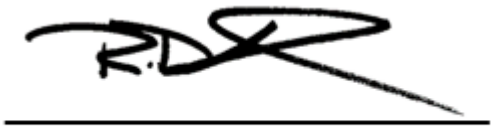
Air and Emissions		
Technology	**Method**	**Analyte**
GC/MS	TO-15 (Full Scan)	n-Hexane
GC/MS	TO-15 (Full Scan)	Nonane
GC/MS	TO-15 (Full Scan)	n-Pentane
GC/MS	TO-15 (Full Scan)	n-Propylbenzene
GC/MS	TO-15 (Full Scan)	Octane
GC/MS	TO-15 (Full Scan/SIM)	o-Xylene
GC/MS	TO-15 (Full Scan)	p-Ethyltoluene
GC/MS	TO-15 (Full Scan)	Propylene
GC/MS	TO-15 (Full Scan)	sec-Butylbenzene
GC/MS	TO-15 (Full Scan)	Styrene
GC/MS	TO-15 (Full Scan)	tert-Butyl Alcohol
GC/MS	TO-15 (Full Scan)	tert-Butyl Benzene
GC/MS	TO-15 (Full Scan/SIM)	tert-Butyl methyl ether (MTBE)
GC/MS	TO-15 (Full Scan/SIM)	Tetrachloroethylene
GC/MS	TO-15 (Full Scan)	Tetrahydrofuran
GC/MS	TO-15 (Full Scan/SIM)	Toluene
GC/MS	TO-15 (Full Scan/SIM)	trans-1,2-Dichloroethene
GC/MS	TO-15 (Full Scan/SIM)	trans-1,3-Dichloropropene
GC/MS	TO-15 (Full Scan/SIM)	Trichloroethene
GC/MS	TO-15 (Full Scan/SIM)	Trichlorofluoromethane (Freon 11)
GC/MS	TO-15 (Full Scan/SIM)	Trichlorotrifluoroethane (Freon 113)
GC/MS	TO-15 (Full Scan)	Vinyl Acetate
GC/MS	TO-15 (Full Scan/SIM)	Vinyl chloride

Air and Emissions		
Technology	**Method**	**Analyte**
GC/MS	TO-17 (WMS/RAD130) Mod	1,1,1-Trichloroethane
GC/MS	TO-17 (WMS/RAD130) Mod	1,1,2,2-Tetrachloroethane
GC/MS	TO-17 (WMS/RAD130) Mod	1,1,2-Trichloroethane
GC/MS	TO-17 (WMS/RAD130) Mod	1,1-Dichloroethane
GC/MS	TO-17 (WMS/RAD130) Mod	1,1-Dichloroethene
GC/MS	TO-17 (WMS/RAD130) Mod	1,2,4-Trimethylbenzene
GC/MS	TO-17 (WMS/RAD130) Mod	1,2-Dichlorobenzene
GC/MS	TO-17 (WMS/RAD130) Mod	1,2-Dichloroethane
GC/MS	TO-17 (WMS/RAD130) Mod	1,3,5-Trimethylbenzene
GC/MS	TO-17 (WMS/RAD130) Mod	1,3-Dichlorobenzene
GC/MS	TO-17 (WMS/RAD130) Mod	1,4-Dichlorobenzene
GC/MS	TO-17 (WMS/RAD130) Mod	2-Butanone (MEK)
GC/MS	TO-17 (WMS/RAD130) Mod	4-Methyl-2-pentanone (MIBK)
GC/MS	TO-17 (WMS/RAD130) Mod	Benzene
GC/MS	TO-17 (WMS/RAD130) Mod	Carbon tetrachloride
GC/MS	TO-17 (WMS/RAD130) Mod	Chlorobenzene
GC/MS	TO-17 (WMS/RAD130) Mod	Chloroform
GC/MS	TO-17 (WMS/RAD130) Mod	cis-1,2-Dichloroethene
GC/MS	TO-17 (WMS/RAD130) Mod	Cyclohexane
GC/MS	TO-17 (WMS/RAD130) Mod	Ethanol
GC/MS	TO-17 (WMS/RAD130) Mod	Ethyl Acetate
GC/MS	TO-17 (WMS/RAD130) Mod	Ethylbenzene
GC/MS	TO-17 (WMS/RAD130) Mod	m,p-Xylene
GC/MS	TO-17 (WMS/RAD130) Mod	n-Heptane

Air and Emissions		
Technology	**Method**	**Analyte**
GC/MS	TO-17 (WMS/RAD130) Mod	n-Hexane
GC/MS	TO-17 (WMS/RAD130) Mod	o-Xylene
GC/MS	TO-17 (WMS/RAD130) Mod	Propylbenzene
GC/MS	TO-17 (WMS/RAD130) Mod	tert-Butyl methyl ether (MTBE)
GC/MS	TO-17 (WMS/RAD130) Mod	Tetrachloroethylene
GC/MS	TO-17 (WMS/RAD130) Mod	Toluene
GC/MS	TO-17 (WMS/RAD130) Mod	trans-1,2-Dichloroethene
GC/MS	TO-17 (WMS/RAD130) Mod	Trichloroethene
GC/MS	TO-17 (WMS) Mod	Vinyl chloride
Preparation	**Method**	**Type**
Extraction of sorbent media	Eurofins Air Toxics SOP # 100	Solvent Extraction

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. ADE-1451.



R. Douglas Leonard Jr., VP, PILR SBU

Oregon
Environmental Laboratory
Accreditation Program

NELAP Recognized

Eurofins Air Toxics

CA300005

180 Blue Ravine Road, Ste. B

Folsom, CA 95630

IS GRANTED APPROVAL BY ORELAP UNDER THE 2016 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	Drinking Water	Non-Potable Water	Solids and Chemical Waste	Tissue
Chemistry				

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Travis Bartholomew
Oregon State Public Health Laboratory
ORELAP Program Manager
7202 NE Evergreen Parkway, Suite 100
Hillsboro, OR 97124

EFFECTIVE DATE : **10/18/2022**
EXPIRATION DATE : **10/17/2023**
Certificate No : **CA300005 - 017**

OREGON

Environmental Laboratory Accreditation Program

ORELAP Fields of Accreditation

Eurofins Air Toxics
180 Blue Ravine Road, Ste. B
Folsom, CA 95630

ORELAP ID: CA300005
EPA CODE: CA00933
Certificate: CA300005 - 017

Issue Date: 10/18/2022 Expiration Date: 10/17/2023

As of 10/18/2022 this list supersedes all previous lists for this certificate number.

Matrix	Reference	Analyte Code	Analyte	Method Code	Description
Air					
	40 CFR Part 50 Appendix J			10000507	Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere
		3950	Particulates <10 um		
	ASTM D1945 03			30024443	Natural Gas by Gas Chromatography
		4938	2-Methylbutane (Isopentane)		
		4942	2-methylpropane (Isobutane)		
		4323	Acetylene		
		3755	Carbon dioxide		
		3780	Carbon monoxide		
		4747	Ethane		
		4752	Ethene		
		1767	Helium		
		1772	Hydrogen		
		4926	Methane		
		3853	Natural Gas		
		5007	n-Butane		
		9511	Neopentane		
		1843	Nitrogen		
		5028	n-Pentane		
		5029	n-Propane		
		3895	Oxygen		
	ASTM D1946-90			30024465	Reformed Gas by Gas Chromatography
		3755	Carbon dioxide		
		3780	Carbon monoxide		
		4747	Ethane		
		4752	Ethene		
		1767	Helium		
		1772	Hydrogen		

Eurofins Air Toxics
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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		4926	Methane		
		1843	Nitrogen		
		3895	Oxygen		
	EPA 325B 2013			10277437	Sorbent Tubes Coupled with Thermal Desorption and GC/MS
		9318	1,3-Butadiene		
		4375	Benzene		
		4765	Ethylbenzene		
		5240	m+p-xylene		
		5005	Naphthalene		
		4855	n-Hexane		
		5250	o-Xylene		
		5100	Styrene		
		5140	Toluene		
		5170	Trichloroethene (Trichloroethylene)		
	EPA TO-12			10248201	Non-Methane Organic Compounds by GC/FID
		3860	Non-methane organics		
	EPA TO-13A			10248405	Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS
		5795	2-Chloronaphthalene		
		6385	2-Methylnaphthalene		
		5500	Acenaphthene		
		5505	Acenaphthylene		
		5555	Anthracene		
		5575	Benzo(a)anthracene		
		5580	Benzo(a)pyrene		
		5590	Benzo(g,h,i)perylene		
		5600	Benzo(k)fluoranthene		
		5585	Benzo[b]fluoranthene		
		5855	Chrysene		
		5895	Dibenz(a,h) anthracene		
		6265	Fluoranthene		
		6270	Fluorene		

Eurofins Air Toxics
180 Blue Ravine Road, Ste. B
Folsom, CA 95630

ORELAP ID: CA300005
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Issue Date: 10/18/2022 Expiration Date: 10/17/2023

As of 10/18/2022 this list supersedes all previous lists for this certificate number.

Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		6315	Indeno(1,2,3-cd) pyrene		
		5005	Naphthalene		
		6615	Phenanthrene		
		6665	Pyrene		
	EPA TO-13A SIM			10248449	Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS SIM
		5795	2-Chloronaphthalene		
		6385	2-Methylnaphthalene		
		5500	Acenaphthene		
		5505	Acenaphthylene		
		5555	Anthracene		
		5575	Benzo(a)anthracene		
		5580	Benzo(a)pyrene		
		5590	Benzo(g,h,i)perylene		
		5600	Benzo(k)fluoranthene		
		5585	Benzo[b]fluoranthene		
		5855	Chrysene		
		5895	Dibenz(a,h) anthracene		
		6265	Fluoranthene		
		6270	Fluorene		
		6315	Indeno(1,2,3-cd) pyrene		
		5005	Naphthalene		
		6615	Phenanthrene		
		6665	Pyrene		
	EPA TO-14A			10248609	Volatile Organic Compounds with SUMMA canister and GC/MS
		5160	1,1,1-Trichloroethane		
		5110	1,1,2,2-Tetrachloroethane		
		5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
		5165	1,1,2-Trichloroethane		
		4630	1,1-Dichloroethane		
		4640	1,1-Dichloroethylene		

Eurofins Air Toxics

180 Blue Ravine Road, Ste. B

Folsom, CA 95630

ORELAP ID: CA300005

EPA CODE: CA00933

Certificate: CA300005 - 017

Issue Date: 10/18/2022 Expiration Date: 10/17/2023

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		5155	1,2,4-Trichlorobenzene		
		5210	1,2,4-Trimethylbenzene		
		4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
		4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)		
		4610	1,2-Dichlorobenzene		
		4635	1,2-Dichloroethane (Ethylene dichloride)		
		4655	1,2-Dichloropropane		
		5215	1,3,5-Trimethylbenzene		
		9318	1,3-Butadiene		
		4615	1,3-Dichlorobenzene		
		4620	1,4-Dichlorobenzene		
		4735	1,4-Dioxane (1,4-Diethyleneoxide)		
		4836	1-Propene (Propylene)		
		4410	2-Butanone (Methyl ethyl ketone, MEK)		
		4860	2-Hexanone (MBK)		
		4542	4-Ethyltoluene		
		4995	4-Methyl-2-pentanone (MIBK)		
		4315	Acetone		
		4375	Benzene		
		5635	Benzyl chloride		
		4395	Bromodichloromethane		
		4400	Bromoform		
		4450	Carbon disulfide		
		4455	Carbon tetrachloride		
		4475	Chlorobenzene		
		4575	Chlorodibromomethane		
		4485	Chloroethane (Ethyl		

Eurofins Air Toxics

180 Blue Ravine Road, Ste. B

Folsom, CA 95630

ORELAP ID: CA300005

EPA CODE: CA00933

Certificate: CA300005 - 017

Issue Date: 10/18/2022 Expiration Date: 10/17/2023

As of 10/18/2022 this list supersedes all previous lists for this certificate number.

Matrix	Reference	Analyte Code	Analyte	Method Code	Description
			chloride)		
		4505	Chloroform		
		4705	cis & trans-1,2-Dichloroethene		
		4680	cis-1,3-Dichloropropene		
		4555	Cyclohexane		
		4625	Dichlorodifluoromethane (Freon-12)		
		4750	Ethanol		
		4765	Ethylbenzene		
		4835	Hexachlorobutadiene		
		4895	Isopropyl alcohol (2-Propanol, Isopropanol)		
		4900	Isopropylbenzene (Cumene)		
		5240	m+p-xylene		
		4950	Methyl bromide (Bromomethane)		
		4960	Methyl chloride (Chloromethane)		
		5000	Methyl tert-butyl ether (MTBE)		
		4975	Methylene chloride (Dichloromethane)		
		5005	Naphthalene		
		4825	n-Heptane		
		4855	n-Hexane		
		5090	n-Propylbenzene		
		5250	o-Xylene		
		5100	Styrene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5120	Tetrahydrofuran (THF)		
		5140	Toluene		
		4685	trans-1,3-		

Eurofins Air Toxics

180 Blue Ravine Road, Ste. B

Folsom, CA 95630

ORELAP ID: CA300005

EPA CODE: CA00933

Certificate: CA300005 - 017

Issue Date: 10/18/2022 Expiration Date: 10/17/2023

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
			Dichloropropylene		
		5170	Trichloroethene (Trichloroethylene)		
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
		5235	Vinyl chloride		
		5260	Xylene (total)		
	EPA TO-15			10248803	VOCs collected in Canisters by GC/MS
		5160	1,1,1-Trichloroethane		
		5110	1,1,2,2-Tetrachloroethane		
		5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
		5165	1,1,2-Trichloroethane		
		4630	1,1-Dichloroethane		
		4640	1,1-Dichloroethylene		
		5180	1,2,3-Trichloropropane		
		5182	1,2,3-Trimethylbenzene		
		5155	1,2,4-Trichlorobenzene		
		5210	1,2,4-Trimethylbenzene		
		4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
		4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)		
		4610	1,2-Dichlorobenzene		
		4635	1,2-Dichloroethane (Ethylene dichloride)		
		4655	1,2-Dichloropropane		
		5215	1,3,5-Trimethylbenzene		
		9318	1,3-Butadiene		
		4615	1,3-Dichlorobenzene		
		4676	1,3-Diethylbenzene		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		4620	1,4-Dichlorobenzene		
		4735	1,4-Dioxane (1,4-Diethyleneoxide)		
		4917	1-Butene		
		4833	1-Pentene		
		4836	1-Propene (Propylene)		
		5220	2,2,4-Trimethylpentane		
		4666	2,2-Dimethylbutane		
		4667	2,3,4-Trimethylpentane		
		4669	2,3-Dimethylbutane		
		4671	2,3-Dimethylpentane		
		4672	2,4-Dimethylpentane		
		4410	2-Butanone (Methyl ethyl ketone, MEK)		
		4535	2-Chlorotoluene		
		4538	2-Ethyltoluene		
		4860	2-Hexanone (MBK)		
		4934	2-Methyl-2-Butene		
		4937	2-Methylbutadiene (Isoprene)		
		4938	2-Methylbutane (Isopentane)		
		4939	2-Methylheptane		
		4946	2-Methylhexane		
		4941	2-Methylpentane (Isohexane)		
		4942	2-methylpropane (Isobutane)		
		4531	3-Ethyltoluene (1-Methyl-3-ethylbenzene)		
		4529	3-Methyl-1-Butene		
		4532	3-Methylheptane		
		4533	3-Methylhexane		
		4534	3-Methylpentane		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		4542	4-Ethyltoluene		
		4910	4-Isopropyltoluene (p-Cymene)		
		4913	4-Methyl-1-Pentene		
		4995	4-Methyl-2-pentanone (MIBK)		
		4300	Acetaldehyde		
		4315	Acetone		
		4320	Acetonitrile		
		4323	Acetylene		
		4325	Acrolein (Propenal)		
		4340	Acrylonitrile		
		4355	Allyl chloride (3-Chloropropene)		
		4357	alpha-Methylstyrene		
		4375	Benzene		
		5635	Benzyl chloride		
		4390	Bromochloromethane		
		4395	Bromodichloromethane		
		4400	Bromoform		
		4450	Carbon disulfide		
		4455	Carbon tetrachloride		
		4475	Chlorobenzene		
		4575	Chlorodibromomethane		
		4577	Chlorodifluoromethane (Freon-22)		
		4485	Chloroethane (Ethyl chloride)		
		4505	Chloroform		
		4525	Chloroprene (2-Chloro-1,3-butadiene)		
		4705	cis & trans-1,2-Dichloroethene		
		4680	cis-1,3-Dichloropropene		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		4602	cis-2-Butene		
		4604	cis-2-Hexene		
		4603	cis-2-pentene		
		4555	Cyclohexane		
		4562	Cyclopentane		
		4563	Cyclopentene		
		4595	Dibromomethane (Methylene bromide)		
		4625	Dichlorodifluoromethane (Freon-12)		
		4627	Dichlorofluoromethane (Freon 21)		
		4725	Diethyl ether		
		4747	Ethane		
		4750	Ethanol		
		4752	Ethene		
		4755	Ethyl acetate		
		4765	Ethylbenzene		
		4835	Hexachlorobutadiene		
		4895	Isopropyl alcohol (2-Propanol, Isopropanol)		
		4900	Isopropylbenzene (Cumene)		
		5240	m+p-xylene		
		4950	Methyl bromide (Bromomethane)		
		4960	Methyl chloride (Chloromethane)		
		4990	Methyl methacrylate		
		5000	Methyl tert-butyl ether (MTBE)		
		4965	Methylcyclohexane		
		4966	Methylcyclopentane		
		4975	Methylene chloride (Dichloromethane)		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		5005	Naphthalene		
		5007	n-Butane		
		4435	n-Butylbenzene		
		5875	n-Decane		
		4825	n-Heptane		
		4855	n-Hexane		
		5026	n-Nonane		
		5027	n-Octane		
		5028	n-Pentane		
		5029	n-Propane		
		5090	n-Propylbenzene		
		6747	n-Undecane		
		5250	o-Xylene		
		5253	p-Diethylbenzene		
		4440	sec-Butylbenzene		
		5100	Styrene		
		4420	tert-Butyl alcohol		
		4445	tert-Butylbenzene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5120	Tetrahydrofuran (THF)		
		5140	Toluene		
		4685	trans-1,3-Dichloropropylene		
		4607	trans-2-Butene		
		4606	trans-2-Hexene		
		4608	trans-2-pentene		
		5170	Trichloroethene (Trichloroethylene)		
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
		5225	Vinyl acetate		
		5230	Vinyl bromide		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
			(Bromoethane)		
		5235	Vinyl chloride		
		5260	Xylene (total)		
	EPA TO-15 GC/MS SIM			10248858	VOCs collected in Canisters by GC/MS SIM
		5160	1,1,1-Trichloroethane		
		5110	1,1,2,2-Tetrachloroethane		
		5185	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)		
		5165	1,1,2-Trichloroethane		
		4630	1,1-Dichloroethane		
		4640	1,1-Dichloroethylene		
		4585	1,2-Dibromoethane (EDB, Ethylene dibromide)		
		4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)		
		4610	1,2-Dichlorobenzene		
		4635	1,2-Dichloroethane (Ethylene dichloride)		
		4615	1,3-Dichlorobenzene		
		4620	1,4-Dichlorobenzene		
		4375	Benzene		
		4455	Carbon tetrachloride		
		4475	Chlorobenzene		
		4485	Chloroethane (Ethyl chloride)		
		4505	Chloroform		
		4645	cis-1,2-Dichloroethylene		
		4625	Dichlorodifluoromethane (Freon-12)		
		4765	Ethylbenzene		
		4795	Ethylene oxide		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		5240	m+p-xylene		
		4960	Methyl chloride (Chloromethane)		
		5000	Methyl tert-butyl ether (MTBE)		
		5005	Naphthalene		
		5250	o-Xylene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5140	Toluene		
		4700	trans-1,2-Dichloroethylene		
		4685	trans-1,3-Dichloropropylene		
		5170	Trichloroethene (Trichloroethylene)		
		5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)		
		5235	Vinyl chloride		
	EPA TO-17			10312206	Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes
		4640	1,1-Dichloroethylene		
		4735	1,4-Dioxane (1,4-Diethyleneoxide)		
		6380	1-Methylnaphthalene		
		6385	2-Methylnaphthalene		
		5500	Acenaphthene		
		5505	Acenaphthylene		
		5555	Anthracene		
		4375	Benzene		
		4505	Chloroform		
		4645	cis-1,2-Dichloroethylene		
		4765	Ethylbenzene		
		6265	Fluoranthene		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		6270	Fluorene		
		4895	Isopropyl alcohol (2-Propanol, Isopropanol)		
		5240	m+p-xylene		
		5005	Naphthalene		
		5250	o-Xylene		
		6615	Phenanthrene		
		6665	Pyrene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5140	Toluene		
		4700	trans-1,2-Dichloroethylene		
		5170	Trichloroethene (Trichloroethylene)		
		5235	Vinyl chloride		
		5260	Xylene (total)		
	EPA TO-17 Modified 2			10312217	Hydrocarbons in Ambient Air Using WMS Passive Sampling Tubes
		5160	1,1,1-Trichloroethane		
		5110	1,1,2,2-Tetrachloroethane		
		5165	1,1,2-Trichloroethane		
		4630	1,1-Dichloroethane		
		4640	1,1-Dichloroethylene		
		5150	1,2,3-Trichlorobenzene		
		5155	1,2,4-Trichlorobenzene		
		5210	1,2,4-Trimethylbenzene		
		4610	1,2-Dichlorobenzene		
		4635	1,2-Dichloroethane (Ethylene dichloride)		
		5215	1,3,5-Trimethylbenzene		
		4615	1,3-Dichlorobenzene		
		4620	1,4-Dichlorobenzene		

OREGON

Environmental Laboratory Accreditation Program

ORELAP Fields of Accreditation

Eurofins Air Toxics
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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		9546	1,4-Dithiane		
		4410	2-Butanone (Methyl ethyl ketone, MEK)		
		4995	4-Methyl-2-pentanone (MIBK)		
		6698	alpha-Pinene		
		4375	Benzene		
		4455	Carbon tetrachloride		
		4475	Chlorobenzene		
		4505	Chloroform		
		4645	cis-1,2-Dichloroethylene		
		4555	Cyclohexane		
		6208	d-Limonene		
		4750	Ethanol		
		4755	Ethyl acetate		
		4765	Ethylbenzene		
		6774	Halothane (2-Bromo-2-chloro-1,1,1-trifluoroethane)		
		5240	m+p-xylene		
		4960	Methyl chloride (Chloromethane)		
		4990	Methyl methacrylate		
		5000	Methyl tert-butyl ether (MTBE)		
		5005	Naphthalene		
		4825	n-Heptane		
		4855	n-Hexane		
		5090	n-Propylbenzene		
		5250	o-Xylene		
		5100	Styrene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5140	Toluene		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		4700	trans-1,2-Dichloroethylene		
		5170	Trichloroethene (Trichloroethylene)		
		5235	Vinyl chloride		
	EPA TO-3			10312400	Method for the Determination of Volatile Organic Compounds in Ambient Air Using Cryogenic Preconcentration Techniques and Gas Chromatography With Flame Ionization and Electron Capture Detection
		9408	Gasoline range organics (GRO)		
	Modified EPA TO-17 Passive RAD130 Tube 2			60032351	The Determination of Hydrocarbons in Air Via RAD130 RADIELLO Passive Sample Tubes
		5160	1,1,1-Trichloroethane		
		5110	1,1,2,2-Tetrachloroethane		
		5165	1,1,2-Trichloroethane		
		4630	1,1-Dichloroethane		
		4640	1,1-Dichloroethylene		
		5210	1,2,4-Trimethylbenzene		
		4610	1,2-Dichlorobenzene		
		4635	1,2-Dichloroethane (Ethylene dichloride)		
		5215	1,3,5-Trimethylbenzene		
		4615	1,3-Dichlorobenzene		
		4620	1,4-Dichlorobenzene		
		4410	2-Butanone (Methyl ethyl ketone, MEK)		
		4995	4-Methyl-2-pentanone (MIBK)		
		4375	Benzene		
		4455	Carbon tetrachloride		
		4475	Chlorobenzene		
		4505	Chloroform		
		4645	cis-1,2-Dichloroethylene		
		4555	Cyclohexane		

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Matrix	Reference	Analyte Code	Analyte	Method Code	Description
		4750	Ethanol		
		4755	Ethyl acetate		
		4765	Ethylbenzene		
		5240	m+p-xylene		
		5000	Methyl tert-butyl ether (MTBE)		
		5005	Naphthalene		
		4825	n-Heptane		
		4855	n-Hexane		
		5090	n-Propylbenzene		
		5250	o-Xylene		
		5100	Styrene		
		5115	Tetrachloroethylene (Perchloroethylene)		
		5140	Toluene		
		4700	trans-1,2-Dichloroethylene		
		5170	Trichloroethene (Trichloroethylene)		
		5235	Vinyl chloride		

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2023
Issued April 01, 2022

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. HEIDI HAYES
EUROFINS AIR TOXICS
180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630

NY Lab Id No: 11291

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES AIR AND EMISSIONS
All approved analytes are listed below:

Chlorinated Hydrocarbons	
1,2,4-Trichlorobenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Hexachlorobutadiene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Polynuclear Aromatics	
Acenaphthene	EPA TO-13A
Acenaphthylene	EPA TO-13A
Anthracene	EPA TO-13A
Benzo(a)anthracene	EPA TO-13A
Benzo(a)pyrene	EPA TO-13A
Benzo(b)fluoranthene	EPA TO-13A
Benzo(g,h,i)perylene	EPA TO-13A
Benzo(k)fluoranthene	EPA TO-13A
Chrysene	EPA TO-13A
Dibenzo(a,h)anthracene	EPA TO-13A
Fluoranthene	EPA TO-13A
Fluorene	EPA TO-13A
Indeno(1,2,3-cd)pyrene	EPA TO-13A
Naphthalene	EPA TO-13A
	EPA TO-17
	EPA TO-14A
	EPA TO-15
Polynuclear Aromatics	
Phenanthrene	EPA TO-13A
Pyrene	EPA TO-13A
Purgeable Aromatics	
1,2,4-Trimethylbenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,2-Dichlorobenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,3,5-Trimethylbenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,3-Dichlorobenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,4-Dichlorobenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Benzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Chlorobenzene	EPA TO-17
	EPA TO-14A
	EPA TO-15

Serial No.: 64608

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Purgeable Aromatics	
Ethyl benzene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Isopropylbenzene	EPA TO-17
	EPA TO-15
m/p-Xylenes	EPA TO-17
	EPA TO-15
o-Xylene	EPA TO-17
	EPA TO-15
Styrene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Toluene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Total Xylenes	EPA TO-17
	EPA TO-14A
	EPA TO-15
Purgeable Halocarbons	
1,1,1-Trichloroethane	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,1,2,2-Tetrachloroethane	EPA TO-14A
	EPA TO-15
Purgeable Halocarbons	
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,1,2-Trichloroethane	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,1-Dichloroethane	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,1-Dichloroethene	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,2-Dibromoethane	EPA TO-14A
	EPA TO-15
1,2-Dichloroethane	EPA TO-17
	EPA TO-14A
	EPA TO-15
1,2-Dichloropropane	EPA TO-17
	EPA TO-14A
	EPA TO-15
3-Chloropropene (Allyl chloride)	EPA TO-15
Bromodichloromethane	EPA TO-14A
	EPA TO-15
Bromoform	EPA TO-15

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All approved analytes are listed below:

Purgeable Halocarbons	
Bromomethane	EPA TO-14A
	EPA TO-15
Carbon tetrachloride	EPA TO-17
	EPA TO-14A
	EPA TO-15
Chloroethane	EPA TO-14A
	EPA TO-15
Chloroform	EPA TO-17
	EPA TO-14A
	EPA TO-15
Chloromethane	EPA TO-14A
	EPA TO-15
cis-1,2-Dichloroethene	EPA TO-17
	EPA TO-14A
	EPA TO-15
cis-1,3-Dichloropropene	EPA TO-14A
	EPA TO-15
Dibromochloromethane	EPA TO-15
Dichlorodifluoromethane	EPA TO-14A
	EPA TO-15
Methylene chloride	EPA TO-17
	EPA TO-14A
	EPA TO-15
Tetrachloroethene	EPA TO-17

Purgeable Halocarbons	
Tetrachloroethene	EPA TO-14A
	EPA TO-15
trans-1,2-Dichloroethene	EPA TO-17
	EPA TO-14A
	EPA TO-15
trans-1,3-Dichloropropene	EPA TO-14A
	EPA TO-15
Trichloroethene	EPA TO-17
	EPA TO-14A
	EPA TO-15
Trichlorofluoromethane	EPA TO-17
	EPA TO-14A
	EPA TO-15
Vinyl chloride	EPA TO-17
	EPA TO-14A
	EPA TO-15
Volatile Chlorinated Organics	
Benzyl chloride	EPA TO-14A
	EPA TO-15
Volatile Organics	
1,2-Dichlorotetrafluoroethane	EPA TO-14A
	EPA TO-15
1,3-Butadiene	EPA TO-17
	EPA TO-14A

Serial No.: 64608

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2023
Issued April 01, 2022

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. HEIDI HAYES
EUROFINS AIR TOXICS
180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630

NY Lab Id No: 11291

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES AIR AND EMISSIONS
All approved analytes are listed below:

Volatile Organics

1,3-Butadiene	EPA TO-15
1,4-Dioxane	EPA TO-17
	EPA TO-15
2,2,4-Trimethylpentane	EPA TO-17
	EPA TO-15
2-Butanone (Methylethyl ketone)	EPA TO-17
	EPA TO-15
4-Methyl-2-Pentanone	EPA TO-15
Acetone	EPA TO-15
Carbon Disulfide	EPA TO-17
	EPA TO-15
Cyclohexane	EPA TO-15
Hexane	EPA TO-17
	EPA TO-15
Isopropanol	EPA TO-15
Methyl tert-butyl ether	EPA TO-17
	EPA TO-15
n-Heptane	EPA TO-15
Vinyl acetate	EPA TO-15

NEW YORK STATE | Department of Health

Serial No.: 64608

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NELAP RECOGNIZED TNI ACCREDITATION BODY

APPENDIX F

LABORATORY STANDARD OPERATING PROCEDURES

eurofins	Always check on-line for validity.	Level:
Document number: **QA-SOP11880**	**Laboratory Equipment Verifications - Balance, Syringe, Pipette, Weights, and Other Equipment**	**Standard Operating Procedure**
Old Reference: **1-P-QM-QMA-9015389; DOD - LOM-SOP-ES-235**		
Version: **13**		Organisation level: **5-Sub-BU**
Approved by: **UKL3** Effective Date: **01-JUL-2022**	Document users: **4_EUUSLA_ELLE_All_Technical**	Responsible: **5_EUUSLA_Env Quality Assurance_All**

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Revision Log
Reference
Cross Reference
Scope
Definitions
Personnel Training and Qualifications
Safety Precautions and Waste Handling
Procedure
A. Balances
B. Weights
C. Syringes
D. Pipettes
E. Class B Volumetric labware
F. Verification of labware to Class A glassware specifications
G. Other Laboratory Equipment Requiring Verification
Documentation of Verification
Calculations

Revision Log

Revision:	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Cross Reference	Enhancement	Added Form *QA-FRM50673*
Procedure B.4.	Enhancement	Added criteria and Form *QA-FRM50673* to evaluate the impact of 'F' qualified weights on ELLE

Revision:	12	**Effective Date:**	Oct 8, 2021
Section	**Justification**	**Changes**	
Revision Log	Formatting requirement	Removed revision logs up to the previous version	
Title	Clarification	Revised to include all Equipment	
Purpose	Redundant Information	Removed section, info is in Scope	

Revision:	12	**Effective Date:**	Oct 8, 2021
Scope	Clarification		Listed scope by procedure. Referenced other verification SOPs.
Definitions	Clarification		Added definitions of Instrument vs. Equipment
Procedure A.	PALA		Added that the 3 year verification criteria is for PALA weight sets
Procedure G.	TNI2016V1M4		Added requirements for Equipment verification.

Reference

1. *ASTM Standard Specification for Laboratory Weights and Precision Mass Standards,* E 617-97.

2. *ASTM Standard Specification for Laboratory Glass Volumetric Flasks*, E 288-03

3. *ASTM Standard Specification for Laboratory Glass Graduated Cylinders*, E 1272-02

4. *DoD Quality Systems Manual for Environmental Laboratories*, current version

5. *The TNI Standards*, current version

6. *25 Pa 252.306*, current version

7. Center of Expertise in Environmental Analysis of Quebec; *Guidelines for Analytical Work in Chemistry*, DR-12-SCA-01, March 3, 2011.

8. *Chemical Hygiene Plan*, current version

Cross Reference

Document	Document Title
QA-SOP11183	Thermometer Use and Calibration
QA-SOP11901	Instrument Maintenance and Calibration
QA-FRM45536	Syringe Verifications Template
QA-FRM50673	F Qualified Weight Impact Assessment Spreadsheet

Scope

This procedure addresses the following routine maintenance and calibration verification procedures for laboratory equipment:

- Balances (analytical and top-loading) - Procedure A.
- ASTM Class 1 Weights - Procedure B.
- Volumetric Syringe Verification (≤10-µL in size) - Procedure C.
- Mechanical pipettes (i.e. eppendorf-style pipettes, repipettors) - Procedure D.
- Volumetric Labware to ASTM Class B Standards - Procedure E.
- Volumetric Labware to ASTM Class A Standards - Procedure F.
- Laboratory Equipment Requiring Verification - Procedure G.

Thermometers are addressed in *QA-SOP11183*. Instruments are addressed in *QA-SOP11901*. Bottle-top dispensers are verified by this procedure only if used for critical volumes. The requirement for verification applies to equipment where quantitative results are dependent on their accuracy.

Some regulatory programs or special-use equipment have additional requirements for calibration checks and/or maintenance. Because of the wide variety of these devices used by the laboratory, it is recommended that analysts also refer to the manufacturer’s instruction manual for additional information.

NOTE: This procedure does not apply to instrument autosampler syringes.

Definitions

1. NIST – National Institute of Standards and Technology

2. ASTM – American Society for Testing and Materials

3. Class 1 Weights (ASTM) – These weights are designated as high-precision standards for calibration. They are used for the monthly (or daily, if desired) calibration check of balances as reference standards for calibrating other weights. These weights are recommended for calibration of balances using optical or electrical methods for accurately weighing quantities below 20 mg.

4. DOD QSM – Department of Defense Quality Systems Manual

5. Sensitivity – The smallest amount that the equipment can measure.

6. Accuracy - The degree of agreement between an observed value and an accepted reference value.

7. Precision - The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

8. Equipment - machines that are required to complete the steps of the analysis - i.e. autoclaves, hot water baths, digestors, sonicators, microwaves, etc. Equipment does not generate analytical data.

9. Instrument - Instruments provide a measurable result of an analyte. Instruments have specific calibration criteria. See *QA-SOP11901*.

Personnel Training and Qualifications

Personnel performing this procedure must have documentation of reading, understanding and agreeing to follow this version of the SOP.

Analysts must be trained to use the equipment and work with an experienced analyst prior to performing the verification procedure independently.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Procedure

A. Balances

1. Operation

a. Analytical balances must be in an area that is vibration-free in order for the balance to remain level and supply accurate readings. A stabilizing slab can be used on a counter top or in a hood in order to minimize vibrations.

b. Balances must be located away from laboratory traffic and protected from drafts and sudden temperature and humidity changes whenever possible.

c. Special precautions must be taken to avoid spillage of chemicals on the pan or inside the balance case. The interior of the balance housing must be kept scrupulously clean.

d. Before using any balance, check to assure that it is level. In order to obtain accurate readings, a balance must be level. It is the responsibility of each user to ensure that the bubble within the level is fully within the indicator circle each time that they approach the balance for use. If any portion of the bubble is outside of the circle, the balance must be brought back to level and the calibration re-verified prior to use.

e. Do not overload the balance and avoid jarring. Gently place all objects to be weighed on the pan.

f. Each balance is marked with its range and it must not be used for weights outside that range. The total weight placed on the balance is equal to the weight of the tared vessel plus the vessel contents and this total must be within the weight range capacity of the balance. Balance calibration checks (daily and monthly) must span the range of use.

g. A balance could be marked as limited use. The firm that performs the annual check may add a limited use sticker to the balance that will state the limitation such as "corners". This indicates that the balance does not weigh properly when the load is not placed in the center of the pan. Therefore caution should be used to properly center all loads when weighing.

2. Balance Checks

NOTE: To perform the routine checks, tare the balance with a container representative of the weighing vessel normally used.

a. Daily calibration verification

(1) Check each balance for proper calibration prior to use on each day that it is used. Perform using at least three Class 1 weights that bracket the range of use.

(2) In order to preserve the highly accurate nature of the weights, they must be handled with great care. Ensure the balance pan is free of debris before placing a weight on the pan. Never touch weights with anything other than forceps, and transfer the weights directly from the case to the pan of the balance.

(3) If a balance must be physically moved during the day, perform an additional check of the level and calibration.

b. Acceptance criteria

(1) For **top-loading balances**, the reading must be ±2% or ±0.02g of the true value of the weight, whichever is greater.

(2) For **analytical balances**, the reading must be ±0.1% or ±0.5mg, whichever is greater.

c. Corrective action

(1) For a balance that is not operating within the stated acceptance criteria, first verify the cleanliness of the weights. Clean weights and perform the check again. Some balances are equipped with built-in calibration weights permitting automatic calibration. Consult the manufacturer's manual to see if any adjustments are recommended to correct the problem.

(2) If the problem cannot be resolved, immediately take the balance out of service and place a call to the manufacturer or the professional balance service firm to address the situation. See *QA-SOP11901* in the event of a calibration check failure or the need to take the balance out of service.

(3) Data generated since the last acceptable daily/monthly calibration must be evaluated by management on a case-by-case basis.

d. Annual check

(1) An annual check of the balance must be made by a qualified (ISO *17025 accredited*) professional service firm. This check includes a calibration verification and appropriate preventative maintenance (e.g., cleaning). The Environmental Quality Assurance Department is responsible for scheduling this annual check.

(2) A confirmation of the calibration range defined on the label by the balance is performed following the annual calibration of the balance.

B. Weights

1. If weights are dropped or potentially damaged they need to be checked against alternate weights either from Quality Assurance(QA) or another weight set.

2. Document the comparison in the logbook. Be sure to include the serial number of the alternate weights.

3. All weights must meet the defined acceptance criteria.

4. Reclassification

a. Class 1 weights are available from the Quality Assurance (QA) department for use. The weights must be signed out and returned upon completion of the check. It is the responsibility of QA to have their weights reclassified every 3 years by a qualified (ISO 17025 accredited) calibration firm. A 3-year cycle is required under PALA (Quebec) accreditation. This weight set is used for checking balances in the labs that come under the PALA scope.

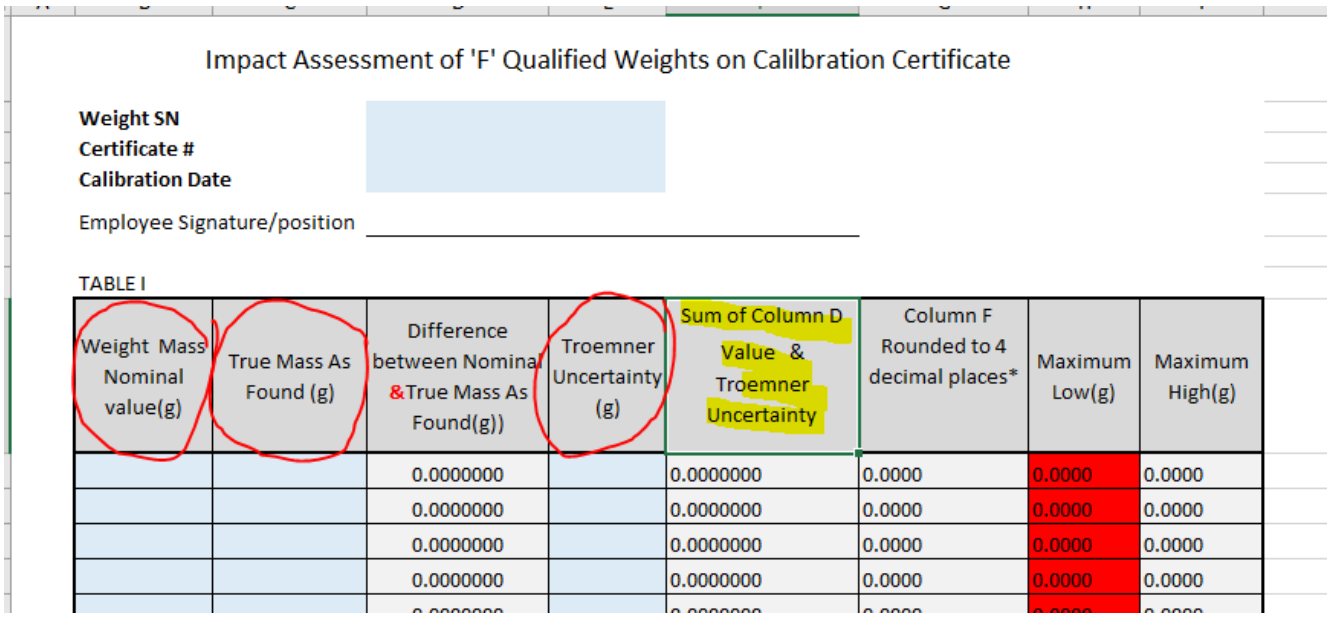
b. If a technical department not under PALA accreditation chooses to purchase their own Class 1 weights, it is their responsibility to ensure they are reclassified every 5 years by a qualified (ISO 17025 accredited) calibration firm.

c. A certificate of reclassification is maintained on file to document traceability to NIST materials used in the recalibration operation. This certification statement, provided with mass standards, certifies that the nominal values of the weights are correct within the prescribed limits. The reclassification certificates for the weights are filed in QA.

d. Any weight that is qualified on the reclassification certificate as failing the 'As Found tolerance test' ('F' qualified) must be evaluated by a member of the QA department prior to returning the weight to use in the department.

(1) Use Form *QA-FRM50673* (F Qualified Weight Impact Assessment Spreadsheet) to determine if there is an impact to balance calibration checks that were performed using the 'F' qualified weights.

(a.) Populate Table I with the following values from the calibration certificate; Weight Mass Nominal value, True Mass As Found(g) and the Uncertainty .



Impact Assessment of 'F' Qualified Weights on Calilbration Certificate

Weight SN
Certificate #
Calibration Date

Employee Signature/position _____

TABLE I

Weight Mass Nominal value(g)	True Mass As Found (g)	Difference between Nominal &True Mass As Found(g))	Troemner Uncertainty (g)	Sum of Column D Value & Troemner Uncertainty	Column F Rounded to 4 decimal places*	Maximum Low(g)	Maximum High(g)
		0.0000000		0.0000000	0.0000	0.0000	0.0000
		0.0000000		0.0000000	0.0000	0.0000	0.0000
		0.0000000		0.0000000	0.0000	0.0000	0.0000
		0.0000000		0.0000000	0.0000	0.0000	0.0000

(b.) The 'Uncertainty' value is added to the difference between the 'Weight Mass Nominal Value' and the 'True Mass As found' reflects the the worst case scenario . The value is rounded to 4 decimal places to reflect the highest level of precision achieved with the use of the analytical balances at ELLE.

(c.) A Maximum Low(g) or Maximum High(g) value in Table I is calculated based on the subtraction or addition of the rounded value calculated above in step (b).

(d.) The Table II 'Analytical Balance Criteria' calculation is based on the following analytical balance acceptance criteria defined in Procedure A,3.

For analytical balances, the reading must be ±0.1% or ±0.5mg, whichever is greater.

(e.) The low and high 'Balance Acceptance Range' in Table II is calculated based on the subtraction or addition of the value calculated above in step (d).

(f.) Interpreting the results

1. A Maximum Low(g) or Maximum High(g) value in Table I that is within the low and high balance acceptance limits demonstrates that the 'F' qualification assigned to the weight by the Calibration company had no impact on the ELLE balance calibration checks performed while using that weight.

2. A Maximum Low(g) or Maximum High(g) value in Table I value that falls outside of the low or high balance acceptance limits requires further investigation to determine if there was an impact on the ELLE balance calibration checks performed using the 'F' qualified weight. These values will be highlighted red in Table I.

C. Syringes

1. Verification

a. Verification is not required for syringes used for handling gas standards.

b. When performing this verification, gloves must be worn to eliminate the possibility of oils from your hands adding weight to the weighing vessel.

c. Verification of Syringes

(1) Pull a volume of reagent water into the syringe that represents ½ the total volume of the syringe (e.g. 25 µL for a 50-µL syringe, 100 µL for a 200-µL syringe).

(2) Ensure that there are no air bubbles and accurately set the syringe to the volume to be measured.

(3) Dispense the reagent water into a tared medicine cup or small vial on an analytical balance.

(4) The weight must fall within the tolerance limits listed in Table 1 below.

Table 1 - Syringe Tolerance Limits

Syringe Size (µL)	Volume of Water (µL)	Target Weight (g)	Tolerance Limit (g)
10	5	0.005	(±4%) 0.0048 - 0.0052
20	10	0.010	(±2%) 0.0098 - 0.0102
50	25	0.025	(±2%) 0.0245 - 0.0255
100	50	0.050	(±2%) 0.049 - 0.051
200	100	0.100	(±2%) 0.098 - 0.102
500	250	0.25	(±2%) 0.245 - 0.255

1000	500	0.5	(±2%) 0.49 – 0.51

2. Verification Frequency

a. Initial verification upon receipt:

(1) Perform ten (10) trials as described in Procedure C.1.

(2) If there are several syringes from one lot, test one representative syringe from that lot.

(3) Do not place a syringe (or lot) that is outside the acceptable tolerance into general use.

(4) Notify the department supervisor when new syringes fail and ensure that the vendor is contacted.

(5) If the syringe is within the acceptable tolerance apply the appropriate tape label, using designated color scheme from Table 2 below, and place it in the laboratory for general use.

Table 2 - Syringe Tape Color Code	
Month/Year of calibration	Tape Color
January – even year	Red
July – even year	Blue
January – odd year	Yellow
July – odd year	Green

b. Continuing verification is performed every six months in January and July.

(1) Perform three (3) trials as described in Procedure C.1.

(2) If the syringe is within the acceptable tolerance apply the appropriate tape label and place it in the laboratory for general use.

(3) **Discard any syringe that is outside the tolerance during this verification.**

c. If evidence of wear or deterioration is observed during normal lab operations, recheck the syringe to ensure proper operation and accuracy or discard.

D. Pipettes

Pipettes - eppendorf-style fixed volume or adjustable pipettes, bottle-top dispensers, repipettors

NOTE: Any pipette found to be contaminated by aspirated liquid or contain a plunger that is excessively "sticky" must be cleaned and verified prior to use.

1. Operation – refer to manufacturer's instructions for specific steps. The following actions need to be taken into account for any pipette.

a. Pipettes held at an angle will take up more liquid than pipettes held vertically. Pipettes should be held in an upright, vertical position.

b. The density of liquid is dependent on the temperature of the water. Hot and cold liquids can lead to errors in the amount of liquid aspirated. To avoid temperature interferences, pipette liquids that have reached ambient temperature.

c. The measured weight to set volume comparison is made based on the density of reagent water being equivalent to 1 g/mL at ambient temperature.

d. For adjustable pipettes, never use a setting below the lowest volume or above the highest volume of the pipette.

e. Change the pipette tip between each trial.

2. Verification

a. Must be performed each day of use, prior to use. Bottle-top dispensers used for non-critical volumes may have quarterly verification. Daily verification must be used in applications where quantitative results are dependent on their accuracy.

b. Perform and record a minimum of three trials at each nominal volume (volume of use).

(1) The mean must be within ±2% of the nominal volume (bias).

(2) Based on the replicate measurements, RSD must be ≤ 1% of the nominal volume (precision).

(3) If the check fails, the test can be repeated but there must be two passing checks. Otherwise, perform cleaning and maintenance followed by verification.

E. Class B Volumetric labware

Class B Volumetric labware - e.g. Teflon and HDPE flasks and graduated cylinders that are not used for critical volumes.

1. Verification

a. If the labware is to be used for critical volume preparations (i.e. standard preparation), the labware must be verified to Class A specifications per Procedure F. below.

b. Must be performed by lot, or prior to first use and annually thereafter.

c. Perform and record 10 trials at each nominal volume (volume of use).

(1) The mean must be within ±2% of the nominal volume (bias).

(2) Based on the replicate measurements, RSD must be ≤ 1% of the nominal volume (precision).

(3) If the check fails, the test can be repeated but there must be two passing checks. Otherwise, perform cleaning and maintenance followed by verification.

F. Verification of labware to Class A glassware specifications

1. Tare the clean and dry volumetric on a top-loading balance with at least 0.001 g specificity.

2. Fill volumetric to the mark with reagent water, taking care not to splash water on the walls of the volumetric.

3. Measure and record the weight of the reagent water in the volumetric.

4. Determine the temperature by placing a thermometer in the volumetric after weighing.

5. Calculate the volume (see Calculation section).

6. Verify that the weight meets the tolerances listed in Table 4 below.

7. Engrave an "A" next to the engraved serial number as verification that the volumetric has been checked and meets Class A acceptance criteria.

Table 4 - Required tolerances

Capacity (ml)	Class A flasks	Class A graduated

	(+/- ml)	cylinders (+/- ml)
5	0.02	0.05
10	0.02	0.10
25	0.03	0.10
50	0.05	0.25
100	0.08	0.50
200	0.10	0.50
250	0.12	1.00
500	0.20	2.00
1000	0.30	3.00
2500	0.50	6.00

G. Other Laboratory Equipment Requiring Verification

1.
All equipment that has an effect on the accuracy, precision, or validity of an analysis or preparation must be calibrated and/or verified at least annually. The procedures must be listed in the department's Work Instructions. Use form *QA-FRM41248* to track scheduled maintenance for equipment.

2. This section lists some common laboratory equipment and the criteria for annual verifications. However, some methods, regulatory programs, special-use equipment, or manufacturer's instructions may require other verifications or more frequent verifications.

3. Any equipment verification requirements must be detailed in the department's work instructions or SOPs.

4. Verification can be performed internally with measuring equipment with a current NIST-traceable certificate of analysis, or externally by an ISO 17025 certified vendor.

5. Microwaves - verify the temperature at least annually.

6. Autoclaves - verify the temperature and pressure at least annually.

7. Barometers - verify the pressure reading at least annually.

8. Tumblers, Shakers, Rotators with specific RPM specifications - verify the RPMs at least annually.

Documentation of Verification

A. All the above verifications, any repairs or maintenance must be documented in a maintenance and calibration logbook and/or a verification logbook or acceptable alternative (database, excel spreadsheet, etc.). The acceptance criteria must be noted in the log. Corrective action must be documented for any checks that are out of specification.

B. The unique identification of the equipment (balance, pipette, weight set, etc.) used to perform the various calibrations must also be documented.

Calculations

A. Percent Difference (%D):

$$\%D = \frac{Measured\ Weight - Targeted\ Weight}{Targeted\ Weight} \times 100$$

B. Relative Standard Deviation (RSD):

$$RSD = \frac{Standard\ Deviation\ of\ the\ data\ set}{Mean\ of\ the\ data\ set} \times 100$$

NOTE: The measured weight to set volume (targeted weight) comparison is made based on the density of reagent water being equivalent to 1 g/mL.

C. Volume Calculation for Class A glassware specifications:

$$V_{flask} = \frac{W_{flask+water} - W_{flask}}{\rho_{water}}$$

where:

Vflask = volume of the flask or graduated cylinder

Wflask + water = weight of the water and flask or graduated cylinder

Wflask = weight of the flask or graduated cylinder

*p*water = density of water based off the measured temperature

Density of reagent water	
Temperature °C	Density (g/ml)
16.0	0.99897
16.5	0.99889
17.0	0.99880
17.5	0.99871
18.0	0.99862
18.5	0.99853
19.0	0.99843
19.5	0.99833
20.0	0.99823
20.5	0.99812
21.0	0.99802
21.5	0.99791
22.0	0.99780
22.5	0.99768
23.0	0.99757

11183 Thermometer Use and Calibration
11901 Instrument Maintenance and Calibration
41248 Scheduled Maintenance
45536 Syringe Verifications Template
50673 F Qualified Weight Impact Assessment Spreadsheet

End of document

Version history

Version	Approval	Revision information	
12	30.SEP.2021		
12.1	01.OCT.2021	Corrected typographical error in title	
13	17.JUN.2022		

eurofins	Always check on-line for validity. **GC and GC/MS Instrumentation Maintenance**	Level: **Work Instruction**
Document number: **T-VOA-WI7619**		
Old Reference: **1-P-QM-PRO-9015467; DOD-SOP-MS-004**		
Version: **9**		Organisation level: **5-Sub-BU**
Approved by: **UCSS** Effective Date: **10-MAR-2017**	Document users: **6_EUUSLA_GC/MS Volatiles_All Analysts, 6_EUUSLA_GC/MS Volatiles_Management**	Responsible: **5_EUUSLA_GC/MS Volatiles_Manager**

Revision Log
Reference
Purpose
Scope
Basic Principles
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Procedure

Revision Log

Revision 09		**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Scope	Reflect current inventory	Added Agilent Technologies instrument 5977

Revision: 8	**Effective Date:** Feb 03, 2015	
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Title	Reflects combination of two former procedures	The new Title is: GC and GC/MS Instrument Maintenance
Throughout Document	Reflect re-identification of documents in EtQ	Replaced all prior Level 1, 2, 3, and 4 document numbers (analyses excluded) with EDR numbers
Reference	Clarification	Added GC references from1-P-QM-PRO-9015492
Purpose	Reflects current company name	Updated company name
Scope	Clarification	Added GC information from 1-P-QM-PRO-9015492
Procedure	Clarification	Added GC information from 1-P-QM-PRO-9015492
Appendix I	Enhancement	Added troubleshooting guide from 1-P-QM-PRO-9015492

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5. GC-17A, Ver. 3 User's Manual, Shimadzu, 1995.

6. *HP 5890A Shelf Reference Manual*. Hewlett-Packard, Sept 1983.

7. *Model 4560 Sample Concentrator Operator's Manual*. OI Analytical, Revision 1.0, March 1992

8. *Model 4551 Vial Multisampler Operator's Manual*. OI Analytical, Version 1.0, November 1999.

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15. *Agilent 7890A Gas Chromatograph Advanced User Guide*. Agilent Technologies, First Edition, March 2007.

16. *Archon Instruction Manual for Model 5100 Autosampler System*. Dynatech Precision Sampling Corporation, Revision I, 196 – 5100A, 1995.

17. *Chemical Hygiene Plan*, Current version.

Purpose

This document serves as a guideline for both general and comprehensive maintenance procedures to be used in the GC/MS and GC Volatiles Department at Eurofins Lancaster Laboratories Environmental (ELLE).

Scope

The guidelines outlined in this standard operating procedure are used when performing preventive or corrective maintenance on the following GC/MS and GC systems:

Hewlett-Packard (5890GC/5972MSD)

Hewlett-Packard/Agilent Technologies (6890GC/5973MSD)

Agilent Technologies (7890GC/5975MSD/5977MSD)

Shimadzu (GC/MS QP5000)

Hewlett-Packard (5890GC) / OI Analytical (4560, 4551, 4430, 5320)

Hewlett-Packard (5890GC) / OI Analytical (4560, 4551, 4430, 4410)

Hewlett-Packard (5890GC) / OI Analytical (4560, 4551, 5220, 5230)

Hewlett-Packard (6890GC) / OI Analytical (4560, 4551, 4430, 5320)

Hewlett-Packard (6890GC) / OI Analytical (4560, 4551, 4430, 4410)

Hewlett-Packard (6890GC) / OI Analytical (4560, 4551, 5220, 5230)

Agilent (7890A GC) / OI Analytical (4660, 4551, 4430, 4410)

Basic Principles
Maintenance is to be done in order to ensure maximum system performance.

Safety Precautions and Waste Handling
All laboratory waste is accumulated, managed and disposed of in accordance with Federal and State laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management and pollution prevention. Certain instrument preparations need to be made to ensure the personal safety of all laboratory employees or service personnel. For example, the mass spectrometer needs to be properly cooled and/or vented before the ion source is removed for cleaning. The necessary preparation is indicated in the specific instrument's manual for the desired maintenance procedure.

Personnel Training and Qualifications
All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP.

The analyst must mentor with a trained analyst. Mentoring includes observation of maintenance and hands-on practice. This continues until the trainee performs the maintenance independently.

Procedure
1. General maintenance – This is done on an as needed basis. The analyst informs the supervisor of the need for maintenance due to the instrument performance. Along with input from the supervisor or experienced analyst, it is determined what maintenance is needed. A rigid schedule is not followed for the frequency of mechanical pump or turbo pump oil changes. General maintenance involves the following:

a. Purge and Trap maintenance (GC and GC/MS)

b. Septum replacement (GCMS)

c. Mechanical or turbo pump oil changes (GC/MS)

2. Comprehensive maintenance – This is also done on an as needed basis. The analyst must inform the supervisor of the need for maintenance due to the instrument performance. Along with input from the supervisor, it is determined what maintenance is needed and whether the analyst, or the appropriate service personnel performs the maintenance. In the event that a supervisor is unavailable, an experienced analyst performs the maintenance deemed necessary. Comprehensive maintenance involves, but is not limited to the following:

a. Ion source cleaning (GC/MS)

b. Filament replacement (GC/MS)

c. Electron multiplier replacement (GC/MS)

d. Column replacement (GC and GC/MS)

e. Injection port cleaning or replacement (GC and GC/MS)

f. PID lamp replacement (GC)

The manuals for each instrument contain guidelines on the appropriate procedure for comprehensive maintenance.

3. Troubleshooting – Some common GC/MS problems are indicated by the following:

Symptom	Possible Cause	Solution
Inability to tune BFB	Dirty Source	Clean
High baseline	Clogged column/injection port	Clean/replace
Small or no peaks and high column pressure	Clogged injection port	Clean/replace
Poor peak shapes	Bad column/improper He flow	Replace/adjust flow

Note- See Appendix I for GC Troubleshooting

All service calls, maintenance and repairs must be recorded in the appropriate instrument's maintenance logbook. The logbook entry must include why maintenance was needed, a detailed description of the maintenance performed, and resolution (as left). Each entry must be signed (initials and employee number) and dated by the ELLE personnel who performed the maintenance or observed maintenance handled by an outside contractor. Maintenance logs are reviewed on a monthly basis for accuracy.

Appendix I

GC Troubleshooting Guide

Symptom	Instrument	Possible Cause	Remedy
Low purge flow	Purge & Trap	Purge flow regulator not set correctly	While in Purge-Ready, pressure gauge should be set to 20 PSI
		Leak in gas line upstream of sparge vessel	Check gas lines leading to purge flow regulator
		Clogged or dirty sparge filter	Inspect or replace sparge filter
		Clog in line downstream of sparge vessel	Inspect or replace lines to 6-port and trap
Low response	Purge & Trap	Transfer line not turned on	Turn on transfer line to correct temp.
		Trap not heating	Make sure trap is heating during desorb. Turn trap power on.
		Desorb time set to zero	Set desorb time to correct setting
		Low purge flow	See symptoms of low purge flow
		Leak in sparge vessel	

			Leak check sparge vessel and fix any leaks
		Purge pressure out of range	In purge, pressure gauge should read between 6-10 PSI
		Leak in gas line downstream of sparge vessel	Inspect or replace lines to 6-port and trap
		Clogged or dirty sparge filter	Inspect or replace sparge filter
	Detector	Detectors not turned on	Turn detectors on to correct temp.
		Detector gas flows not within specs	Adjust gas flows to proper settings
		PID electrometer not set correctly	Adjust setting of PID electrometer to correct setting
		Leak around PID lamp	Replace o-ring at base of PID lamp
	GC	Injector not turned on	Turn on injector to correct temp.
		Dirty septa in injection port	Replace septa in injection port

Symptom	Instrument	Possible Cause	Remedy
No response (FID)	Detector	Flame not lit	Ignite flame
		Detectors not turned on	Turn on detectors to correct temp
		Trap not turned on	Turn trap temp to on
		Desorb time set to zero	Set desorb time to correct setting
		Computer not acquiring data	Turn computer off and on
		Detector gas flows not within specs	Adjust gas flows to proper settings

No response (PID)	Detector	PID lamp not lit	Check lamp to see if it's lit; replace lamp if defective
		Detectors not turned on	Turn on detectors to correct temp
		Trap not turned on	Turn trap temp to on
		Desorb time set to zero	Set desorb time to correct setting
		Computer not acquiring data	Turn computer off and on
		Detector gas flows not within specs	Adjust gas flows to proper settings
		Leak around PID lamp	Replace o-ring at base of PID lamp

Noisy baseline (FID)	Detector	Detector gas flows not within specs	Adjust gas flows to proper settings
		Data integration set to low in Chromperfect method	Adjust area reject, threshold, and peak width in method
		Bad wire connection	Check wiring for loose connections or weak spots

Noisy baseline (PID)	Detector	Old PID lamp	Inspect or replace PID lamp

		Voltage of PID lamp set too low	Increase PID voltage on PID power supply
		Fault in Chromperfect data board	Reboot computer
		Detector gas flows not within specs	Adjust gas flows to proper settings
		Data integration set to low in Chromperfect	Adjust area reject, threshold, and peak width in method
		Bad wire connection	Check wiring for loose connections or weak spots

Symptom	Instrument	Possible Cause	Remedy
Shifting retention times	GC	Leak in gas line downstream of sparge vessel	Inspect or replace lines to 6-port and trap
		Leak at injection port	Inspect around injection port for leaks
		Column flow too low for mass flow controller	Increase column flow
		GC oven exhaust doors not closing during heat ramp	Motor for exhaust doors will need replaced
		Faulty mass flow controller	Inspect and replace mass flow controller

No surrogates or internal standards	SIM/SAM	SIM not turned on	Turn SIM on in 4560 configuration
		No response (see symptom for No response)	See causes for no response
		SIM board fault	Inspect SIM LEDs while sampling to ensure power to SIM
		Bubble in standard syringe	Inspect syringe for leaks
		SIM spiker valve not turning correctly	Inspect and replace SIM spiker valve

Surrogate Standard inconsistent	SIM/SAM	Standard in wrong SIM syringe	Refill SIM syringe with correct standard
		SIM spiker valve not turning correctly	Inspect and replace SIM spiker valve
		Dirty sparge filter or sparge vessel	Change sparge filter, clean sparge vessel
		Dirty lines from 6-port valve	Inspect or replace lines to 6-port and trap
		Dirty water management	Inspect or replace Water management
		Standard syringe not seated properly in SIM valve	Tighten standard syringe
		Bubble in standard syringe	Inspect syringe for leaks
		SAM gas pressure not turned on or set too low	Inspect that head pressure is set above 30 PSI and toggle is turned on
		SAM spiker inlet tube clogged	Remove and inspect the inlet tube to make sure it is free flowing

Symptom	Instrument	Possible Cause	Remedy
Needle tower not ready error	Autosampler	Autosampler fault	Turn autosampler off/on to reset
		Autosampler needle bent	

			Replace needle and sleeve, turn autosampler off/on to reset
		Slider on needle tower not sliding or spring is missing	Inspect needle tower slider to make sure it is sliding up and returning
		Needle tower switch broken	Inspect and replace needle tower switch
		CPU board on 4560 has faulty memory	Remove jumpers (JP1 & JP2) on 4560 CPU board to clear memory
		CPU board on 4551 has faulty memory	Remove jumper (JP1) on 4551 CPU board to clear memory

Sparge vessel not being rinsed with water	Autosampler	No water in wash vial	See symptoms of no water in wash vial
		Wash cycle out of calibration	Perform wash station calibration according to O.I. manual
		Peristaltic pump tubing worn	Replace peristaltic pump tubing
		Pinch valve tubing worn	Replace pinch valve tubing

No water in wash vial	Autosampler	Wash cycle out of calibration	Perform wash station calibration according to O.I. manual
		No water in water reservoir bottle	Fill water bottle with water
		Peristaltic pump tubing worn	Replace peristaltic pump tubing
		Pinch valve tubing worn	Replace pinch valve tubing
		Wash pump not operating correctly	Inspect and replace wash pump
		Siphon tube filter in wash bottle is clogged	Replace siphon tube filter

Symptom	Instrument	Possible Cause	Remedy
Wash vial overflowing	Autosampler	Wash cycle out of calibration	Perform wash station calibration according to O.I. manual
		Peristaltic pump tubing worn	Replace peristaltic pump tubing
		Pinch valve tubing worn	Replace pinch valve tubing

Water being left on top of vial in autosampler	Autosampler	Pinch valve tubing worn	Replace pinch valve tubing

Water leak in autosampler	Autosampler	Lines to autosampler six port loose	Inspect and tighten fittings around six port
		Lines to autosampler needle loose	Inspect and tighten fittings around needle
		Lines to SIM spiker loose	Inspect and tighten fittings around SIM

12356 Chemical Hygiene Plan

End of document

Version history

Version	Approval	Revision information	
8	03.FEB.2015		
9	24.FEB.2017		

eurofins	Always check on-line for validity. **Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA**	Level: **Work Instruction**
Document number: **T-MET-WI7965**		
Old Reference: **1-P-QM-WI-9015067**		
Version: **20**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **27-APR-2022**	Document users: **6_EUUSLA_Metals_Hg Analysis, 6_EUUSLA_Metals_Hg Analysis Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Sample Analysis
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Data Review
Instrument Maintenance and Repair

Revision Log

Revision	20	**Effective Date**: This Version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Header	Clarification	Update to reflect current company name
Procedure B.2.c.	Clarification	Updated to reflect current process
Sample Analysis 3. 4. and 6.	Current Process	Updated to reflect current process

Revision	19	**Effective Date**: Nov 24,2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	Current Practice	Updated QC IDs
LIMS ID	New procedure	Added new LIMs method IDs
Cross Reference	Update	Added Do Not Use Form and verification SOP
Basic Principals	Current Process	Updated to reflect current process
Sample Collection, Preservation, and Handling	Method Required	Added information regarding preservation hold time
Apparatus and Equipment	Addition	Added products used for analysis
Reagents and Standards	Clarification	Added note about deviation from method
Calibration	Update	Criteria has been moved to new SOP and removed wording of old LIMs
Procedure	Update/Enhancement	Added direction for new LIMs and feature in Envoy
Sample Analysis	Update	Updated to current practice
Calculations	Enhancement	Add units to water sample
Quality Assurance/Quality	Update	change to reference Verification SOP

Control 2		
Data Review	Update	Updated to reflect current practice
Instrument Repair and Maintenance	Enhancement	Added Q-E*QA-FRM6871*

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 7470A, September 1994

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 7471B, February 2007.

3. Test Methods for Evaluating Solid Wastes, SW-846 Method 7471A, September 1994

4. Method 245.1 (rev. 3), Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectroscopy, USEPA 600/R-94/111 May 1994.

5. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI11948	Preparation of Solids by EPA 7471A or B for Mercury Analysis
T-MET-WI11924	Digestion of Aqueous Samples by SW-846 Method 7470A
T-MET-WI26740	Digestion of Aqueous Samples for Mercury by EPA 245.1
T-MET-WI9084	Preparation of Mercury Solutions and Standards
QA-SOP11178	Demonstrations of Capability
QA-SOP11901	Instrument Maintenance and Calibration
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits
QA-SOP11886	Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples
QA-FRM6871	Do Not Use - Environmental
T-MET-WI35797	Metals Data Verification Process

Scope

This method is used for determination of mercury in aqueous and solid samples. The optimum concentration range for this method is 0.2 to 5.0 ppb.

Matrices - EPA 7470A and EPA 245.1 are applicable to water analysis. EPA 7471A and EPA 7471B are applicable to soil and tissue analysis. EPA 245.1 is applicable to drinking water analysis.

Method Detection Limits (MDLs) are based on annual statistical evaluation of laboratory data and are subject to change. The current MDLs and RLs are maintained in the LIMS, and are subject to change without notification.

Basic Principles

The Leeman Labs Mercury Analyzer utilizes continuous flow technology with drying of the sample vapor for the analysis of mercury by automated vapor generation. The reaction for the mercury analysis is a simple reduction reaction. The mercury is reduced with stannous chloride to liberate mercury metal and Tin (IV) chloride. An inert gas is used to sweep the volatile mercury into the absorption cell in the optical path of the atomic absorption spectrophotometer. The dry vapor enters one path of the optical cell, which has been optimized for fast response (small diameter), and sensitivity (long length).

Mercury is measured using a solid state detector with a wide dynamic range and a mercury source that delivers a stable source of emission at 254 nm. The signal is referenced to the simultaneous absorbance of air through direct view of the lamp. The system adds Stannous chloride to the samples via a "Y" connection in the pump tubing. The peristaltic pump then carries the sample/stannous mix to the liquid gas separator. Argon gas is bubbled through the liquid and used to transport the volatile mercury into the detector. The mercury is reduced with stannous chloride to liberate mercury metal and Tin (IV) chloride.

Definitions

1. CRA - Low Level Check Standard

2. MSA – Method of Standard Additions

3. SPLP - Synthetic Precipitation Leaching Procedure

4. TCLP – Toxicity Characteristic Leaching Procedure

5. QC Type Designators:

    a. BKG – unspiked background sample

    b. DUP – Sample Duplicate

c. MS – sample spike

d. MSD – Sample spike duplicate

e. MB –Preparation Blank (Water/ Solid). Equivalent to a Method Blank (MB)

f. LCS/LCSD - Laboratory Control Sample/Laboratory Control Sample Duplicate

Interferences
Potassium permanganate is added to samples to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from reagent water.

Samples high in chlorides require additional permanganate (as much as 25 mL) because, during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 253.7 nm. Take care to ensure that free chlorine is absent before the mercury is reduced and swept into the cell by using an excess of hydroxylamine sulfate (or chloride) reagent.

Copper has been reported to interfere; however, copper concentrations as high as 10 mg/kg had no effect on recovery of mercury from spiked samples.

Safety Precautions and Waste Handling
All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO3) – This acid can cause skin burns. Add nitric acid to samples in a hood to avoid exposure to toxic fumes.

Sulfuric acid (H2SO4) – This acid is a strong oxidizing agent and can cause severe burns. Sulfuric acid spills are extremely slippery, adding to the danger. Always use in a fume hood. Never mix with concentrated HCl or concentrated KMNO4 to avoid a violent reaction (explosive splattering and extreme heat).

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCl with concentrated H2SO4 to avoid a violent reaction. Always use in a fume hood.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds. Samples that contain dust may be hazardous. Open in a fume hood.

Samples that may contain cyanide require special precautions to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications
All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing the instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the system to set up sequences, perform the calculations, interpret raw data, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four laboratory control samples or one blind sample. Refer to *QA-SOP11178* for more guidance on these options.

Sample Collection, Preservation, and Handling
Aqueous samples are collected in plastic or glass containers, preserved to a pH of <2 with nitric acid. Samples must be analyzed within 28 days of collection.
NOTE: Regulatory Drinking Water samples (EW) are collected in 1-L plastic or glass containers and must be analyzed by EPA 245.1. Drinking water samples are not analyzed for dissolved mercury.

Solid samples are collected in glass containers and stored at 0° to 6°C not frozen. Samples must be analyzed within 28 days of collection.

Dissolved Mercury: Samples to be analyzed for soluble mercury requiring filtration at the lab must be submitted unpreserved. The sample is run through a 0.45 micron filter within 5 days of receipt and are collected in plastic containers and preserved to a pH of <2 with HNO3.

Samples must be held for 16 hours following preservation and checked again prior to processing.

Store sample digestates in plastic bottles at room temperature. Store standards and digestates separately.

Apparatus and Equipment

1. Hydra II Mercury Analyzer
2. Leeman Labs Envoy software – a windows based program to help navigate the software.
3. 15-mL graduated polypropylene screw cap tubes (certified ± 1%)
4. 10-mL sterile disposable syringes
5. 25-mm syringe filters, PTFE, 0.45-µm
6. 40-mL clear glass VOA vials and lids
7. 50-mL polypropylene containers and covers (digestion vessels for block digestion) - certified clean and Class A equivalent

Reagents and Standards

A. Store all standards and reagents in polyethylene or glass containers at room temperature. Label the container with the solution name, lot number, date prepared, the expiration date, the initials of the person preparing the solution, and the storage conditions.

NOTE: Standard/ spiking concentration and reagent vendors are subject to change without notification.

B. Reagents use the following or equivalent:

1. Nitric acid, 70.0% to 71.0% HNO3, Fisher Trace Metal Grade reagent, 1.428 g/mL; Store in glass container at room temperature. Follow manufacturer's expiration date.
2. Sodium chloride, NaCl, J.T. Baker, Certified ACS. Store in plastic container at room temperature. Follow manufacturer's expiration date.
3. Hydroxylamine hydrochloride, NH2OH·HCl, J.T. Baker, Certified ACS. Store in plastic container at room temperature. Follow manufacturer's expiration date.
4. Reagent Water
5. Stannous chloride solution, 10% SnCl, Baker Analyzed reagent, ACS. Store in plastic container at room temperature. Follow manufacturer's expiration date.
6. Hydrochloric acid, HCl, 36.5% to 38.0%, Fisher Trace Metal Grade reagent, 1.194 g/mL or equivalent. Store in glass container at room temperature. Follow manufacturer's expiration date.

C. For the preparation of calibration blanks, ICBs, CCBs, calibration standards, ICVs, CCVs, CRAs, Method Blanks, LCSs and Matrix Spikes solutions, see Form *T-MET-WI9084*.

D. General solutions - See Form *T-MET-WI9084*.

NOTE: Method states to use Sulfuric acid when making Stannous Chloride, however, manufacture requires HCl. The lab practices this deviation in order to maintain instrument performance.

Calibration

Leeman Labs Hydra II Mercury Analyzer

1. The software program has been developed to check the correlation coefficient of the curve, run appropriate ICV and CCVs at proper intervals, and check the percent recoveries of the ICV and CCVs.
2. Due to the instrument software limitations, the calibration blank is included in the correlation coefficient calculation.
3. A recalibration and reread of any associated samples is required for any checks that fall outside the windows.
4. For the frequency, acceptance criteria and corrective action see SOP *T-MET-WI35797*
5. For the preparation of calibration standards, see *T-MET-WI9084*.
6. The calibration is part of each run shown in the LIMs system

Procedure

A. Sample Digestion

1. Aqueous samples are digested by EPA 7471A/B according to SOP *T-MET-WI11924*.
2. Aqueous samples are digested by EPA 245.1 according to SOP *T-MET-WI26740*.
3. Solid samples are digested according to SOP *T-MET-WI11948*.

B. Leeman Labs Hydra II Mercury Analyzer Operation

1. Instrument Setup

a. Turn ON the power to the instrument (switch in the back) and computer.

b. Ensure that Argon supply is set to 15 psi.

c. Double click the Envoy icon on the desktop to initialize the instrument software.

d. Put on the peristaltic pump cassettes. Do not over tighten. At the end of shift, remove them from the pump.

e. Place levers in the 1 o-clock position to avoid stalling the pump. Do not fully tighten at this point.

f. Check that the rinse bottle is full and Luer connections are tight. Only a 'light' finger tightening is required. Refill the rinse tank with a 2.0% Hydrochloric Acid (HCl) solution. For preparation of 2.0% HCl solution, see *T-MET-WI9084*.

g. Check that the 10% stannous chloride bottle is full and Luer connections are tight. Only a 'light' finger tightening is required. For preparation of 10% stannous chloride, see *T-MET-WI9084*.

h. Click the start icon on the Tool Bar to turn on the peristaltic pump and press the green play button.

i. Check to see that the lamp, pump and gas turn on. If necessary, open the Method/Instrument Control Panel and turn them on and set appropriate parameters.

j. When the pump is turning, tighten the cassettes by lowering the levers to a horizontal position. Allow 20 minutes for lamp and pump equilibration.

a) There is an option to use Chart Recorder which displays when the instrument is optimized. To utilize this feature follow these steps
   i. Observe Instrument
   ii. Stabilization Tools
   iii. Chart Recorder : resize window to ~1200 seconds or 10mins.

k. Inspect all system connections for leaks.

l. The system is now ready to be optimized for automated analysis.

2. Autosampler and Run Setup

a. Clear previous analyses
   i. Analysis Tab
   ii. Tools
   iii. Database Manger
   iv. Create Archive

b. Scan the samples from their label that is on the sample itself into the Envoy program under the Sequence Tab
   i. Select Sequence
   ii. New
   iii. Select correct rack size
   iv. Scan samples in order

c. Check QC
   i. Method Tab
   ii. QC control checks tab
   iii. Modify QC as needed to set pass/fail flags

d. Press Run Sequence (Test tube rack icon): The calibration and sequence will run automatically with CCV and CCB every 10 analyses.

e. The results of the calibration and samples can be observed in the Analysis Tab.

Sample Analysis

1. Filtering Samples

a. Samples that are cloudy or have particulate suspended in solution must be filtered prior to analysis.

b. Difficult matrix samples or samples with limited volume may be filtered using a 10-mL sterile disposable syringe fitted with a 0.45 um PTFE syringe filter.

c. If any samples are filtered, the MB and the LCS on the batch must be filtered.

d. Document all filtrations on the run cover sheet.

2. Dilutions

a. Dilute samples with appropriate matrix matching solution when necessary to yield a response that falls within the calibration range.

b. Stop run if sample is above 4.5ppb. Rinse system and dilute sample immediately. Reanalyze. If the subsequent sample analyzed after an over range sample has a detection, reanalyze the subsequent sample as well.

c. Report the results for the least dilute sample where the concentration measured is within the acceptable calibration range.

3. Data Export: follow the below step by step instructions
   On the instrument
   a. Analysis Tab
   b. Report Tab
   c. Select Statisics
   d. Select Load
   e. Select TALS Export
   f. Select OK
   g. Check all data on this run
   h. Select Report
   i. Select CSV File
      1.Name CSV file (2034301MO7)
   j. Select Save
   k. Open IDAT sequence shortcut on desktop
   l. Highlight and copy run file
   m. Open TALS import file on desktop and paste run

4. Attach raw data to run: follow the step by step instructions
   On the instrument
   a. Analysis Tab
   b. Report Tab
   c. Select Detailed
   e. Select Load
   f. Select Detailed TALS
   g. Select OK
   h. Check all data on this run
   i. Select report
   j. Select CSV file
      1.Name CSV file (2034301MO7)
   k. Select Save

NOTE: Do not paste this report into the TALS import file.

5. See Data Review section for when data is in LIMs system. See SOP *T-MET-WI35797* for final data review.

6. Shutdown

   a. Place Stannous Chloride and rinse tubing into 2% HCl for minimum of 5 minutes.

   b. Place tubing into reagent water for a minimum of 5 minutes

   c. Remove tubing from reagent water to allow the aspirating of air for a minimum of 5 minutes.

   Never leave bottle of Stannous Chloride and rinse connected to the instrument if the pump clamps are released because siphoning can occur and cause damage to the instrument.

NOTE: Do not turn off power switch to instrument on a daily basis.

Calculations

1. Final Result

   a. Water sample (ug/L)

$$\text{Instrument Reading} \times \frac{\text{Dilution Volume}}{\text{Aliquot Volume}} \times \frac{\text{Final Volume}}{\text{Sample Volume}}$$

   b. Solid sample (mg/kg)

$$\text{Instrument Reading} \times \frac{\text{Dilution Volume}}{\text{Aliquot Volume}} \times \frac{\text{Final Volume}}{\text{Sample Weight (grams)}}$$

2. Relative percent different (RPD)

$$RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where:

S = first sample value

D = duplicate sample value

3. Spike recovery

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = spiked sample result

SR = sample result

SA = spike added

4. Correlation Coefficient

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N})(\sum Y^2 - \frac{(\sum Y)^2}{N})}}$$

Where :

X = the known concentration

Y = the instrument response

N = the total number of data points

5. Serial Dilution

$$\%\ Difference = \frac{(5 \times SDR) - SR}{SR} \times 100$$

Where:

SDR = serial dilution result

SR = sample result

6. Methods of standard additions (MSA)

Take 4 identical aliquots of the same sample. Leave one unspiked. Spike the other 3 aliquots with different levels of a standard solution. Add blank solution to sample aliquots so that the final volume is the same for all. Use small volumes of spiking solution to avoid diluting the sample more than 10%. Analyze the 4 aliquots and record the instrument readings in absorbance. Use the readings and spike values to find the slope and x- and y- intercepts. The x- intercept is the result.

$$\text{Slope} = m = \frac{\sum x_i y_i - (\sum x_i \sum y_i)/n}{\sum x_i^2 - (\sum x_i)^2/n}$$

$$\text{Y-Intercept} = b = \bar{y} - m\bar{x}$$

$$\text{Result} = -\frac{b}{m}$$

$$\text{Correlation Coefficient} = r = \frac{\sum\{(x_i - \bar{x})(y_i - \bar{y})\}}{\sqrt{\left[\sum (x_i - \bar{x})^2\right]\left[\sum (y_i - \bar{y})^2\right]}}$$

The correlation coefficient (r) for the least squares fit must be ³0.995. If the r value is <0.995, the MSA must be repeated at the same dilution. If the r value is again low, the result with the higher r value is verified and both are flagged with a "+" in the data package. If the r value is <0.990, the sample is run at an interference dilution to overcome matrix effects. This usually requires a raised limit of quantitation. If a client requests a particular limit of quantitation that prohibits further dilution, then the sample is repeated at the same dilution and the best of the two results is verified.

Statistical Information/Method Performance
Generate MDLs and LOQs according to *QA-SOP11892*. The department supervisor maintains annual study data.

QC limits for MS/MSD, and LCS/LCSD are established through statistical analysis of historical data. The limits are maintained in the LIMS for the relevant analysis numbers.

The department supervisor requests that a Quality Assurance Specialist update to the LIMS as needed. Update the department database via a download from the LIMS.

Quality Assurance/Quality Control
Batch Quality Control

1. For the preparation and concentrations of Batch Quality Control see *T-MET-WI9084*.

2. For the frequency, acceptance criteria and corrective action see *T-MET-WI35797*.

3. For EPA 7470A, 7471A, and 7471B, a digestion batch is up to 20 samples. Each batch must contain a MB, LCS, BKG, DUP, MS and MSD (an LCSD is used if there is insufficient sample for an MSD).

4. For EPA 245.1 Rev 3, a digestion batch is up to 10 samples. Each batch must contain a MB, LCS, BKG, DUP, and MS (an LCSD is used if there is insufficient sample for an MSD).

Data Review

1. To view imported analytical batch in the LIMS, follow these steps:
    a. Go to Analyst
    b. Choose Analyst Desktop II
    c. Select the instrument where the data is pulled from on the left hand side by expanding the Instrument option
    d. Data will be listed with a designated analytical batch number given by the LIMs system under the instrument where it was analyzed.
    e. Record this designated analytical batch number on prep batch paperwork.

2. How to complete 1st level review of analytical batch
    a. Once analytical batch is located from following steps in #1 double click to open the batch
    b. Choose Edit button
    c. When asked if data should be processed choose No
    d. Edit Standards/Batch QC
        i. Scan calibration standards from prep batch sheet
    e. If PDS is on analytical run enter PDS data
        i. Go to the Reagents tab at the bottom
        ii. Scan lot number of spike used in PDS
        iii. Enter volume of spike used for PDS. Normally this would be 0.1mL to a final volume of 10mL
        iv. Go to Worksheet Tab and enter a final volume for the PDS. Normally, this would be 10mL
    f. Calculate Results
        i. Go to Samples Results Tab

ii. Highlight all samples by using Ctrl + L
iii. Right click and choose Identify
iv. Once samples are and calibration and all identified it is always a good practice to recalculate by hitting F6

g. Evaluate the Results
i. Go to the Sample List tab
ii. Either look at each line individually to ensure calibration and data are valid or filter by job number and evaluate data
iii. Look for recoveries in the spiked calibration as well as the batch QC
iv. Look for contamination in blanks
v. Look for E flags for samples that need to be diluted. If they were diluted check that the dilution makes sense.

h. Enter Batch Information
i. Prior to saving batch right click and chose View Batch Information or press Ctrl + 1
a. If you try to save batch without going to this screen the program will prompt you
ii. Enter analyst
iii. Enter Stannous Chloride ID lot #
iv. Enter tube lot #s if dilutions were made, filtering of samples occurred, or PDS was used
v. Enter lot number of filters used
vi. Hit Ok to save

i. Attach Raw Data
i. Go to IDAT Sequence folder \\lldata\Env\IDAT-Sequences
ii. Find the analytical run by searching the unique run number given to it by the analyst.
iii. Double Click on file once located
iv. Once file is open, Save As pdf file and name the file the analytical run number give to the data by the LIMs system.
v. Open Sharefile in Google Chrome
vi. Go into the Personal Folder and choose Browse Files
vii. Find File and select Upload
viii. Once uploaded into Sharefiles go into the analytical batch in the LIMs system and choose Docs button at top
ix. Right click and select Add New Document
x. Select the document in the Personal Folder in Sharefiles and hit Select
xi. Hit OK and now the raw data file is attached into the analytical batch

j. 1st level data
i. Once data has been confirmed by analyst to be valid and the raw data is attached go to Sample List tab
ii. Highlight calibration and samples that are valid (if all samples Ctrl +L to highlight)
iii. Either do Ctrl + Shift + 1 to turn status to 1st Level or right click, Review Sample, Choose 1st Level Review

Instrument Maintenance and Repair

A. Routine Maintenance

1. Replace the pump tubing as needed under normal daily usage.
a. Inspect tygon supply lines for discoloration and cloudiness
b. Check peri-pump lines for flattening

2. As needed for foamy samples, replace liquid/gas separator
a. Remove and rinse the clear front panel
b. For severe foam replace entire gas box module

3. If liquid has entered the optical cell, check the optical cell and windows, and if needed, clean the optical cell.

a. Wipe the optical cell with a soapy solution (one drop of liquid Ivory soap to 500 mL reagent water) and warm tap water.

b. Rinse with reagent water and dry. To speed the drying of the optical cell, connect the heater plug to the optical cell with the windows off for several minutes.

c. Clean the quartz windows with methanol and a piece of lens paper.

4. Document any maintenance in the Mercury maintenance logbook located next to the instrument.

NOTE: Detailed instructions for the maintenance and troubleshooting of the Leeman Labs Mercury Analyzer can be found in the Leeman Labs Hydra II Mercury Analyzer Manual.

B. Taking an instrument/analysis out of service/returning an instrument/analysis to service.

NOTE: In the event of an equipment failure, perform the steps in SOP *QA-SOP11901*:

1. Document the nature of the failure in the maintenance logbook.

2. Document how and when the defect was discovered.

3. Notify a supervisor or experienced analyst to determine a person who can decide on appropriate action to take.

4. The instrument must be clearly tagged as Out of Service. The tag must be printed from Q-E*QA-FRM6871* contain the following information:

a. Date taken out of service.

b. Employee who took the instrument out of service.

c. Reason for tagout.

5. The date taken out of service and the date returned to service must be documented in the logbook.

6. Document any corrective action that was taken and the result of that corrective action (i.e., system calibration within specifications, etc.) to bring the equipment back into service.

7. Supervisory personnel must perform a documented evaluation and review of instrumentation/equipment where a major or uncommon failure has occurred to assess the potential impact the failure could have on the calibration and/or qualification of the instrument.

8. After a repair, document whether the function has been fixed. Calibration or verification activities are to be performed before the instrumentation is put back into service.

11178 Demonstrations of Capability
11886 Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples
11892 Determining Method Detection Limits and Limits of Quantitation
11896 Establishing Control Limits
11901 Instrument Maintenance and Calibration
11924 Digestion of Aqueous Samples by SW-846 Method 7470A
11948 Preparation of Solids by EPA 7471A or B for Mercury Analysis
26740 Digestion of Aqueous Samples for Mercury by EPA 245.1
35797 Metals Data Verification Process
6871 Do Not Use - Environmental
9084 Preparation of Mercury Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
18	29.JUL.2019		
19	24.NOV.2020		
20	27.APR.2022		

eurofins	Always check on-line for validity. **VOCs and GRO by GC/MS in Waters and Wastewaters by EPA 8260C/D**	Level: **Work Instruction**
Document number: **T-VOA-WI8194**		
Old Reference: **1-P-QM-WI- 9013078**		
Version: **11**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **11-MAY-2022**	Document users: **6_EUUSLA_GC/MS Volatiles_GC/MS Auditors/Verifiers, 6_EUUSLA_GC/MS Volatiles_Level II Peer Review, 6_EUUSLA_GC/MS Volatiles_Management, 6_EUUSLA_GC/MS Volatiles_SW846 8260B/C Water**	Responsible: **5_EUUSLA_GC/MS Volatiles_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Preparation of Glassware
Calibration
Procedure
Calculations
Statistical Information/method Performance
Quality Assurance/Quality Control
Table 1
Table 2
Table 3

Revision Log

	Revision: 11	**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per G-DC-SOP16244	Removed revision logs up to the previous version
Header	Update	Added UST LIMs IDs

	Revision: 10	**Effective Date:** 08.APR.2021
Section	**Justification**	**Changes**

	Revision: 10	**Effective Date:** 08.APR.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per G-DC-SOP16244	Removed revision logs up to the previous version
Cross Reference	Update	Added reference to QA SOP for information regarding LLOQ
Reagents and Standards 2.d	Correction	Updated TSC Figure references
Calibration D	Enhancement	Added reference to Figure 3 for preparation
Quality Assurance/ Quality Control	Enhancement	Added reference to QA SOP for LLOQ procedure
Table 2	Clarification	Added note concerning alternative ion selection for quantitation
Figure 1-7	Update	Added Figure # and updated method to include 8260D, removed 8260A

Reference

1. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), SW-846 Method 8260C, August 2006.

1. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), SW-846 Method 8260D, June 2018.

2. Determinative Chromatographic Separations, SW-846 Method 8000D, Revision 4, July 2014.

3. Purge and Trap for Aqueous Samples, SW-846 Method 5030B, December 1996.

4. Purge and Trap for Aqueous Samples, SW-846 Method 5030C, Rev 3, May 2003.

5. *Total Petroleum Hydrocarbons Analysis-Gasoline Method*, California Department of Health Services, LUFT Task Force.

6. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-VOA-WI7691	Glassware Washing
T-VOA-WI7619	GC and GC/MS Instrumentation Maintenance
T-VOA-WI7629	GC/MS Volatile Standards Traceability
T-VOA-WI7692	Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles
T-VOA-WI8373	GC/MS Volatiles Audit Process
T-VOA-WI8400	Level II Review of GS/MS Volatiles
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is suitable for the determination of the target compounds listed and maintained in the LIMS (Laboratory Information Management System) for aqueous matrices. Associated MDLs/LOQs are also listed in the LIMS under the analysis number and/or Project Information lists. Non-target volatile compounds in the sample can be tentatively identified (TIC) using a mass spectral reference library comparison. This analysis must be performed by or under the direct supervision of an operator experienced in the analysis of volatile organics by purge and trap GC/MS methodologies and skilled in mass spectral interpretation. Using this method, the TICs are quantitated with an estimated concentration. Compounds other than those listed in the LIMS for this group of master scans are analyzed using USEPA SW-846 Method 8260C. Theoretical Standard Calibration (TSC) Sheets are included in the Appendix (Figures 1-7). These TSC sheets are to serve as examples only and may not reflect most current version in use. Due to poor purging efficiency or poor gas chromatographic performance, some analytes require calibration at higher levels and higher practical quantitation limits (PQLs). Any additional compounds must be added to the theoretical standard concentrations (TSC) sheet. Standards containing additional analytes must be prepared as described in the Standards section of this document. Both secondary stock solutions and matrix spike solutions must be prepared for use in analyzing additional compounds.

Basic Principles

A 5-mL or 25-mL sample or a dilution of a sample is placed in a specially designed purge vessel. The sample is purged with an inert gas and the effluent gas passed through a sorbent tube where the volatile organics are trapped. After purging, the sorbent trap is rapidly heated and backflushed on to the head of a gas chromatographic (GC) capillary column. The GC column is temperature programmed to separate the volatile compounds, which are subsequently detected and identified using mass spectrometric techniques.

When a compound reaches the Mass Spectrometer, it is bombarded by high-energy electrons (70 eV). This causes the compound to fragment and form ions. The positive ions are focused into a quadrupole mass analyzer, where the ions are separated according to their mass/charge ratios during rapid repetitive scans. These ions are then amplified and detected with an electron multiplier.

The resulting time/intensity/mass spectra data are stored and processed by a computer. Target compounds are identified on the basis of relative retention times and mass spectral matches to standards, which are injected every 12 hours on the same system. The internal standard method is used for quantitation.

The GRO analysis is typically performed in conjunction with the analysis of other volatile target compounds by SW-846 Method 8260C. The GRO quantitation range is 0.1 minutes before the peak apex of C6 (hexane) to 0.2 minutes after the peak apex of C12 (dodecane); however, other ranges can be established. By establishing a (C12) GRO window to 0.2 minutes following the elution of dodecane, the areas from a trio of unresolved peaks eluting near to the upper limit of the range must consistently be included in the total GRO area. In addition, the range remains tight enough to ensure that no C13 or greater compounds can be included in the total GRO area. The C4 range retention time is determined by selecting the first peak after the air and/or artifact peak minus 0.1 minutes in the first standard analyzed in the ICAL. The C5 range retention time is 0.1 minutes before the peak apex of pentane. This analysis must be performed by or under the direct supervision of an operator experienced in the analysis of volatile organics by GC/MS purge and trap methodologies. The area of the total ion chromatogram for the GRO range is determined. The area of the internal standards and surrogate standards are found and subtracted from the total area of the chromatogram within the desired time range. The resulting area is then quantitated versus the internal standard, fluorobenzene.

Interferences

Contaminant sources are volatile compounds in the laboratory environment, impurities in the inert purging gas, carryover from samples containing high concentrations of volatile organic compounds and dirty glassware. The analyst must demonstrate that the system is free from interferences (by producing acceptable method blank data) before analyzing a batch of samples. Matrix effects from heavily contaminated waters can interfere with the internal standard responses, target analytes and surrogate recoveries, thereby hindering accurate quantitation. See Section 4.0 of SW-846 Method 8260C for further discussion.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; therefore, each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as the use of fume hoods, safety glasses, lab coats, and gloves. Neat compound sources and stock solutions must be collected into a lab pack upon expiration. The lab pack is delivered to Safety personnel for appropriate disposal. Expired secondary standard solutions in methanol must be disposed of as solvent waste. Pour expired secondary standard solutions into the appropriate solvent waste collection container. Aqueous calibration standard mixes are disposed of as nonhazardous aqueous waste due to the low concentration. Samples with a pH ≤2 are taken to storage until disposal in an acid waste container.

Personnel Training and Qualifications

Education Requirement: A 4-year Baccalaureate Degree from an accredited College or University in one of the physical sciences and/or one to three years of relevant gas chromatography experience.

Analysts must be trained in the proper method of volatile organic sample preparation and analysis as determined by the supervisor(s). All training and education relating to volatile organic sample preparation and analysis must be documented by each analyst in his/her training record. Specifically, each new chemist trains with an experienced chemist for the first 12 weeks depending on the individual and his/her previous experience. The first 12 weeks are spent working one-on-one with the trainer. This time is less if the new chemist has prior relevant experience in GC/MS and/or analytical chemistry background.

During the training period, the new chemist learns daily maintenance, calibration techniques, data and library search review, and forms generation. He/she is also required to read all relevant SOPs and EPA methods. All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP. Each analyst must perform an Initial Demonstration of Capability to measure proficiency. Thereafter, an annual Demonstration of Capability is performed and maintained in the analyst's training records.

NOTE: A separate Demonstration of Capability for GRO is required.

Sample Collection, Preservation, and Handling

The samples to be analyzed with this method must be stored in a refrigerator at 0°C to 6°C, not frozen. Samples are collected in 40-mL vials with no headspace. Preserve samples to a pH of <2 in order to prevent degradation of aromatic compounds that are present in the sample. 1:1 HCL is the recommended preservative. Preserved samples must be analyzed within 14 days of collection; those that are not preserved must be analyzed within 7 days of collection. Samples to be tested for Acrolein and Acrylonitrile must be collected without headspace in vials that are preserved to a pH range of 4.0 to 5.0 and must be analyzed within 7 days of collection. Samples may also be submitted in unpreserved vials for Acrolein and Acrylonitrile, but must be analyzed within 3 days of collection. Unpreserved samples from South Carolina for Acrolein and Acrylonitrile do not meet RCRA requirements and must be qualified. Samples submitted outside of the pH range or analyzed outside of the specified holding time windows will be reported with a comment on the final analytical report.

Apparatus and Equipment

1. Gastight micro-syringes – 1 to 1000 µL (various sizes)
2. 5-mL gastight syringes
3. Analytical balance, capable of accurately weighing ±0.0001 g
4. Glassware
   a. Class-A Volumetric flasks with ground-glass stopper
   b. Vials, 1.5-mL, 15-mL, and 40-mL screw cap, with Teflon™/silicone septa
   c. Mininert vials, 1 mL, 2 mL, and 5 mL

5. Purge and trap device – Consisting of the sample purger, the trap, and desorber; the OI Analytical 4560, OI Analytical 4660, or equivalent meets the requirements of this method. The purging chamber must have the purge gas passing through the sample as finely divided bubbles and minimize the headspace between the sample and the trap to <15 mL.

6. Autosampler – OI Analytical 4551, OI Analytical 4552, Archon, or equivalent meets the requirements of this method.

7. Spiker unit – OI analytical Model 4551/4552 SAM/Spiker or equivalent. One or two automated syringe spikers can be added to the OI Analytical Model 4551/4552 autosampler to automatically introduce 1 µL of internal standard (ISTD), surrogate standard, and/or matrix spiking solutions to the sample as it is being transferred to the sparge vessel. The Archon has a groove that can deliver 1 µL of appropriate standards.

8. GC/MS system – The Agilent 5890GC/5972 MSD, Agilent 6890GC/5973MSD, Agilent 6890GC/5975MSD and Shimadzu GC/MS QP5000 meet the requirements for this method.

9. Data System/Computer/Software – this is interfaced to the GC/MS system that continuously acquires and stores data during the analysis, and can process/reduce data to generate the appropriate forms and supporting data. The software used for acquisition is HP Chemstation®, and data reduction is accomplished using Target® software.

10. GC Columns

a. Column 1 – 30M × 0.25 mm ID DB624 capillary column with a 1.4-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

b. Column 2 – 20M × 0.18 mm ID DB624 capillary column with a 1.0-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

c. Column 3 – 20M × 0.18 mm ID DB-VRX capillary column with a 1.0-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

NOTE: Refer to *T-VOA-WI7619* for instrumentation maintenance and troubleshooting.

Reagents and Standards

A. Reagents

1. Reagent water is defined as water in which an interferent is not observed at or above the reporting limit for parameters of interest. In general, the deionized water supplied at the taps in the laboratory meets these criteria. If the reagent water does not meet the requirements, see your supervisor for further instructions.

2. Methanol, Purge and Trap Grade or equivalent.

B. Standards

See *T-VOA-WI7629* for standards traceability.

1. Stock standard solutions – Stock solutions must be prepared in methanol. Standards are prepared from ampulated and neat compounds obtained from suppliers that indicate the purity of the compound. No correction for purity is made if the purity is listed as ≥96%. Pre-made solutions can be used if the supplier documents the concentrations of the solutions. All ampulated standards are stored at ≤-10°C until the expiration date indicated by the vendor or for 1 year if no expiration date is provided.

a. For most of the target compounds, the stock standard solutions are purchased from a vendor as custom mixes (V for calibration and Q for separate source quality control). The internal and surrogate standards are purchased from a vendor, as well as the target compounds that are gases at room temperature. These gaseous standards have a 1-week expiration date, starting from the date they are opened.

b. 8260A Surrogate standard spiking solution (8260SS) – a 2500 µg/mL stock standard solution of dibromofluoromethane, toluene-d8, 4-bromofluorobenzene, and 1,2-dichloroethane-d4 is prepared in methanol by a commercial supplier.

c. 8260A Internal standard spiking solution (8260IS) – a 2500 µg/mL stock standard solution of fluorobenzene, chlorobenzene-d5, 1,4-dichlorobenzene-d4, and 12500 µg/mL deuterated tertiary butyl alcohol (tBA-d10) is prepared

in methanol by a commercial supplier. Deuterated tertiary butyl alcohol (tBA-d10) is used sometimes as an auxiliary ISTD.

d. GRO calibration standard – a 5500-µg/mL stock unleaded gasoline composite prepared in methanol by a commercial supplier.

e. GRO QC standard – a 20,000-µg/mL stock unleaded gasoline composite prepared in methanol by a commercial supplier

To prepare stock standards from neat compounds:

(1) Place about 9.8 mL methanol or an equivalent solvent into a tared 10.0-mL glass-stoppered volumetric flask. Weigh the flask to the nearest 0.1 mg.

(2) Add the liquids using a syringe or pipette by adding 2 or more drops of the assayed material to the flask, being careful that no drop hits the side of the flask. Reweigh the flask, record/note the amount, dilute to volume, stopper, and mix by inverting the flask at least 3 times. Calculate the concentration of the standard.

(3) The stock standard solutions are stored in Teflon™-sealed screw-capped vials at ≤-10°C. The compound name, concentration, date prepared, expiration date, preparer name and storage method must appear on the bottle.

(4) Replace in-house prepared stock standard solutions every 6 months.

2. Secondary dilution standards - Using the stock standard solutions, prepare secondary stock solutions in methanol containing the desired compounds. These standards are prepared by calculating the volume of each stock standard required to produce a given volume of a mixed working standard with a known concentration of each analyte. When custom mixes are used, these are diluted down individually or combined together with other mixes. The working standard is tested according to *T-VOA-WI7629*. The verified working standard is poured into Teflon-lined screw-capped GC vials or mininert vials and stored at ≤-10°C. A designator indicating the standard name, month, and day of preparation and expiration date must be on the standard vials. The designator and all data pertaining to the working standard preparation are to be recorded in the standards logbook. Replace secondary dilution standards every 2-4 weeks (1 week for standards containing gases) unless otherwise indicated.

a. 1,4-Bromofluorobenzene (BFB) standard – Prepare a 50-µg/mL solution of BFB in methanol by diluting the stock standard (prepared from neat material) with methanol to a final volume of 100 mL. The volume of stock standard used varies depending on the actual stock concentration.

b. IS/SS spiking solution – Dilute 1 mL of 8260IS and 1 mL of 8260SS with methanol to 10-mL final volume (resulting in a concentration of 250 µg/mL, 1250 µg/mL for tBA-d10). This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained.(50& µg/L for 5-mL purge, 10 µg/L for 25-mL purge).

c. Calibration spiking solution – Prepare solutions in methanol that contain the compounds of interest at known concentrations. Suggested calibration levels are 1, 4, 10, 20, 50, 100, and 300 ppb for 5-mL purge analysis. Suggested calibration levels are 0.2, 0.5, 1, 2, 5, 10, and 25 ppb for 25-mL purge analysis. A Theoretical Standard Concentration (TSC) sheet is filled out for all initial calibrations (see Figures 1, 2, and 5). Replace calibration spiking solution every 2-4 weeks (1 week for standards containing gases).

d. Matrix spiking solution – Prepare second source solutions in methanol that contain the compounds of interest at known concentrations. A TSC sheet is filled out for all quality control samples (see Figures 3, 4 and 6). These solutions serve as both the matrix spiking solution and the laboratory control sample solutions. Matrix spikes also serve as duplicates. Therefore, two aliquots of the same sample need to be spiked for analysis with these solutions. Replace matrix spiking solution every 2-4 weeks (1 week for standards containing gases).

Store all standard solutions at ≤-10°C and protected from light.

Preparation of Glassware

All glassware is cleaned according to *T-VOA-WI7691*.

Calibration

A. Instrument conditions

1. The purge and trap device must have the trap conditioned for at least 10 minutes at 180° to 220°C at a flow rate of 20 to 60 mL/min prior to initial use.

2. An example of purge and trap conditions are listed below:

Purge Gas	Helium
Purge Flow	35 - 45 mL/min
Purge Temperature	40°C for 8260C waters
Purge Time	11 minutes
Desorb Temperature	190°- 220°C
Desorb Time	0.5 to 4 minutes **
Bake Temperature	180°-220°C
Bake Time	5 – 16 min

**Range as suggested by the purge and trap instrument manufacturer

NOTE: Purge and trap conditions are changed to optimize instrument operations. A record of actual purge and trap conditions for each instrument is found in the appropriate instrument maintenance log.

3. The suggested gas chromatographic operating conditions are listed in the table below, depending on the column used:

	Column 1	Column 2	Column 3
Column liquid phase	DB-624	DB-624	DB-VRX
Carrier gas	Helium	Helium	Helium
Carrier gas flow	0.8 mL/min	0.6 mL/min	0.6 mL/min
Make-up gas flow	None	None	None
Initial temperature	45°C	45°C	45°C
Initial hold time	4.5 min	2.5 min	4 min
Temperature ramp	12°/min until 100°C then 25°/min until 240°C	12°/min until 100°C then 25°/min until 235°C	25°/min until 60°C then 36°/min until 240°C
Final temperature	240°C	235°C	240°C
Final hold time	None	.02 min	1 min

4. The recommended mass spectrometer operating conditions are listed below:

Mass range:	35 – 300 amu
Scan time:	One scan cycle per second or less and resulting in at least five scans per chromatographic peak

NOTE: It is not necessary to use the exact parameters listed above. Equivalent columns and conditions that give the performance required by the method are acceptable.

B. Tuning

Tune the GC/MS system to meet the criteria in Table 1 following a 50-ng injection of BFB. The chromatographic conditions must be the same as those under which the samples are analyzed except that the temperature ramp is increased and the initial temperature and flow rate is different. The BFB tune must be verified every 12 hours.

The tune must be evaluated by taking the average of the three scans across the BFB peak apex with a background subtraction of a scan within 20 scans prior to the start of the BFB peak.

NOTE: All standards, samples, and associated quality control samples must be analyzed with the same MS parameters as those used to obtain a successful tune.

C. Initial calibration

1. The initial internal standard calibration consists of analyzing seven distinct levels of analyte concentrations and producing response factors for each compound (six levels are required if second order regression fits are used). Calibration for GRO consists of analyzing six distinct levels of GRO area in order to produce a response factor for the GRO quantitation range of interest using the internal standard, fluorobenzene. The relative standard deviation of the response factor determines the suitability of the average relative response factor for calculation of the GRO concentration. Refer to Figure 1, 2 or 5 for the preparation of the calibration standards and Figure 7 for preparation of GRO standards. The relative standard deviation of the response factors determines the suitability of the average relative response factor for calculation of the analyte concentration. Prior to the analysis of any calibration level, retention time markers must be run for the GRO range of interest. The retention time markers are hexane (C6) and Dodecane (C12). Other markers can be used if different ranges are required by a project.

NOTE: 5 levels of standard are required by the method.

a. When using an OI 4552 or OI 4551 autosampler, the standards (including target and surrogate compounds) are prepared and poured into 40-mL vials with Teflon™-lined septa. A 5-mL or 25-mL aliquot is withdrawn from the vial by the autosampler. The aliquot is transferred through the spiker unit to add the IS/SS spiking solution and then transferred to the sparge vessel.

b. Purge and desorb according to instrument conditions listed in Calibration A.

c. Collect GC/MS data until the end of the GC run.

d. Empty and rinse the purging chamber at least twice with reagent water prior to loading another sample into the vessel, to minimize the possibility of carryover contamination.

e. Each level is analyzed as described above. Next, tabulate the area response of the characteristic ions (Table 2) against concentration for each analyte, surrogate standard, and internal standard and calculate relative response factors (RRF) for each compound (see Calculation section). The calibration is valid for 12 hours from the injection of the BFB tune standard, at which time a new tune check and a continuing calibration check standard are evaluated prior to the analysis of additional samples. The following table describes the guidelines for an acceptable initial calibration:

Frequency	Acceptance Criteria	Corrective Action
Initially and then when analytes in the daily calibration standard fail criteria.	1. % RSD of≤20% is required for all analytes. 10% of the analytes may fail this criteria. 2. The relative retention times of the target compounds must agree within 0.06 relative retention time (RRT) units. The exception would be in the case of system maintenance. 3. Minimum response factors must be met for select compounds. See Table 3.	1. Any target analyte with a %RSD of ≤20% must use the average RRF for quantitation. For any analyte in which the %RSD >20%, a first-degree linear regression can be used (providing that the correlation coefficient [CC] is ≥0.995). A quadratic fit ** (using 6 stds) can also be used (provided the coefficient of determination [CD] is >0.99). If the linear fit and quadratic fit pass the criteria for any given analyte, then use the line/curve with the smallest positive y-intercept. If the y-intercept quantifies to be greater than the LOQ, consult your supervisor immediately or recalibrate. If CC or CD is <0.995 for linear or <0.99 for quadratic, recalibrate. Supervisory approval is required for exceptions to these guidelines. If >10% target analytes fail, recalibration is required. If a linear or quadratic curve fit is used for a target analyte, the calibration data must be refit back into the calibration model for all calibration levels. Percent error between the calculated and expected amounts of an analyte should be ≤30% for all standards. For some data uses, ≤50% may be acceptable for the lowest calibration point. NOTE: Quadratic regression cannot be used for South Carolina compliance samples. 2.-3. Perform system maintenance and recalibrate.

**Consult USEPA method 8000D for non-linear curve fitting techniques/guidelines

f. Each level is analyzed as described above. Next, tabulate the area response for the GRO quantitation range minus the peak areas for the internal and surrogate standards that elute within the GRO range. Calculate the relative

response factor (RRF) for GRO (see Calculation section) using the internal standard peak area for fluorobenzene. Although four internal standard compounds are spiked for the 8260C analysis, only one, fluorobenzene, is used for the quantitation of the GRO result.

Calculate the average relative response factors for the GRO quantitation range of interest. The calibration levels are evaluated on the basis of the relative standard deviation of the RRF values (%RSD). The %RSD for the GRO range of interest must be ≤20%. If the calibration meets this requirement then the average RRF is used to calculate sample concentrations. If the %RSD is >20% then re-analysis of one or more levels can be necessary before the calibration is valid.

D. Following the calibration, an Initial Calibration Verification (ICV) standard must be run. The ICV acts as a second source standard to check against the initial calibration. All analytes must meet ICV acceptance windows of 70%-130% and is prepared according to the TSC sheet in Figure 3. If the ICV does not meet the aforementioned criteria, a second ICV is analyzed before invalidating the initial calibration. Upon failure of the second ICV, the system must be recalibrated after proper corrective action is taken. For the GRO analysis, the ICV is prepared according to the TSC sheet in Figure 7 (QC prep). The ICV acts as a second source standard to check against the initial calibration. Results must quantitate within the 70-130% window. If the ICV does not meet the aforementioned criteria, a second ICV can be run before invalidating the initial calibration. Upon failure of the second ICV, the system must be recalibrated after proper corrective action is taken.

E. Continuing calibration verification (CCV) – The CCV is performed by analyzing a CCV standard in subsequent tune periods after an initial calibration. The CCV (prepared daily due to aqueous nature) is analyzed at 50 ppb for 5-mL purge waters and 10 ppb for 25-mL purge waters. The CCV is considered valid when the criteria listed below are met:

Frequency	Acceptance Criteria	Corrective Action
Every 12 hours.	1. % Drift of ≤20% is required for all analytes. No more than 20% of analytes may fail this criteria if not detected in proceeding samples. 2. The relative retention times (RRT) of the target compounds must agree within 0.06 RRT units. The exception would be in the case of system maintenance. 3. The extracted ion current profile (EICP) area for each internal standard must fall within the window of –50 % to +100 % from the mid-level standard area produced during the last initial calibration. 4. Minimum response factors must be met for select compounds. See Table 3.	1.-4. In the event that the continuing calibration verification (CCV) standard fails any of these criteria, sample analysis must be suspended and the CCV must be re-analyzed. If the re-analysis fails any of the criteria then adjustments are to be made to the analytical system to return it to its original condition, followed by the analyses of 2 consecutive CCVs at the same level that failed. If both CCVs pass the criteria, then sample analysis can continue. Otherwise, the system must be recalibrated and the samples reanalyzed, or the data can be qualified.

A 1100-ppb standard (prepared daily due to aqueous nature) is analyzed for the GRO analysis. The calibration is considered valid if the percent drift is ≤20%. Also, the internal standard peak area of fluorobenzene for the CCV is monitored against the mid-point standard of the initial calibration and must be –50% to +100% of the area counts. If any criteria listed above fails, the CCV is considered invalid. In the case where two consecutive CCVs fail, corrective action must be taken which can include re-analysis of the calibration check, instrument maintenance, and/or recalibration. If the criteria are met, the selected quantitation method from the initial calibration is used for blank and sample calculations until the end of the 12-hour period.

F. MDL Sensitivity Check- A MDL Sensitivity Check must be analyzed in cases where compounds fail to meet the % drift criteria in the CCV and have decreased sensitivity (-20% drift or greater). Affected compounds can be reported as non-detects if it is demonstrated that there is adequate sensitivity to detect the compound at the MDL. If the failed compound is detected, the concentration must be reported as an estimated value.

Procedure

A. Method Blank

Analyze the method blank as described above for the initial calibration standards using reagent water. Refer to table in QA/QC section for specific requirements. The method blank is examined for interfering peaks. Any target compound peaks are calculated as described under the Calculations section of this procedure. All compounds must be less than

the reporting limit for the associated samples. If the blank values exceed these values, corrective action must be taken and the method blank reanalyzed until the criteria are met. The method blank must be analyzed before processing any samples.

B. Laboratory Control Sample/ Duplicate and Matrix Spike/Duplicate: Refer to table in QA/QC section for specific requirements.

C. Qualitative analysis

A compound is identified by comparison of the following parameters with those of a standard of this suspected compound (standard reference spectra). In order to verify identification, the following criteria must be met:

1. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other.

2. The compound relative retention time must compare within ±0.06 RRT units of the RRT of the standard.

3. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

4. The relative intensities of the characteristic ions must agree within 30% of the relative intensities of these ions in the reference spectrum. Analyst discretion is used to determine compound identification. Example: for an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

5. The above criteria apply to hits greater than or equal to the LOQ. For hits between the MDL and the LOQ, both the criteria listed above and the analyst's discretion is used to determine compound identification.

6. The analyst must account for peaks that are greater than 10% relative intensity in the sample mass spectrum, but not present in the standard mass spectrum. Also, if a compound fails any of the criteria listed above but in the judgment of the mass spectral interpretation specialist is a correct identification, the identification is used and the quantitation of the peak is performed.

The primary and secondary ions for the target compounds can be found in Table 2.

7. For GRO, the Total Ion Chromatogram (TIC) is reviewed to insure proper integration around the 8260 surrogates and internal standards. Also the TIC is checked to make sure all major peaks are integrated.

D. Quantitative analysis

Once a compound has been identified, quantitation is based on the internal standard technique and the integrated area from the extracted ion current profile (EICP) of the primary characteristic ion. The list of primary characteristic ions is listed in Table 2.

The quantitation of the GRO range is performed using the equations listed in the Calculations section of this procedure. All calculations must report concentrations in values of µg/L. In the case where the total GRO concentration exceeds the calibration range, the sample is re-analyzed at a dilution that brings the GRO concentration within the calibration range of the GC/MS system.

E. Sample Analysis

A 5-mL or 25-mL aliquot of the sample is analyzed using the same instrumental conditions as the standard (whether ICAL or CCV), tune and method blank. If the QA criteria are satisfied and no target compounds are detected at concentrations above the calibration range, the results can be reported. To avoid possible matrix effects, sample carryover and re-analyses, an initial dilution is performed if:

1. Prescreening indicates a high volatile organic content in the sample

2. Historical data (or lack thereof) and/or sample appearance indicate a need for dilution

If target compounds are detected in the sample at concentrations above the calibration range, a dilution must be performed (See *T-VOA-WI7692* for information on when cleaning blanks must be run). See Section 11.5.6 in method SW-846 8260C for recommended dilution procedures.

Calculations

A. Calibration calculations

1. Calculation of the relative response factor (RRF):

$$RRF = \frac{[A(x) \times C(is)]}{[A(is) \times C(x)]}$$

Where:

A(x) = Characteristic ion area for the compound being measured

A(is) = Characteristic ion area for the specific internal standard

C(x) = Concentration of the compound being measured

C(is) = Concentration of specific internal standard

2. Regression Equations:

1st Order (linear) regression: Y = MX + B

2nd order (quadratic) regression: Y = CX2 + MX + B

Where:

x = Area(Std) /Area(Istd)
Y = Conc.(Std)/Conc.(Istd)
M = 1st degree slope
C = 2nd degree slope
B = Y-intercept

3. Percent relative standard deviation (%RSD):

$$\% \ RSD = \frac{Standard\ Deviation}{Mean} \times 100$$

4. Calculation of the percent drift:

$$\% \ Drift = \frac{C(i) - C(c)}{C(i)} \times 100$$

Where:

C(i) = Calibration check compound standard concentration
C(c) = Measured concentration using selected quantification method

B. QA Calculations

1. Calculation of percent recovery

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = Spiked sample result

SR = Sample result

SA = Spike added

2. Relative percent difference (RPD):

$$RPD = \frac{MSR - MSDR}{(1/2)(MSR + MSDR)} \times 100$$

Where:

MSR = Matrix spike measured concentration

MSDR = Matrix spike duplicate measured concentration

3. Analyte Concentration

$$Concentration\ (\mu g/L) = \frac{(Ax)(Is)}{(Ais)(RRF)}$$

Where:

Ax = Area of the quantitation ion peak for the compound to be measured

Ais = Area of the quantitation ion peak for the appropriate internal standard

Is = Concentration of internal standard added in µg/L

RRF = Relative response factor from the initial calibration

Statistical Information/method Performance

The LCS must contain 80% to100% of the compounds in the calibration mix. LCS, MS, and surrogate recoveries and RPD are compared to the limits stored on the LIMS. These limits are statistically derived but must fall within 70% to 130% recovery for South Carolina compliance samples. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated on an annual basis in accordance with 40 CFR Part 136. The MDLs are maintained in the LIMS. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor. The department database is updated via a download from the LIMS.

Quality Assurance/Quality Control

Each analysis batch (consisting of no more that 20 samples) must contain a method blank, a laboratory control sample (LCS), and either an unspiked background sample (US), a matrix spike (MS), a matrix spike duplicate (MSD), a

laboratory control sample/laboratory control sample duplicate (LCS/LCSD) or a duplicate (DUP). The LCS serves as a 2nd source standard verification of the initial calibration (ICAL). Additional QC samples are required to meet project or state certification requirements. Every sample or QC analysis must contain internal standards and surrogate compounds at a concentration of 50 µg/L for a 5-mL purge or 10 µg/L for a 25-mL purge. For South Carolina samples, an LCS duplicate (LCSD) is only necessary per client request, or when adequate sample volume is not provided to prepare a matrix spike and matrix spike duplicate (MS/MSD). It is not appropriate to prepare and analyze an LCSD with each batch of samples if adequate sample volume has been provided for a MS/DUP or MS/MSD.
The laboratory will establish the Lower Limit of Quantitation (LLOQ) at concentrations where both quantitative and qualitative requirements can consistently be met for 8000D. The LLOQ is the lowest concentration at which the laboratory has demonstrated target analytes can be reliably measured and reported with a certain degree of confidence, which must be ≤ the lowest point in the calibration curve. The LLOQ/LLOQVs (Limit of Quantitation Verifications) are analyzed once per instrument per quarter. See SOP *QA-SOP11892*.

The GC/MS system must be tuned to meet the criteria in Table 1 following BFB injection. The chromatographic conditions must be the same as those under which the samples are analyzed except that the rate of temperature ramping may be increased and the initial temperature and column flow may be different. The BFB tune must be verified every 12 hours.

Quality Control Item	Acceptance Criteria	Corrective Action
1. Internal Standards Added to every sample, standard, method blank and QC sample	1. Peak areas within -50% to +100% of the area in the associated reference standard. 2. Retention time (RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then reanalyze samples. 2. If re-injecting meets the criteria, report this analysis. 3. If this reanalysis still shows the same problem, report results from first analysis and qualify data with a comment.
2 Surrogates Added to every sample, standard, method blank and QC sample	All % recoveries must fall within statistically derived QC limits, which are evaluated on a semi-annual basis.	If non-compliant, check for calculation or preparation errors. If no errors are found, check system for problems and reanalyze. If this reanalysis still shows the same problem, report first analysis and qualify data with a comment. If recoveries are outside of specification high and no target compounds are detected, then a reanalysis or comment is not required.
3 Method Blank (MB) Performed during each tune period after the initial calibration or CCV (minimum of 1 MB per 20 samples)	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. Quantitative results for all target compounds must be less than the reporting limit for the associated samples.	1.-2.Inspect system for possible problems and reanalyze. 3. If the MB contains target analytes and the associated samples do not, then no corrective action is required. If the target compounds in the MB are also in the associated samples, then they must be reanalyzed after a clean MB is obtained (certain projects may allow some exceptions for common laboratory contaminants like methylene chloride and acetone up to 5X the LOQ)
Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) LCS analyzed with each batch of ≤ 20 samples LCSD analyzed if MS/MSD unavailable See Figure	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All % recoveries must fall within statistically derived QC limits, which are evaluated on a semi-annual basis.	1.-2. If non-compliant, check for calculation or preparation errors. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD re-analysis still fails, perform appropriate system maintenance and restart the tune period. Only with a LCS % recovery failing high (for the requested target compounds) with targets non-detected in the sample, can the results be reported. Otherwise, the sample must be analyzed with a compliant LCS.

Quality Control Item	Acceptance Criteria	Corrective Action
Matrix Spike/Matrix Spike Duplicate (MS/MSD) MS/MSD analyzed with each batch of ≤ 20 samples (if sufficient sample volume available) See Figures 4 and 5 for preparation info.	1. % Recoveries must fall within statistically derived QC limits, which are evaluated on a semi-annual basis 2. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries and/or RPDs outside of QC limits, consult the supervisor.

NOTE: Prior to release from the analytical laboratory, all data is reviewed in accordance with *T-VOA-WI8373* or *T-VOA-WI8400* (dual purge and trap).

Table 1

BFB Key Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15% to 40% of mass 95
75	30% to 60% of mass 95
95	base peak, 100% relative abundance
96	5% to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5% to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5% to 9% of mass 176

Table 2

Primary and Secondary Ions

Compound Name	Primary Ion	Secondary Ion
Chloromethane	50	52
Vinyl Chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
1,1-Dichloroethene	96	61, 63
Acetone	43	58
Carbon Disulfide	76	78
Methylene Chloride	84	49, 86
1,1-Dichloroethane	63	65, 83
trans-1,2-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 63
2-Butanone	43	72
Chloroform	83	85
1,2-Dichloroethane	62	98
1,1,1-Trichloroethane	97	61, 99
Carbon Tetrachloride	117	119
Benzene	78	
Trichloroethene	95	130, 132

Compound Name	Primary Ion	Secondary Ion
1,2-Dichloropropane	63	76
Bromodichloromethane	83	85
cis-1,3-Dichloropropene	75	77, 110
trans-1,3-Dichloropropene	75	77, 110
1,1,2-Trichloroethane	97	83, 85
Dibromochloromethane	129	127
Bromoform	173	175
4-Methyl-2-pentanone	43	58
Toluene	92	91
Tetrachloroethene	166	131, 164
2-Hexanone	43	58
Chlorobenzene	112	77
Ethylbenzene	91	106
Xylene (total)	106	91
Styrene	104	78
1,1,2,2-Tetrachloroethane	83	85, 131
Dibromofluoromethane	113	111
1,2-Dichloroethane-d4	102	104
Fluorobenzene	96	70
Toluene-d8	98	100
Chlorobenzene-d5	117	82
4-Bromofluorobenzene	95	174
1,4-Dichlorobenzen-d4	152	115

NOTE: Alternative ions may be used for quantitation due to response factor, ion interference or other analytical needs.

Table 3
Minimum Relative Response Factors For ICAL and CCV

Volatile Compounds	Minimum Response Factor
Dichlorodifluoromethane	0.100
Chloromethane	0.100
Vinyl Chloride	0.100
Bromomethane	0.100
Chloroethane	0.100
Trichlorofluoromethane	0.100
1,1-Dichloroethene	0.100
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100
Acetone	0.100
Carbon Disulfide	0.100
Methyl Acetate	0.100
Methylene Chloride	0.100
trans-1,2-Dichloroethene	0.100
cis-1,2-Dichloroethene	0.100
Methyl tert-Butyl Ether	0.100
1,1-Dichloroethane	0.200
2-Butanone	0.100
Chloroform	0.200
1,1,1-Trichloroethane	0.100
Cyclohexane	0.100
Carbon Tetrachloride	0.100
Benzene	0.500
1,2-Dichloroethane	0.100
Trichloroethene	0.200
Methylcyclohexane	0.100
1,2-Dichloropropane	0.100
Bromodichloromethane	0.200
cis-1,3-Dichloropropene	0.200
trans-1,3-Dichloropropene	0.100
4-Methyl-2-pentanone	0.100
Toluene	0.400

1,1,2-Trichloroethane	0.100
Tetrachloroethene	0.200
2-Hexanone	0.100
Dibromochloromethane	0.100
1,2-Dibromoethane	0.100
Chlorobenzene	0.500
Ethylbenzene	0.100

Table 3 - Continued

Volatile Compounds	Minimum Response Factor
m&p-Xylene	0.100
o-Xylene	0.300
Styrene	0.300
Bromoform	0.100
Isopropylbenzene	0.100
1,1,2,2-Tetrachloroethane	0.300
1,3-Dichlorobenzene	0.600
1,4-Dichlorobenzene	0.500
1,2-Dichlorobenzene	0.400
1,2-Dibromo-3-chloropropane	0.050
1,2,4-Trichlorobenzene	0.200

Attachment:
Figure 1 (.doc)
Figure 2 (.doc)
Figure 3 (.doc)
Figure 4 (.doc)
Figure 5 (.doc)
Figure 6 (.doc)
Figure 7 (.xls)

11892 Determining Method Detection Limits and Limits of Quantitation
7619 GC and GC/MS Instrumentation Maintenance
7629 GC/MS Volatile Standards Traceability
7691 Glassware Washing
7692 Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles
8373 GC/MS Volatiles Audit Process
8400 Level II Review of GC/MS Volatiles

End of document

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1) Revision Log:
2) Reference:
3) Cross Reference:
4) Purpose:
5) Scope:
6) Reference Modifications:
7) Definitions:
8) Interferences:
9) Safety Precautions, Pollution Prevention and Waste Handling:
10) Personnel Training and Qualifications:
11) Sample Collection, Preservation and Handling:
12) Apparatus and Equipment:
13) Reagents and Standards:
14) Calibration:
15) Procedure:
16) Calculations:
17) Statistical Information and Method Performance:
18) Quality Assurance/Quality Control and Corrective Action:
19) List of Attachments:

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Revision: 1	**Effective Date:** This version	
Section	**Justification**	**Changes**
throughout	Required	Replaced TestAmerica Seattle with EFGS

2) Reference:

2.1 Method 8260D, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Revision 4, June, 2018, SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Sixth Edition, EPA Office of Solid Waste.

2.2 Method 5035A, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, Revision 1, July, 2002, SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition and all promulgated updates, EPA Office of Solid Waste, January 2005.

2.3 Department of Defense (DoD), Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories Based on ISO/IEC 17025:2005(E) and The NELAC Institute (TNI) Standards, Volume 1, (September 2009), DoD Quality Systems Manual Version 5.3, 2018.

3) Cross Reference:

Document	**Document Title**
EFGS-Q-QM-QM5805	QA Manual
EFGS-S-HS-12066	Chemical Hygiene Plan
EFGS-Q-QD-SOP2710	Class 1 Weight Calibration, Balance Verification, Calibration & Maintenance
EFGS-S-HS-SOP2991	Waste Disposal Procedures for Client Sample Waste
CW-E-M-001	Corporate Environmental Health and Safety Manual
EFGS-Q-QD-SOP41922	Receipt, Preparation, Storage and Verification of Standards and Reagents and Traceability Protocols
EFGS-Q-QD-SOP41891	Storage Blank Handling and Analysis
EFGS-T-WC-SOP41035	Percent Moisture/Percent Solids
EFGS-Q-QD-SOP41889	Quality Control Program

Document	Document Title
EFGS-Q-QD-SOP2812	Procedures for Nonconformance, Corrective Actions and the Control of Non-Conforming Work
CA-Q-P-003	Calibration Curves and the Selection of Calibration Points
EFGS-P-DR-SOP2801	Data Review and Validation and Monthly Logbook Reviews
CA-Q-S-006	Detection and Quantitation Limits
CA-Q-S-002	Manual Integration
EFGS-Q-QD-SOP2814	Personnel Training and Demonstration of Capability Procedures

4) Purpose:

4.1 Volatile compounds are introduced into the gas chromatograph by the purge and trap method. The components are separated via the gas chromatograph and detected using a mass spectrometer in selected ion mode, which is used to provide both qualitative and quantitative information.

4.2 Aqueous samples are purged directly. Soils are preserved by extracting the volatile analytes into methanol and an aliquot of the methanol is purged.

4.3 In the purge-and-trap process, an inert gas (generally Helium) is bubbled through the solution at ambient temperature and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column (trap) is heated and back flushed with inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is then heated to elute the components, which are detected with a mass spectrometer in selected ion mode.

4.4 Qualitative identifications are confirmed by analyzing standards under the same conditions used for samples and comparing the resultant mass spectra and GC retention times. Each identified component is quantified by relating the MS response for an appropriate selected ion produced by that compound to the MS response for another ion produced by an internal standard.

5) Scope:

5.1 This method is applicable to the determination of volatile organic compounds (VOCs) in water, wastewater, soils, sludges, and other solid matrices. Standard analytes are listed in Table 1.

5.2 The method is based upon a purge-and-trap, gas chromatograph/mass spectrometric (GC/MS) procedure. The approximate working range is 0.5 to 50 mg/L for 8260D SIM waters, 5 to 70 mg/kg for soils. Reporting limits are listed in Table 1 and Table 2.

5.3 Method performance is monitored through the use of surrogate compounds, matrix spike/matrix spike duplicates (MS/MSD), and laboratory control spike/laboratory control spike duplicate samples (LCS/LCSD).

5.4 On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 13.2.1 in the Quality Assurance Manual.

6) Reference Modifications:

Item	Method	Modification
1	8260D	Storage conditions for standards are listed as <6C or as recommended by manufacturer. Eurofins Frontier Global Sciences follows 8260B guidelines to store standards at -10C or as recommended by manufacturer.
2	8260D	The minimum RF values for 2-Hexanone are based on a lab study in full scan mode and not as listed in the method.
3	5035A	The aliquot of methanol extract taken for analysis is 125 uL rather than the 100 uL specified in Table 1 of the method.

7) Definitions:

7.1 Batch

The batch is a set of up to 20 samples of the same matrix processed using the same procedures and reagents within the same time period. Using this method, each 4-bromofluorobenzene (BFB) analysis will normally start a new batch. Batches for soils are defined at

the sample preparation stage and may be analyzed on multiple instruments over multiple days, although reasonable effort should be made to keep the samples together.
The Quality Control batch must contain a matrix spike/spike duplicate pair (MS/MSD), a Laboratory Control Sample (LCS), and a method blank. If there is insufficient sample to perform the MS/MSD, a duplicate LCS is used to establish batch precision when requested by the client. Refer to SOP *EFGS-Q-QD-SOP41889* for further details of the batch definition.

7.2 Method Blank (MB)

A method blank consisting of all reagents added to the samples must be analyzed with each batch of samples. The method blank is used to identify any background interference or contamination of the preparation and analytical system, which may lead to the reporting of elevated concentration levels or false positive data. Sparged water or water that has been boiled then cooled to ambient temperature is used as the blank medium for water batches and muffled Ottawa Sand for soil batches. Prepared (muffled at 400C for at least 4 hours) batches of Ottawa sand are tracked using the reagent data base in the Laboratory Information Management System (known as TALS) and are at the time of the writing of this SOP named with the following convention: VoaSand_XXXXX.

7.3 Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

A blank matrix (reagent water or muffled Ottawa Sand) is spiked with the analytes of interest and is carried through the entire analytical procedure. Analysis of this sample with acceptable recoveries of the spiked materials demonstrates that the laboratory techniques for this method are acceptable. A laboratory control sample duplicate is a second aliquot prepared at the same time as the first. The duplicate demonstrates precision in the preparation.

7.4 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples. Each sample, blank, LCS/LCSD, and MS/MSD is spiked with surrogate standards. Surrogate spike recoveries must be evaluated by determining whether the concentration (measured as percent recovery) falls within the required recovery limits.

7.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

A matrix spike is an environmental sample to which known concentrations of target analytes have been added. A matrix spike duplicate is a second aliquot of the same sample, which is prepared and analyzed along with the sample and matrix spike. Matrix spikes and duplicates are used to evaluate accuracy and precision in the actual sample matrix.

7.6 Initial Calibration Verification (ICV)

The ICV is a second-source calibration verification standard. i.e., different than the source of calibration standards.

7.7 Continuing Calibration Verification (CCV)

A solution of method analytes, surrogate compounds, and internal standards used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

8) Interferences:

8.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All of these materials must be routinely demonstrated to be free from interferences under conditions of the analysis by running laboratory method blanks as described in the Quality Control section. The use of ultra high purity gases, boiled and cooled to ambient or sparged purified reagent water, and approved lots of purge-and-trap-grade methanol will greatly reduce introduction of contaminants. In extreme cases, the purging vessels may be pre-purged to isolate the instrument from laboratory air contaminated by solvents used in other parts of the laboratory.

8.2 Samples can be contaminated by diffusion of volatile organics (particularly Methylene chloride and fluorocarbons) into the sample through the septum seal during shipment and storage. A field blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

8.3 Matrix interferences may be caused by non-target contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source depending upon the nature and diversity of the site being sampled.

8.4 Cross-contamination can occur whenever high-level and low-level samples are analyzed sequentially or in the same purge position on an autosampler. Whenever an unusually concentrated sample is analyzed, it should be followed by one or more blanks to check for cross-contamination. The purge and trap system may require extensive bake-out and cleaning after a high-level sample.

8.5 Some samples may foam when purged due to surfactants present in the sample. When this kind of sample is encountered, an antifoaming agent (e.g., J.T. Baker's Antifoam B silicone emulsion) can be used. When an antifoaming agent is used in a sample, it must be added to the batch quality control samples.

9) Safety Precautions, Pollution Prevention and Waste Handling:

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

9.1 Specific Safety Concerns or Requirements

9.1.1 Cut resistant gloves should be used in addition to Nitrile glove when handling materials with sharp, jagged edges or when opening glassware (VOA vials) or packages containing glassware.

9.1.2 The autosampler, purge and trap, gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

9.1.3 The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

9.1.4 There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

9.1.5 Cut resistant gloves or a protective cloth must be used when opening and closing voa vials.

9.1.6 The toxicity or carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable. Cautions are included for known extremely hazardous materials.

9.2 Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the SDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

Material	Hazards	Exposure Limit (1)	Signs and symptoms of exposure
Methanol (MeOH)	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
1 – Exposure limit refers to the OSHA regulatory exposure limit.			

9.3 Pollution Control

It is Eurofins Frontier Global Sciences policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention".

9.4 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste

disposal procedures are incorporated by reference to Waste Disposal SOP *EFGS-S-HS-SOP2991*.

9.4.1 Waste Streams Produced by the Method

9.4.1.1 VOA vials containing acidic water; VOA vials containing extracted acidic water and small amounts of methanol are collected in large plastic satellite waste bins marked "Hazardous Waste." At or before the waste reaches 55 gallons, the contents are transferred to the waste warehouse where the vials are bulked into a 55 gallon waste barrel and sent out for incineration.

9.4.1.2 VOA vials containing extracted soil samples, which will contain small amounts of methanol and possibly sodium bisulfate. Unused sample extracts are held for at least 40 days, in case further testing is deemed necessary. After at least 40 days have passed these sample extracts are transported to the waste room were they are bulked into the flammable liquid loose pack barrel and sent out for incineration.

9.4.1.3 Expired Standards. Expired standards are collected in satellite containers marked "Hazardous Waste." At or before the containers reach 55 gallons the containers are taken to the waste warehouse where they are bulked into an expired standards lab pack and sent out for incineration.

10) Personnel Training and Qualifications:

10.1 An analyst must perform an initial demonstration of capability (IDOC) that includes four replicates of a secondary source before being qualified to analyze samples without supervision. Continuing DOC will be maintained and monitored via performance on LCSs and other QC samples, as well as obtaining acceptable results on proficiency testing exercises.

10.2 Training is documented by the employee and supervisor, and is kept on file in the QA Office. The employee must read, understand, and by signing the training document, agree to perform the procedures as stated in all Standard Operating Procedures (SOPs) related to this method.

10.3 All employees must also, on a yearly basis, read the Quality Manual (QM), and complete the yearly Ethics training.

10.4 All training documents including IDOCs, CDOCs, Initial QA orientation, and Ethics training are stored by the Quality Assurance Manager in the employees training file for ten years after the employee is no longer working for Eurofins Frontier Global Sciences.

10.5 Chemical Safety Training, Compressed Gas Training, Chemical Hygiene Plan documentation, and Shipping of Hazardous goods, are stored by the Health and Safety Officer for ten years after the employee is no longer working for Eurofins Frontier Global Sciences.

11) Sample Collection, Preservation and Handling:

11.1 Water samples are normally preserved at pH < 2 with 1:1 hydrochloric acid. The holding time for acid-preserved samples is 14 days from sample collection. For compliance with Method 8260D, unpreserved samples must be tested within 7 days of collection.

11.2 Soils

11.2.1 Approved sampling containers for Method 5035 are EnCoreTM or TerraCoreTM and VOAs preserved with methanol.

11.2.2 Soil collected using the EnCoreTM or TerraCoreTM sampler must be preserved in the laboratory within 48 hours of sampling.

11.3 Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time [1]	Reference
Waters	Three 40-mL VOA vials	40 mLs	HCl, pH < 2; Cool 0-6ºC	14 Days	40 CFR Part 136.3 / 5030
Waters	Three 40-mL VOA vials	40 mLs	Cool 0-6°C	7 Days	40 CFR Part 136.3 / 5030
Soils	Three Encore Samplers	5 grams	Cool 0-6°C or -10 to -20°C	48 Hrs for Preservation or 14 Days	5035A

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time [1]	Reference
Soils	40 ml VOA vial or 4oz septa top jar	10 grams or 25 grams	Methanol <6°C	14 Days	5035A

[1] Inclusive of preparation and analysis.

11.4 Aqueous samples are stored in three 40 ml glass VOA vials with Teflon lined septa at 0-6°C, with minimal headspace. If a bubble is present and it is less than 6 mm in diameter, analysis may continue. If headspace exceeds this amount, then a non-conformance memo must be written and in some cases client approval requested to continue analysis.

11.5 Soil Sample Collection using Field Methanol Preservation

11.5.1 A pre-tared four ounce volatile soil jar with an accompanying VOA vial containing 25ml of a methanol) is sent out for each sample when the sampling occurs in the state of Alaska. Otherwise a pre-tarred VOA vial containing 10 mLs of methanol is sent out for each sample required. In addition the appropriate amount of trip blanks are also sent out. All bottles sent to the field are labeled with the tare weight and lot number of the methanol/surrogate solution or methanol.

11.5.2 For sampling in the state of Alaska, twenty-five gram field samples are collected by placing 25 g of sample in the four ounce soil jar with septa lined lid and then adding one VOA vial containing the 25 mLs of methanol/surrogate solution. Otherwise, ten gram field samples are collected by adding 10 g of sample to a 40 mL VOA vial containing 10 mL of methanol. The ratio of mL of methanol to grams of sample should be 1:1.

11.6 Soil Sample Collection using EnCoreTM or TerraCoreTM samplers.

11.6.1 If the sample is collected a sample in an EnCoreTM sampler a minimum of one EnCores should be provided to the lab. If the samples are collected using the TerraCore sampler a minimum of one 40-ml VOA vial with 5 grams of soil. Samples must be received prior to 48 hours from sampling in order to be frozen or extracted in methanol. Following shipment back to the laboratory, the soil is preserved in methanol.

11.7 A refrigerator or freezer blank is stored in each refrigerator or freezer with the samples. This is analyzed at minimum every 14 days, but may be analyzed more frequently as needed (see SOP *EFGS-Q-QD-SOP41891*). The refrigerator or freezer blank should be run immediately after the method blank.

11.8 Percent Moisture Correction for Soils

A percent moisture correction may be performed on soil samples to adjust the extraction final volume of the sample in order to allow for the miscible solvents effect, as required by the client. Percent moisture must be determined if results will be reported as dry weight and percent moisture correction to be performed; refer to SOP *EFGS-T-WC-SOP41035* for determination of percent moisture. For all methanolic samples with a % moisture of greater than 10%, the following formula is used to determine the corrected final volume:

Corrected FV = ((g of sample * % Moisture/100) + mL of Methanol) * 40

(Also noted in section 16.9)

12) Apparatus and Equipment:

12.1 Instrumentation

- Gas Chromatograph: The gas chromatograph (GC) system must be capable of temperature programming.
- Gas Chromatographic Column used for 8260 SIM:
  - 30 m X 0.25mm ID Rxi-624Sil MS with 1.4 µm film thickness.

  Note: Other columns may be used. The serial number of the column used is documented in the instrument maintenance logbook.
- Mass Spectrometer: The mass spectrometer must be capable of scanning 35-270 amu as fast enough to acquire 5, but preferably 10 scans per peak, using 70 volts electron energy in the electron impact mode and capable of producing a mass spectrum that meets the required criteria.
- GC/MS interface: In general glass jet separators are used but any interface (including direct introduction to the mass spectrometer) that achieves all acceptance criteria may be used.
- Purge and Trap Device: The purge and trap device consists of the sample purger, the trap, and the desorber.
- Sample Purger: The recommended purging chamber is designed to accept between 5 mL and 25 mL samples with a water column at least 3 cm deep. The purge gas must pass through the water column as finely divided bubbles, each with a diameter of less

than 3 mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. Alternative sample purge devices may be used provided equivalent performance is demonstrated.
- Trap: A variety of traps may be used, depending on the target analytes required. The O.I. #10 (Tenax/Silica gel/Carbon Molecular Sieve) is recommended. Other traps may be used if the Quality Control criteria are met.
- Desorber: The desorber should be capable of rapidly heating the trap up to 270 °C depending on the trap packing material. .
- Purge-and-trap Autosampler: An autosampler capable of sampling from a sealed vial, OI 4100, or equivalent.

12.2 Computer hardware and software

- Computer with a minimum 1GB memory, Pentium 4 processor, 80 G hard drive or equivalent or as recommended by instrument manufacturer.
- LIMS system: TALS version 1.0 or higher.
- Data acquisition system: Agilent ChemStation (version E.02.02) or equivalent. Agilent's ChemStation, is used for data acquisition and storage on machine-readable media. Since no processing is done by ChemStation and since there are no audit trail functions associated with data acquisition, the audit trail feature for ChemStation may be either enabled or disabled. The other component, Chrom, is used for data processing such as the measurement of peak area or peak height. By design, the audit trail feature for Chrom is always enabled.
- Data processing: Chrom version 1.2 or higher. The computer must have software that allows searching any GC/MS data file for ions of a specified mass and plotting such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between the specified time or scan-number limits. In addition, for the non-target compounds, software must be available that allows for the comparison of sample spectra against reference library spectra. A standard from the middle of the calibration curve should be used as the reference library. The computer system must also be capable of backing up data for long-term off-line storage.

12.3 Supplies

- Microsyringes: 0.5 mL gas tight and larger, 0.006-inch ID needle
- Balance: Top-loading balance capable of weighing 0.1 g. The balance used for sample preparation is calibrated daily by a designated primary analyst (a back-up analyst is also assigned should the primary be unavailable). The analyst must perform this check according to SOP *EFGS-Q-QD-SOP2710*. It is also the responsibility of any analyst performing work on the balance to check the Balance logbook to determine if the daily calibration check has been completed, before beginning work.
- Scintillation Vials: 20 mL with screw caps.
- Volumetric flasks: 50 mL and 100 mL, class A with ground-glass or Teflon ® stoppers.
- Spatula: Stainless steel.
- Disposable pipettes: Pasteur.
- pH paper: (0-7).
- Helium: Ultra high purity, gr. 5, 99.999%.
- Nitrogen: Ultra high purity, from cylinders or gas generators, may be used as an alternative to helium for purge gas.

13) Reagents and Standards:

13.1 Document reagent/standards and reagent/standard preparation in TALS using the reagent module as described in SOP *EFGS-Q-QD-SOP41922*.

13.2 Reagents

13.2.1 Methanol: Purge and Trap Grade, High Purity

13.2.2 Reagent Water: High purity water that meets the requirements for a method blank when analyzed. (See Section 19.3.) Reagent water may be purchased as commercial distilled water or filtered in the laboratory using Barnstead B pure and E Pure filtration systems and prepared by purging with an inert gas for a minimum of 2 hour or boiling and cooling to ambient temperature prior to use. Other methods of preparing reagent water are acceptable.

13.3 Standards

13.3.1 If stock or secondary dilution standards are purchased in sealed ampoules they may be used up to the manufacturer's expiration date.

13.3.1.1 Purchased standards are stored at the manufacturer's specifications (i.e. ambient, freezer, refrigerator). Standards prepared from these purchased standards are stored in the freezer.

13.3.2 Calibration Stock Standard Solutions: Components of stock solutions may be purchased as certified solutions from commercial sources or prepared from pure standard materials as appropriate. These standards are prepared in methanol and

stored in Teflon-sealed screw-cap bottles with minimal headspace at <-10°C. Each month a new standard is prepared. Note: Standards may be prepared on a more frequent basis based on analyst observed signs of degradation.

13.3.3 Calibration Working standards: A working solution containing the compounds of interest prepared from the stock solution(s) in methanol. These standards are stored in the freezer. Working standards are monitored by comparison to the initial calibration curve. If any of the calibration check compounds drift in response from the initial calibration by more than 20%, then corrective action is necessary. Generally, an analysis of all individual compounds meeting the method criteria will suffice, however a continual failure of a compound may include steps such as instrument maintenance, preparing a new calibration verification standard or tuning the instrument. If the corrective actions do not correct the problem (two CCVs in a row fail), then a new initial calibration must be performed.

13.3.4 Aqueous calibration standards are prepared in reagent water using the calibration working standards. These aqueous standards must be prepared daily.

Likewise, medium level methanolic calibration standards are prepared in reagent water with a matrix matched methanol concentration of one fortieth P & T methanol using the calibration working standards and must be prepared daily.

13.3.5 Internal standards (IS) are added to all samples, standards, and blank analyses by the autosampler. Refer to Table 4 for internal standard components.

13.3.6 Surrogate Standards are added to all samples, standards, and blank analyses by the autosampler: Refer to Table 5 for surrogate standard components and standard concentration.

13.3.7 Laboratory Control Sample Spiking Solutions: Refer to Table 6 for LCS components and standard concentration.

13.3.8 Matrix Spiking Solutions: The matrix spike contains the same components as the LCS. Refer to Table 6.
13.3.9 Tuning Standard: A standard is made up that will deliver 5 ng of 4-Bromofluorobenzene on column upon injection.

13.4 As soon as standard preparations for the day are completed, the standards must be refilled to minimize headspace and returned to the freezer.

13.5 Managers/supervisors or a designee are expected to check their areas on a monthly basis for expired standards/reagents and dispose of them according to SOP *EFGS-S-HS-SOP2991*.

14) Calibration:

14.1 Summary

Prior to the analysis of samples and blanks, the GC/MS system must be tuned and calibrated. Tuning is accomplished by analyzing 4-bromofluorobenzene (BFB) to establish that the GC/MS system meets the standard mass spectral abundance criteria. The GC/MS system must be calibrated initially at a minimum of five concentrations to determine the linearity of the response utilizing target calibration standards. The calibration must be verified each twelve-hour time period for each GC/MS system.

14.2 Recommended Instrument Conditions

14.2.1 General

Electron Energy:	70 volts (nominal)
Mass Range:	35–270 amu
Scan Time:	to give at least 5 scans/peak, ≤ 1 seconds/scan
Injector Temperature:	200 – 250 °C
Source Temperature:	According to manufacturer's specifications
Transfer Line:	Temperature: 250 – 300 °C
Purge Flow:	40 mL/minute (± 5 mL/min)
Carrier Gas Flow:	1-15 mL/minute, dependent upon column specifications

14.2.2 Gas Chromatograph Temperature Program

The temperature programs vary with the column type and instrumentation used. The GC run program on each instrument should be optimized so that each peak is broad enough to accommodate at least 5 scans across the peak (not counting the scans at the baseline start and end of the peak). The actual individual method parameters used are stored in each individual instrument methods folder on the network and can be referenced there.

14.2.3 Mass Spectrometer/ Scan Parameters

The mass spectrometer is operated in selective ion monitoring mode, with the following ions monitored in each window. The start times for each window are representative, and may vary slightly with chromatographic maintenance.

Alaska List:

Scan Window	Masses Monitored (z)	Start time (min)	Scan Rate (Scans/Sec)
1	39,53,54,62,64,94,96	1.25	3.24
2	45,46,59,61,65,96,98	3.70	3.08
3	61,65 ,67,83,85,96,98,102,111,113	6.80	3.03
4	62,64,65,67,77,78,96,98,102	8.20	3.01
5	47,60,81,83,85,93,95,96,132,164,174	9.00	3.07
6	39,49, 75, 98,100,110	10.00	3.04
7	43,49,58,61,75,79,85,83,97,110,127,129,131,164,166	10.65	3.00
8	79,81,107,109,117,127,129,131,133,	11.25	3.03
9	83,85,95,131,171,173,174,175,176	12.00	3.08
10	75,111,115,146,150,152	13.20	3.00
11	102,118,127,128,129,190,223,225,227	13.0	2.71

BTEX List:

Scan Window	Masses Monitored (z)	Start time (min)	Scan Rate (Scans/Sec)
1	62,64	1.25	3.83
2	43,45,46,61,65,73,96,98	3.00	3.35
3	62,64,65,67,77,78,98,102,111,113,192	7.75	3.35
4	60,77,95,96,113,146	8.60	3.17
5	65,91,92,98,100,131,164,166	10.00	3.27
6	77,81,82,91,106,107,109,117	11.00	3.29
7	77, 91,95,105,106,120,174,176	12.00	3.09
8	77,91,92,105,115,119,120,134,150,152	13.00	3.10
9	102,127,128,129	13.50	3.09

14.3 Instrument Tuning

Each GC/MS system must be hardware-tuned to meet the abundance criteria listed below and in Table 7 for a maximum of a 5 ng injection or purging of BFB. Analysis must not begin until these criteria are met. These criteria must be met for each twelve-hour time period for DoD and BP Lamp samples and at the beginning of each ICAL for all other samples. The twelve-hour time period begins at the moment of injection of BFB. It is critical to accurately estimate the number of samples that can be analyzed within the 12-hour window. When a tune isn't analyzed every 12-hours (i.e., samples are analyzed outside of the 12-hour window), the event must be documented in a non-conformance memo and corrective must be taken. Whenever feasible, samples that were analyzed outside of the 12-hour window will be re-analyzed within a new 12-hour window. When reanalysis is not feasible, results for the affected samples can only be reported if it's technically justified (e.g., subsequent tune passes), the data has been qualified, and it's been authorized and accepted by the client. The BFB may be taken from a specified full-scan BFB Tune injection or from the CCVIS from a SIM injection. In the case of a calibration sequence, a specified BFB Tune must be injected prior to the injection of the first calibration standard. If an acceptable tune is not achieved, the autosampler prepares another tune standard by adding BFB to either the CCVIS or an instrument blank. The autotune process is repeated once. If the subsequent tune attempt fails, one or more of the corrective actions suggested in the Eurofins TestAmerica, Inc. corporate tune policy, CA-Q-QM-002 are attempted.

For commercial samples, a BFB tune is required before the calibration. Each 12 hour window is started with the injection of the CCVIS standard.

Mass	Ion Abundance Criteria
95	50-200% of Mass 174
96	5 to 9 % of Mass 95
173	Less than 2 % of Mass 174

Mass	Ion Abundance Criteria
174	50 to 200 % of Mass 95
175	5 to 9 % of Mass 174
176	Greater than 95 %, but less than 105 % of Mass 174
177	5 to 10 % of Mass 176

14.4 Initial Calibration

14.4.1 A series of five or more initial calibration standards is prepared and analyzed for the target compounds. Nominal calibration levels are 0.02, 0.05, 0.1, 0.5, 1, 5, 10, 25, and 50 µg/L. Certain analytes are prepared at higher concentrations due to poor purge performance. Table 3 shows the calibration levels for each analysis. The purge volume is 5 mL. Other calibration levels and purge volumes may be used depending on the capabilities of the specific instrument or program requirements. Calibration levels may also vary based on analyst discretion in so far as the minimum number of calibration points are met for the curve type utilized (five for average response factor and first order curves, six for second order curves) and the lowest point on the curve is at or below the current Eurofins Frontier Global Sciences reporting limit.

14.4.2 The same purge volume must be used for calibration and sample analysis, and the lowest standard level must be at or below the reporting limit.

14.4.3 It may be necessary to analyze more than one set of calibration standards to encompass all of the analytes required for some tests.

14.4.4 Rejection of Calibration Points

Calibration levels below the reporting limit may be removed provided that the minimum number of calibration points are met for the curve type utilized (five for average response factor and first order curves, six for second order curves), and the lowest standard level is at or below the Eurofins Frontier Global Sciences reporting limit.

High point calibration levels may also be removed so far as the minimum number of calibration points are met for the curve type utilized (five for average response factor and first order curves, six for second order curves) and the midpoint of the curve (the ICIS) is not the highest point of the calibration range.

Generally, it is NOT acceptable to remove mid-points from a calibration. If calibration acceptance criteria are not met, the normal corrective action is to examine conditions such as instrument maintenance and accuracy of calibration standards. Any problems must be fixed and documented in the maintenance logbook. Then the calibration standards must be reanalyzed. If, however, there is documented evidence of a problem with a calibration point (e.g. misinjection, poorly sealed vial, etc…) then one point might be rejected, but it is recommended to re-calibrate.

Refer to Corporate SOP CA-Q-P-003, Calibration Curves, for further details.

14.4.5 Internal Standards

Internal standard calibration is used. The internal standards are listed in Table 4. Target compounds should reference the nearest internal standard. Each calibration standard is analyzed and the response factor (RF) for each compound is calculated using the area response of the characteristic ions against the concentration for each compound and internal standard. See Corporate SOP CA-Q-P-003, for calculation of response factor and other related algorithms.

14.4.6 The most common target analytes are checked for a response factor for each calibration level. See Table 10 for the compound list and guidance relative response factor criteria.

14.4.7 If all of the %RSD values in the calibration are </= 20% for 8260D, then all analytes may use average response factor for calibration. For analytes that fail the RSD criteria, use linear or quadratic curve.

14.4.8 If the software in use is capable of routinely reporting curve coefficients for data validation purposes and the necessary calibration reports can be generated, then the analyst should evaluate analytes with %RSD </= 15% (DoD) or </= 20% (8260D) for calibration on a curve. If it appears that substantially better accuracy would be obtained using quantitation from a curve, then the appropriate curve should be used for quantitation. The correlation coefficient (r) must be ³ 0.990 for SW-846 and must be ≥ 0.995 for DoD clients. For non-linear curves, the coefficient of determination (r2) must be ≥ 0.990 for both SW-846 and DoD requirements.

14.4.9 For 8260D no more than 10% of compounds can fail the 20% RSD/0.990 correlation coefficient requirement. Any individual analyte result that fails the 20%RSD/0.990 correlation coefficient requirement must be flagged or narrated as an estimated concentration.

14.4.10 For any analyte non-detect associated with a calibration that fails the 20%RSD/0.990 correlation criteria there must be a demonstration of adequate sensitivity at the quantitation limit. This is achieved by the successful analysis of a CCVL in the same analytical batch. The criterion for the CCVL is detection only but the standard qualitative identification criteria in the method must be met.

14.4.11 See Corporate SOP CA-Q-P-003 for information on acceptable initial calibration models and associated algorithms.

14.4.12 Initial Calibration Verification (ICV)

Once the initial calibration has been evaluated and determined to be valid, the calibration must be verified with an Initial Calibration Verification (ICV) using a standard prepared from an alternate source. The ICV is generally run at 5 ug/L. As the ICV concentration must not be equal to or greater than the highest calibration level, other ICV levels than those previously listed may be used or multiple levels of ICV may be needed to validate all compounds in the initial calibration curve.

For DoD and LaMP projects each target compound in the ICV must be <20% drift when compared to the initial calibration. For non-DoD and non-LaMP projects, all compounds must be <30% drift when compared to the initial calibration, except for poorly performing compounds listed in Table 8, which must be <45% drift.

For DoD projects analyses may continue if the drift is <30% for identified poor performing analytes with written approval from the client. (Method comment 4PP). See table 8 for the list of indentified poor performers.

For non-DoD and LaMP projects analyses may continue for those analytes that fail the criteria with approval from the client and an understanding that these results would be considered estimates and could be used for screening purposes.

Corrective Action: If the % drift falls outside acceptance criteria, assess the system for possible problems (standard degradation, etc.), re-prepare the verification standard and re-analyze. If the second ICV also fails, corrective action is required (e.g. system maintenance, re-preparing intermediate standards, etc.) and the calibration must be re-prepared and re-analyzed. An acceptable ICV must be achieved before sample analysis. No samples may be run until calibration has been verified. Analytes which do not meet the ICV % drift criteria will be removed from the calibration in the Chrom chromatography software for the method in which the analyte did not meet the method criteria to prevent the reporting of analytes using a deficient calibration curve.

14.4.13 If time remains in the 12-hour period initiated by the BFB injection before the initial calibration for DOD or LaMP projects, samples may be analyzed.For all other samples, a new 12 hour window is established with the injection of the ICV. Otherwise, proceed to continuing calibration, Section 15.3.

15) Procedure:

15.1 One time procedural variations are allowed only if deemed necessary in the professional judgment of management to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation shall be completely documented using a Nonconformance Memo and approved by a Supervisor or group leader and QA Manager. If contractually required, the client shall be notified. The Nonconformance Memo shall be filed in the project file.

15.2 Any unauthorized deviations from this procedure must also be documented as a nonconformance, with a cause and corrective action described.

15.3 Continuing Calibration

15.3.1 The initial calibration must be verified every twelve hours. For DoD projects the calibration must also be verified with a closing continuing calibration standard (CCVC) at the end of each analytical sequence.

15.3.2 Continuing calibration begins with analysis of BFB for DOD and LaMP projects as described in Section 14.3. If the system tune is acceptable, the continuing calibration standard(s) are analyzed. A standard of 5 ug/L is generally used as the CCVIS and CCVC.

15.3.3 For non-DoD projects the RF data from the standards are compared with the initial multi-point calibration to determine the percent drift of the target compounds. For non-DoD and LaMP projects the % drift limits of target compounds should be <20% before analysis proceeds, except for poorly performing compounds listed in Table 8, which must be <50% drift.

15.3.3.1 Non target compounds that exceed the specified limits for Drift or Difference should be flagged.

15.3.4 For DoD and LaMP projects, the percent difference or drift (%D) of target and surrogate compounds must be within ± 20% for the opening CCV.

15.3.5 For DoD projects the percent difference or drift (%D) of target and surrogate compounds must be within ± 50% for the closing CCV (CCVC).

15.3.6 For non-DoD projects the retention time of the internal standards in the continuing calibration standard cannot change by more than 30 seconds (0.5 min) when compared to the most recent multi-point calibration. For DoD projects the retention time of the internal standards in the continuing calibration standard cannot change by more than 10 seconds when compared to the most recent multi-point calibration. The 30 second criteria may only be used for DoD projects if prior written approval is received (method notes will contain "8ISRT" or "Std Var App" to indicate approval has been received). The internal standard areas must not change by more than a factor of 2 (50 - 200 %) from the mid point standard of the most recent multi-point calibration.

15.3.7 If target and/or surrogate compounds do not meet the criteria in Sections 15.3.3 through 15.3.8, the system must be evaluated and corrective action must be taken. The BFB tune and continuing calibration must be acceptable before analysis begins. Extensive corrective action, such as a different type of column, will require a new initial calibration. For non-DoD and LaMP, if two CCVs in a row fail, a new initial calibration must be performed. For DoD two additional consecutive CCVs must be run immediately. If both pass, samples may be reported without reanalysis. If either fails corrective action and re-calibration is required.

Corrective Actions: For non-DoD projects if the CCV recoveries of the target or surrogates compounds exceed their specified limits, and there are no associated sample detections above the RL, the data may be qualified and reported as the system has shown a potentially high bias. For DoD projects, if the CCV recoveries for target compounds exceed their specified limits, and there are no associated sample detections above the RL, the data may be qualified and reported as the system has shown a potentially high bias only if prior approval has been received in writing (method notes will contain "3HR" or "Std Var App" to indicate approval has been received). For all other cases, results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

15.3.8 Once the above criteria have been met, sample analysis may begin. Initial calibration average RFs (or the calibration curve) will be used for sample quantitation, not the continuing calibration RFs. Analysis may proceed until 12 hours from the injection of the BFB (DOD and LaMP) or CCVIS (all other samples) have passed. (A sample desorbed less than or equal to 12 hours after the BFB is acceptable.)

15.4 Sample Preparation

Check the Balance logbook to determine if the daily calibration check has been completed. If it has not, the analyst must perform this check according to SOP *EFGS-Q-QD-SOP2710*

15.4.1 Sample extraction using in house extraction.

15.4.1.1 When extracting the sample, extrude (for 5 g EnCoreTM) or weigh (for 10 g in house soil extraction) the sample into a tared 20 mL scintillation vial. EnCore samples should be extruded into methanol upon receipt. Record scintillation vial lot number, the sample weight, the methanol lot number, the preparation date and the analyst who prepared it in the 5035 preparation batch in TALS. Sample weights are calculated in the laboratory by adding the tare weight of the scintillation vial to the "Tare Weight" column and then entering the weight of the scintillation vial plus sample into the "Vial & Sample" column of the preparation batch sheet for the corresponding sample container ID. This can be done by either a direct read from the balance in the volatiles prep area (preferred method), or by manually entering the weight. If the samples were preserved in MeOH at another TALS lab the calculated initial sample weight can be manually entered into the "Initial Amount" column of the preparation batch sheet for the corresponding sample container ID.

15.4.1.2 For each batch of up to 20 samples a method blank (MB) and a Laboratory Control Sample (LCS) are also extracted. To prepare the method blank (MB); add 10-mL of methanol to 10 g Ottawa sand. To prepare the laboratory control sample (LCS)/laboratory control sample duplicate (LCSD), add 40 uL of the 8260 Working Solution and 10 mL of methanol to 10 g muffled Ottawa sand. (NOTE: The same metal spatulas to weigh soil samples must be used for measuring out the Ottawa sand).

15.4.1.3 If sufficient sample is available, one matrix spike (MS)/matrix spike duplicate (MSD) pair is extracted per extraction batch of up to 20 samples. If the sample set being extracted consists of products, waste oils, or other sample matrixes which based on analyst experience and discretion would not yield acceptable spike results due to matrix effects, a matrix duplicate (MD) and/or MD/MS may be prepared in lieu of and MS/MSD. To prepare the matrix spike (MS)/matrix spike duplicate (MSD), add 40 uL of the 8260 Working Solution and 10 mL of methanol to 10 g pre-weighed soil samples.

15.4.1.4 Add 5 mL (for EnCoreTM or TerraCoreTM) or 10 mL (in house soil extraction) of methanol to all vials immediately after recording sample weight.

15.4.1.5 Vortex the samples for the extraction batch for approximately 10 to 30 seconds to break up any large clumps in the extraction vials. This is especially important for extruded samples as they may be compacted in the EnCoreTM or TerraCoreTM sampling device and come out as a pellet. If after 30 seconds a pellet still remains, vortex for an additional 30 seconds. If pellet still remains, further vortex mixing is not recommended, proceed to next step. It should be noted that the MB and LCS must be vortex mixed the same amount of time as the longest associated sample.

15.4.1.6 After all samples have been vortex mixed, place all samples for the extraction batch into shaker box and set timer for ten minutes. It is recommended that the caps of all vials are checked and tightened before placing in shaker box to prevent leaking. If samples are present which still contain pelletized sample after vortex mixing in step 15.4.1.5, set the timer for 10 to 15 minutes. It is not recommended to shake samples for more than 15 minutes. If a sample still contains pelletized sample after shaking for 15 minutes, vortex the sample for an additional 15 seconds and shake entire batch for additional 5 minutes. Any pelletized sample remaining after second shaking is noted in a NCM in the extraction batch.

15.4.1.7 After samples are shaken, place samples four at a time into centrifuge with inserts for scintillation vials. Spin samples for a sufficient time to create a transparent but not necessarily uncolored layer of methanol extract above the extracted material. The time will vary depending on the nature and particle size of the extracted material. Three to five minutes at 50% speed is usually sufficient. Again it should be noted that the MB and LCS must be centrifuged at the same rate and for the same time as the longest centrifuged associated sample.

15.4.1.8 Solid extracts are stored in the scintillation vial used for extraction and are stored at 0-6^{o}C. The extracts are removed from cold storage and are allowed to return to ambient temperature prior to analysis.

15.4.2 Sample extraction for field preserved.

15.4.2.1 Each containers tare weight is recorded in the TALS preparation batch. Most containers will contain a bar code with the tare weight information that can be scanned for automatic entry into the tare weight entry field in the preparation batch. Sample weights are calculated in the laboratory by adding the received weight of the sample jar to the "Vial & Sample" column of the preparation batch sheet for the corresponding sample container ID. This can be done by either a direct read from the balance in the volatiles prep area (preferred method), or by manually entering the weight. If the samples received are in 4 oz jars with 25 mls of methanol (AK samples) the calculated initial weight of the sample must be adjusted to correct for the weight of the methanol which is not included in the container tare weight. TALS will perform this calculation, however the analyst must enter a "Yes" into the "Sub MeOH Wgt" column of the preparation batch sheet for the corresponding sample container ID. The nominal amount of initial soil should be 10g for VOA vials with 10mL of methanol, or 25g with 25mL of methanol. When the calculated initial weight of the soil deviates by more than 20% of the expected value, high or low, an NCM should be written detailing that the 1:1 ratio of soil:methanol is significantly exceeded. Acceptable weights are 8g-12g for a 10g:10mL sample, and 20g-30g for 25g:25mL sample.

15.4.2.2 For each batch of up to 20 samples a method blank (MB) and a Laboratory Control Sample (LCS) are prepared by the laboratory prior to sample analysis. A MB and an LCS sample consists of 10 g of muffled Ottawa Sand added to a scintillation vial followed by 10-mL of methanol.

15.4.2.3 Add the correct amount of matrix spiking solutions to all LCS samples. An aliquot of 40 uL of the 8260 Working Solution is added to 10 mL extracts.

15.4.2.4 The MB, LCS and any received samples which appear to contain "clumps" of sample which could be broken up with agitation are vortex mixed for up to 1 minute. If no samples require agitation, only the MB and LCS are vortex mixed for approximately 15 seconds to ensure mixing of the sand and added solutions.

15.5 Sample Analysis

15.6 Preliminary Evaluation

15.6.1 Sample screening

Where possible, samples are screened by headspace or GC/MS off-tune analysis to determine the correct aliquot for analysis. Alternatively, an appropriate aliquot can be determined from sample histories. Refer to section 15.11 for Dilutions.

15.7 Sample Analysis Procedure

15.7.1 All analysis conditions for samples must be the same as for the continuing calibration standards (including purge volume, time and flow, desorb time and temperature, column temperatures, multiplier setting etc.).

15.7.2 All samples must be analyzed as part of a batch. The batch is a set of up to 20 samples of the same matrix processed using the same procedures and reagents within the same time period. The batch also must contain a MS/MSD (if sufficient sample volume allows), an LCS, and a method blank.

15.7.2.1 Laboratory generated QC samples (MB, LCS/LCSD, MS/MSD) do not count towards the maximum 20 samples in a batch. Field QC samples are included in the batch count.

15.7.2.2 It is not necessary to reanalyze batch QC with reanalysis of samples. However, any re-runs must be as part of a valid batch.

15.8 Water Samples

15.8.1 All samples and standard solutions must be at ambient temperature before analysis.

15.8.2 For analysis 5 ml are sub sampled by the autosampler.

15.8.3 For analysis internal standards and surrogates are added by the autosampler. Refer to Tables 4 and 5.

15.8.4 MB is prepared by fillinga VOA vial without headspace with reagent water

15.8.5 LCS/LCSD is prepared by adding 5 uL of 8260 Working Solution to a 50 mL volumetric flask and inverting it 3 times. The prepared solution is poured into a VOA vial with no headspace.

15.8.6 MS/MSD samples are prepared by injecting 4.6 uL of 8260 Working Solution through the VOA vial septa using a bevel tipped syringe or directly into the MS or MSD VOA vial.

15.8.7 Purge the sample at ambient temperature with a trap temperature of 25°C.

15.8.8 After purging is complete, dry purge and desorb the sample, start the GC temperature program, and begin data acquisition. After desorption, bake the trap for 5-10 minutes to condition it for the next analysis. When the trap is cool, it is ready for the next sample.

15.8.9 Purge Time, dry purge time, desorb time, bake time, and temperature are optimized for the type of trap in use and the analytical system. The same conditions must be used for samples and standards. Current conditions at the time of writing this SOP, purge time for all instruments is 8 to 11 minutes, dry purge is 1 minute or 2 minutes, bake time is 6 to 9 minutes, desorb temperature is 195 to 220°C, and bake temperature is 220 to 270°C.

15.8.10 Immediately after analysis or immediately after opening the sealed VOA vial and obtaining the necessary aliquots for dilutions, the analyst must check the pH of aqueous samples with narrow range pH paper to ensure the pH is < 2. Record the pH of aqueous samples and the lot number of the pH paper used on the analytical batch sheets along with any dilution factors used. In those cases where the pH is > 2, initiate a non-conformance report and qualify the data, noting if the sample(s) was analyzed outside of the shortened seven-day hold time. Where possible, reanalyze.

15.9 Methanol Extract samples

15.9.1 Fill a VOA vial with reagent water, and remove 900 uL of water using a volumetric pipette.

15.9.2 Add 1075 uL of methanolic extract to the vial and immediately cap the VOA vial invert the vial to ensure that no air bubble larger than 4 mm is present. If there is an air bubble and it is greater than 4 mm, re-prepare sample.

15.9.3 The final volume of reagent water and methanolic extract used is entered into Chrome which then is uploaded into the analytical batch in TALS (43 mls).

15.9.4 Internal standards and surrogates are added by the autosampler. Refer to Tables 4 and 5.

15.9.5 Load the sample in the autosampler and proceed to analyze.

15.9.6 MS/MSD samples for in house extracts are prepared at time of extraction and are prepared for analysis as above. For field preserved samples, an in house post spike of the prepared sample is necessary, and is prepared by injecting 4.6 uL of 8260 Working Solution through the VOA vial septa using a bevel tipped syringe.

15.9.7 Dilutions of methanolic extracts are made by adding proportional amounts of methanol extract to a new VOA vial. This amount is recorded in the initial volume of the sample in the Chrom worklist. Sample dilutions of greater than 5x do not require the removal of water from the VOA vial prior to addition of methanolic extract.

15.9.8 Purge the sample at ambient temperature with a trap temperature of 25°C.

15.9.9 After purging is complete, dry purge and desorb the sample, start the GC temperature program, and begin data acquisition. After desorption, bake the trap for 5-10 minutes to condition it for the next analysis. When the trap is cool, it is ready for the next sample.

15.9.10 Purge Time, dry purge time, desorb time, bake time, and temperature are optimized for the type of trap in use and the analytical system. The same conditions must be used for samples and standards. Current conditions at the time of writing this SOP, purge time for all instruments is 8 to 11 minutes, dry purge is 0-1 minute, bake time is 6 to 9 minutes, desorb temperature is 195 to 220°C, and bake temperature is 220 to 270°C.

15.10 Initial Review and Corrective Actions

15.10.1 Retention Times

For 8260D and DoD projects if the retention time for any internal standard in the continuing calibration changes by more than 10 seconds from the mid-level initial calibration standard, the chromatographic system must be inspected for malfunctions and corrected. Reanalysis of samples analyzed while the system was malfunctioning is required.

15.10.2 Internal Standard Response

If the internal standard response in the daily continuing calibration is more than 200% or less than 50% of the response in the mid-level of the initial calibration standard, the chromatographic system must be inspected for malfunctions and corrected. Reanalysis of samples analyzed while the system was malfunctioning is required.

The internal standard response in a sample is compared to the internal standard response in the daily continuing calibration. Responses from 50% to 200% are acceptable. If a sample fails to meet these internal standard criteria, further investigation is necessary. If the change in sensitivity is a matrix effect confined to an individual sample, reanalysis is not necessary, though may be required to prove matrix effect. If the change in sensitivity is due to instrumental problems, all affected samples must be reanalyzed after the problem is corrected. If the ISTD response falls below 50% and the sample has no target analyte detections above the RL (1/2 the RL for DoD projects), the data may be qualified and reported. This should be done in consultation with the PM and client, an NCM must be written.

15.10.3 Surrogate Standard Recoveries

The surrogate standard recoveries are evaluated to ensure that they are within limits. Corrective action for surrogates out of control will normally be to reanalyze the affected samples. However, if the surrogate standard response is out high and there are no target analytes or tentatively identified compounds, reanalysis may not be necessary. Out of control surrogate standard response may be a matrix effect. It is only necessary to reanalyze a sample once to demonstrate matrix effect (this may be demonstrated by a MS/MSD analysis as well). Reanalysis at a dilution should be considered if appropriate. If a diluted analysis is necessary and surrogate recoveries are in control or less affected, this is sufficient to demonstrate matrix interference.

Re-analysis is not necessary if obvious matrix effect is shown in the chromatograms (e.g. a large co-eluting peak with the same quantitation ion, or non-target interferences) or were noted in sample prep (e.g. high percent moisture content without moisture correction). A non-conformance memo is generated stating the reason for not re-analyzing the affected sample.

15.11 Dilutions

Dilutions for waters are made directly into a 40mL VOA vial and should be prepared just prior to the GC/MS analysis of the sample. For example, a 10X dilution is made by filling a VOA vial to slightly overfull and then removing 4.3 mL of reagent water from the vial. 4.3 mL of sample is then transferred to the vial to bring it back to full and it is immediately capped for analysis. In the worklist this is recorded at a 10.0 dilution,.

Soil dilutions are prepared by adding a smaller aliquot than the standard 1.075mL or by serial dilution for aliquots smaller than 20uL or viscous samples. In the worklist this is recorded as the amount added to 43 mL. The worklist is left as a 1.0 dilution.

If the response for any compound exceeds the working range of the GC/MS system, a dilution of the sample/extract is prepared and analyzed. A dilution should be prepared to ensure that the majority of compounds being diluted for fall in the middle to upper part of the calibration curve (i.e. from 40-90% of their respective calibration range). All reported dilutions must be within the calibration range of the respective analytes and should be compared to other dilutions to ensure that the diluted data "makes sense" as a check for possible dilution errors. If this cannot be accomplished with a single dilution, multiple sample dilutions are necessary. Dilution levels should be considered carefully and it is recommended that a "complicated" sample (one which has more than three compounds which require dilution) is discussed with another analyst or area supervisor as necessary in order to minimize the number of dilutions

required. Samples may be screened to determine the appropriate dilution for the initial run or historical site data may be used to determine initial dilutions.

15.11.1 Guidance for Dilutions Due to Matrix

If the sample is initially run at a dilution and the baseline rise is less than half the height of the internal standards, or if individual non target peaks are less than twice the height of the internal standards, then the sample should be reanalyzed at a more concentrated dilution. This requirement is approximate and subject to analyst judgment and reasonable client requirements and requests.

15.11.2 Reporting Dilutions

The most concentrated dilution will be reported as the base dilution. Other dilution levels will report only the required diluted compounds and all other compounds and surrogates in the dilution will be set to acceptable in the LIMS system and not reported. Other reporting techniques may be required by specific project requirements or client request and will be transferred to the laboratory by the PM using the mechanisms previously discussed. See Section 18.1.3.

15.11.3 Percent Moisture

Analytical results may be reported as dry or wet weight, as required by the client. Percent moisture must be determined if results will be reported as dry weight. Refer to SOP *EFGS-T-WC-SOP41035* for determination of percent moisture.

15.12 Instrument Maintenance

15.12.1 Agilent 5973 Inert, 5973 Network, 5975, 5975B, and 6890N

15.12.1.1 All circuit boards and peripheral attachments are dusted and vacuumed of debris and all plumbing and electrical connections inspected and adjusted; any replacement of worn parts is also done at this time.

15.12.1.2 The injection port is cleaned of debris by removing the injector and column nut and forcing clean methanol through the top of the injector into a waste container at the bottom. The inlet liner and gold seal are replaced as needed (e.g. visibly dirty or discolored, active site issues, etc.) The ion source is disassembled, cleaned, and reassembled with new filaments and insulators, as needed.

15.12.1.3 If low level soils cause recoveries for the internal standard to report low or purge flow to decrease in any consequent CCV's, the pencil filters or injector needle could be clogged. Methanol rinses of these parts may solve the issue, or replacing the part.

15.12.2 Column installation is performed when the following conditions are encountered;

- Heavy column bleed that cannot be eliminated by thermal conditioning.
- Loss of early eluting peaks due to column cutting.
- Inability to chromatographically resolve method performance compound peaks.
- Distortion of peak shapes i.e.; broadening, ghost peaks, split peaks that can't be resolved by injection port maintenance or flow control.

15.12.2.1 Turn the GC oven off and let the system cool to room temperature. Remove the column nut, liner, septum, and press tight inlet connector. Dispose of old column appropriately.

15.12.2.2 Cut approximately six inches off of the end of new columns. Install new column using appropriate sized ferrules and nuts.

15.12.2.3 Turn the GC on and set the injector temperature to 230 °C, oven to the manufacturers recommended isotherm temperature or 10°C below the manufacturers max temperature if an isotherm is not provided and condition for five minutes.

15.12.2.4 Perform an air water check on the system. When the air water spectrum shows acceptable levels, proceed with the mass calibration procedure. For additional information of column replacement see the manufacturer's operator's manual.

15.12.3 OI Analytical 4760 and 4660 Thermal Purge and Trap Concentrator Units

15.12.3.1 A new OI #10 trap is installed by following the instructions from the manufacturer. A new trap should be conditioned per manufacture specifications.

15.12.3.2 Sample lines, internal valves, sparge cells, and sparge cell mounts and fittings are rinsed with purge and trap grade methanol or replaced as necessary.

15.12.3.3 All dust and debris is removed from the circuit boards and tubing replaced where necessary.

15.12.3.4 The purge gas flow rate (40 mL/min ± 5 mL/min) should be measured at the vent and recorded in the maintenance logbook.

15.12.4 OI 4100 or equivalent type auto sampler.

15.12.4.1 Remove debris and perform a calibration per manufacturer's instructions.

15.12.4.2 All dust and debris is removed from the circuit boards and tubing replaced where necessary.

15.12.4.3 The guide rails are wiped down with a Kim wipe and n-Propanol to remove grease buildup and debris.

15.12.4.4 The syringe is cleaned per manufacturer's instructions to remove debris.

15.12.4.5 The rinse reservoir is refilled with purge water prior to analysis.

15.12.4.6 The Internal Standard/Surrogate Standard vial is refilled as needed and primed after filling to ensure the instrument is drawing volume.

15.12.5 Major Maintenance

A new initial calibration is necessary following certain maintenance procedures. These maintenance procedures include changing the column, cleaning the source and replacing the electron multiplier. In addition, a new initial calibration may be necessary if a large amount of routine maintenance occurs at once. This will be determined by evaluating the system using a CCV.

15.12.6 Maintenance Logbook

All maintenance and repairs need to be documented in the instrument's maintenance logbook. The logbook must include the instrument name, serial number for each major component (e.g., GC, autosampler, column) and the date of start-up. When an instrument is not capable of analyzing samples, it needs to be tagged "Out of Service". Logbook entries must include a description of the problem and what actions were taken to address the problem. After an instrument has undergone maintenance or repairs, the system is evaluated using a tune, CCV or ICAL. If the evaluation is successful, the analyst documents in the logbook that the "System returned to control as indicated by a passing CCV" (or ICAL, MB, tune, etc as may be the case).

If columns were replaced during maintenance procedures, the specific make, model and serial numbers of the columns installed need to be entered in the instruments maintenance logbook.

15.13 Troubleshooting

15.13.1 QUESTIONS TO ASK YOURSELF

15.13.1.1 MECHANICAL ISSUE?

- Has the problem just started, or has it been getting worse with time?
- Has anything recently been done to the instrument that may have caused the problem to start?
- Have there been any nasty samples run on the instrument recently?

15.13.1.2 ANALYTE ISSUE?

- Are there any other compounds out or trending out?
- Did the CCV and/or LCS show similar trends?
- Is this a one time event? Or did you see similar signs yesterday?
- Is it failing on other mass specs?
- Did anything change from the last time it passed?
- Have there been any nasty samples run on the instrument recently?

15.13.1.3 INTERNAL/SURROGATE ISSUE?

- Have they been stable up until now?
- Is the gas on and are the standards fresh?
- Are the glass vials correctly positioned and tight?
- Do they look like they are trending in any direction or just fluctuating?
- Is the tune stable? Are the ratios close to the ICAL tune?

15.13.2 BEST PRACTICE

15.13.2.1 If you can – replace the most likely piece in the system, label the old one with which instrument it's from, the date out and possibly the problem you are having e.g. R1, 071010 Bromoform. Test if the problem is fixed. If not, move onto the next thing and replace until the problem is fixed. Then work backward and reinstall the old pieces which are still OK. If you no longer need a part that is still good, label it as such. If a piece is bad and not even good for testing with throw it out and tell your department manager what piece and part number.

15.13.3 TYPICAL FIRST THINGS TO LOOK AT AND TRY

15.13.3.1 IF YOU HAVE A LEAK

- In the 4100 – perform a leak check as described in the operator's manual.
- In the concentrator – Perform a leak check in the system diagnostics to determine which part of the system has a leak.
- With a vial purging leak check around all the fittings starting with the entry from the transfer line, the 4-port valve, the 6-port valve ad around the water management and trap.
- You can also check the flows coming out of the 4-port, leaving the 6-port, there is an adapter which can be added instead of the trap to measure through the water management, from the trap. If all of these measures around 40mls and still you have less than 37 coming out the purge vent it could be leaking across the valves in the side of the concentrator.

15.13.3.2 COMMON PLACE TO LOOK IF IT'S A ANALYTE PROBLEM

- **1,1,2,2-Trichloroethane RRF** – Could be any of the lines as often an active site. Start with transfer line, lines in concentrator, water management and trap, soil valve if installed.
- **Bromoform** – Flow is not 40mls, water management, transfer line, small lines in concentrator. This can sometime be a tune issue as well if it is somewhat different from normal.
- **Naphthalene** carryover/low response – Perform a sample pathway rinse on the purge and trap concentrator. Often water management, change this out and condition with 5 or 6 varying concentrations of an old main or 524 std. e.g. 20ppb, 80ppb, 10ppb, 50ppb etc. Could also be transfer line.
- **Vinyl Chloride** – Usually the first compound to fail low in the standard mix – simply move up to next standard. If you are changing to a new standard every couple of days then your ICAL standards were too fresh and you need to ICAL again.
- **1,1-Dichloroethene** – Usually the first compound to fail low in the Main mix – simply move up to next standard. If you are changing to a new standard every couple of days then your ICAL standards were too fresh and you need to ICAL again.
- **Chloroform** – usually your tune is differing from the ICAL
- Contamination – look back at previous runs, if you have high hits for this compound then run 20 – 30 blanks to clean it up. If you still have high concentrations then the sample possibly blew back into the instrument so could be purge valves or the pencil filter in the back of the Archon.

15.13.3.3 PEAK SHAPE DIFFERENT

- If you have peak tailing on the front end compounds such as Vinyl Chloride, Chloromethane etc then it is often a result of a worn trap.

15.13.3.4 SURROGATES FAILING

- If you have 1,2-DCA failing and all the other surrogates are OK, then the likely cause is the tune. Often the ratios will have moved. Follow the surrogates, if low, then drop ratios etc
- If you have all the surrogates out and it seems to be consistently that way, it could be the following,
  - Is the gas turned on?
  - Is the surrogate vial positioned properly on the archon
  - Your concentration levels in the ICAL maybe incorrect if you have just ICALed.
  - The valve has perhaps worn a little and the nominal value in target needs to be updated, but this can only happen after an ICAL.
  - If the surrogates need to be weighted linear or linear in an ICAL and you see them trending this way for a while its possible the column has gone bad or you may have a standard valve leak.

- You can check to see if it's the autosampler causing the problem by manually injecting IS/SS and turn off the IS and SS on the autosampler
- If two surrogates are high and two are low, sometimes this is because the autosamplersurrogate is not matching with the surrogate you ICAL'd with. Try swapping out the autosampler surrogate and if this does not fix it, re-ICAL the Supp with the new surrogate.

15.13.3.5 INTERNALS FAILING, TRENDING OR BOUNCING

- How fresh is your internals? If they are more than say a month old, they may have gone bad. Is the vial on properly and done up tight (not too tight).
- Is the gas turned on?
- How long has the instrument been using the current filament? More than 4weeks then you may want to change to the other or change the filaments if they are both spent.
- If the internals bouncing seems to correlate with the tune then most likely you want to change filament or clean the source.
- If the internals fall to a value and sit there or raise to a value and sit there you may want to consider ICAL it at that tune setting, instruments have a kind of sweet spot.
- Internals falling off maybe a water buildup and the parameters need looking at on the concentrator. Have a look at other instruments to see how they are set up and try one or two different settings to establish if this helps. Always keep a note of where they were at and what you have changed them too.
- Split ratios can also effect internals, try increasing the ratio to more like 45:1 if not already at this level.

15.13.3.6 CONCENTRATOR STOPS

- Turn it off and on again, it is common for the concentrator to lose the plot every so often.
- Shows a temperature error – check to make sure the trap is covered and the main cover is down properly, any heat escape will cause an error.

15.13.3.7 SEQUENCE STOPS

- You have started on a file that already exists and you have not checked the overwrite file box.
- Communication problem with the GC and MS. Turn off the MS and GC and restart the computer. Restart the MS and GC.

16) Calculations:

16.1 Qualitative Identification for SIM Analysis

16.1.1 An analyte is identified by retention time and by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard reference may be obtained on the user's GC/MS by analysis of the calibration standards or from the NIST Library (same library as used for routine sample analysis). Two criteria must be satisfied to verify identification: (1) elution of sample component at the same GC retention time as the standard component; and (2) correspondence of the sample component and the standard component characteristic ions.

NOTE: Care must be taken to ensure that spectral distortion due to co-elution is evaluated.

16.1.1.1 The sample component retention time must compare to within ± 0.06 RRT units of the retention time of the standard component. For reference, the standard must be run within the same twelve hour tune as the sample.

16.1.1.2 All ions present in the standard mass spectra at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100%) should be present in the sample spectrum.

16.1.1.3 The relative intensities of ions should agree to within ±30% between the standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 20 and 80%.)

16.1.2 If a compound cannot be verified by all the above criteria, but in the technical judgment of the analyst, the identification is correct, then the analyst shall report that identification and proceed with quantitation.

16.1.3 All data are subject to two levels of technical review, as described in SOP *EFGS-P-DR-SOP2801*.

16.2 Accuracy

ICV / CCV, LCS % Recovery = observed concentration x 100

known concentration

MS % Recovery = (spiked sample) - (unspiked sample) x 100
spiked concentration

16.3 Precision (RPD)

Matrix Duplicate (MD) = |orig. sample value - dup. sample value| x 100
[(orig. sample value + dup. sample value)/2]

16.4 Response Factor (RF)

$$RF = \frac{A_x C_{is}}{A_{is} C_x}$$

Where:
A_x = Area of the characteristic ion for the compound to be measured.
A_{is} = Area of the characteristic ion for the specific internal standard.
C_{is} = Concentration of the specific internal standard, ng.
C_x = Concentration of the compound being measured, ng.

16.5 Standard deviation (SD)

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{X})^2}{n-1}}$$

Where:
X_i = Value of X at i through n.
n = Number of points.
$\overline{X}$ = Average value of X_i.

16.6 Percent relative standard deviation (%RSD)

$$\%RSD = \frac{SD}{\overline{RF}} \times 100\%$$

Where $\overline{RF}$ is the mean of RF values for the calibration.

16.7 Percent drift between the initial calibration and the continuing calibration:

$$\%Drift = \frac{C_{expected} - C_{found}}{C_{expected}} \times 100\%$$

Where:
$C_{expected}$ = Known concentration in standard.
C_{found} = Measured concentration using selected quantitation method.

16.8 Calculation of Results for Waters

Sample Conc (ug/L) = C x D

Where:
C = On Column concentration (ppb)
D = Dilution Factor

16.9 Calculation of Results for Methanol Extracts

Sample Conc (ug/Kg) = [On Column (ug/L)] x Extraction Final Volume (mL) x VOA Vial Volume (mL) x 1L (CF) x 1000g (CF)

$$\text{Sample Conc (ug/Kg)} = [\text{On Column (ug/L)}] \times \frac{\text{Extraction Final Volume (mL)}\ ^{1}}{\text{Amount of Soil Sample (g)}\ ^{2}} \times \frac{43\ (\text{mL})}{1.075(\text{mL})} \times \frac{1\text{L (CF)}}{1000\text{mL}} \times \frac{1000\text{g (CF)}}{1\text{Kg}}$$

[1]Extract Final Volume, miscible solvent corrected (mL) = ((g of samples * % moisture/100) + ml of MeOH) * 40 (used when % Moisture of the soil sample is greater than 10%).
[2]Amount of Soil, dry-weight corrected (g) = sample mass (g) * (100 - % moisture/100)

Note: All dry weight corrections are made in LIMS at the time the final report is prepared.

Note: For all methanolic samples with a % Moisture of greater than 10%, it is necessary to adjust the extraction final volume of the sample in order to allow for the miscible solvents effect. This is done by the following equation:

Corrected FV = ((g of samples * % moisture/100) + ml of MeOH) * 40

In these situations, an "other observation" NCM must be generated and the correction and above formula must be noted in the case narrative.

16.10 Upon completion of the analytical sequence:

16.10.1 Review chromatograms online and determine whether manual data manipulations are necessary.

16.10.2 Manual Integrations

16.10.3 All manual integrations must be justified and documented. See Corporate SOP CA-Q-S-002 for requirements for manual integration.

16.10.4 Manual integrations may be processed using Chrom, which stores the before and after chromatograms and the reason for the change, and attaches the analyst's electronic signature.

16.10.5 Alternatively, the manual integration may be processed manually. In the latter case, print both the both the before and after chromatograms and record the reason for the change and initial and date the after chromatogram. Before and after chromatograms must be of sufficient scale to allow an independent reviewer to evaluate the manual integration.

16.11 Compile the raw data for all the samples and QC samples in a batch. The analytical batch is defined as containing no more than 20 field samples.

16.11.1 Perform a level 1 data review using Data Review Checker in TALS and document the review in TALS.

16.11.2 Submit the data package and review checklist to the peer reviewer for the level 2 review. The data review process is explained in SOP *EFGS-P-DR-SOP2801*.

17) Statistical Information and Method Performance:

17.1 Method Detection Limit Study (MDL)/Detection Limit

The method detection limit (MDL) or detection limit (DL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL/DL is determined according to the laboratory's MDL/DL procedure (see SOP CA-Q-S-006). MDL/DLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. The laboratory maintains MDL/DL studies for analyses performed; these are verified at least quarterly unless method requirements require a greater frequency.
For instruments that run samples which fall under LaMP regulations, a yearly MDL Study must be performed and MDLV starting at 1X the MDL.

17.2 Limit of Detection

The limit of detection (LOD) is determined for each analyte and matrix by spiking a quality system matrix at approximately two to four times the detection limit. This spike concentration establishes the LOD. The LOD is verified quarterly for each method and matrix on each instrument that analyzes said method/matrix. Refer to the laboratory's LOD procedure (see SOP CA-Q-S-006)

17.3 Limit of Quantitation

The limit of Quantitation (LOQ) is verified quarterly for each method and matrix on each instrument that analyzed said method/matrix. Refer to the laboratory's LOQ procedure (see SOP CA-Q-S-006)

18) Quality Assurance/Quality Control and Corrective Action:

18.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS QC program code and special instructions to determine specific QC requirements that apply.

18.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in the Eurofins Frontier Global Sciences QAM.

18.1.2 Specific QC requirements for Federal programs, e.g., USACE and Navy projects, are described in DoD QSM v5.3 or the latest promulgated version.

18.1.3 Project-specific requirements can override the requirements presented in this section when there is a written agreement between the laboratory and the client, and the source of those requirements should be described in the project documents. Project-specific requirements are communicated to the analyst via special instructions in the LIMS and may also come in the form of email or written notifications distributed at "project kick off" meetings.

18.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is approved by the supervisor and then automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group also receives NCMs by e-mail for tracking and trending purposes. The NCM process is described in more detail in SOP *EFGS-Q-QD-SOP2812*. This is in addition to the corrective actions described in the following sections.

18.2 Batch Definition

Batches are defined at the sample preparation stage. The batch is a set of up to 20 samples of the same matrix, plus required QC samples, processed using the same procedures and reagents within the same time period. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. The method blank must be run on each instrument and in each analytical batch.

18.3 Method Blanks

For each batch of samples, analyze a method blank. The method blank is analyzed after the calibration standards and before any samples.. For soils, the method blank consists of 10 mL of reagent grade methanol and ten grams of muffled Ottawa sand. For waters, a VOA vial is filled with no headspace with reagent water. Surrogates are added at the instrument by the autosampler and the method blank is carried through the entire analytical procedure.

Acceptance Criteria: For DoD/LaMP projects the method blank must not contain any analyte of interest at or above one-half the reporting limit or above 1/10 the measured concentration of the analyte in the associated samples or 1/10 the regulatory limits, whichever is greater. For DoD projects, when written approval is received (method notes will contain "2CLC" or "Std Var App" to indicate approval has been received), the method blank must not contain any common laboratory contaminants above the reporting limit. Contamination up to the reporting limit is allowed for non DoD/LaMP projects or at or above 1/10 of the measured concentration of that analyte in the associated samples, whichever is higher.

The method blank must have acceptable surrogate recoveries.

Corrective Actions: For DoD projects, if the analyte is a common laboratory contaminant (i.e., acetone, 2-butanone, carbon disulfide and methylene chloride), and written approval has been received, the data may be reported with qualifiers if the concentration of the analyte is less than the reporting limit. For non-DoD if the analyte is a common laboratory contaminant (i.e., methylene chloride, acetone, 2-butanone, ethyl ether, Acetonitrile and hexane) the data may be reported with qualifiers if the concentration of the analyte is less than five times the reporting limit.

Reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the associated samples.

If there is no target analyte greater than the RL (less than one half the RL for DoD clients) in the samples associated with an unacceptable method blank, the data may be reported with qualifiers for non-DoD clients. For DoD clients the data may only be reported if written approval has been received.

If surrogate recoveries in the blank are not acceptable, the data must be evaluated to determine if the method blank has served the purpose of demonstrating that the analysis is free of contamination. If surrogate recoveries are low and there are reportable analytes

in the associated samples, re-extraction of the blank and affected samples will normally be required. Consultation with the client should take place.

If reanalysis of the batch is not possible due to limited sample volume or other constraints, the method blank is reported, all affected analytes in the associated samples are flagged as required by the project, and appropriate comments may be made in a narrative to provide further documentation.

18.4 Surrogates

Every sample, blank (including instrument blanks), and QC sample is spiked with surrogates. Surrogate recoveries in samples, blanks, and QC samples must be assessed to ensure that recoveries are within established limits. The compounds included in the surrogate spiking solutions are listed in Table 5.

Acceptance Criteria: Acceptance limits for surrogate recoveries are set at ± 3 standard deviations around the historical mean or as defined by project or program requirements. Surrogate recovery limits are updated at a fixed frequency by QA and stored in the LIMS.

Corrective Actions: If any surrogates are outside limits, the following corrective actions must take place (except for dilutions):

- Check all calculations for error.
- Ensure that instrument performance is acceptable.
- Recalculate the data and/or reanalyze if either of the above checks reveal a problem.
- Re-prepare and reanalyze the sample or flag the data as "Estimated Concentration" if neither of the above resolves the problem.

The decision to reanalyze or flag the data should be made in consultation with the client. It is necessary to re-prepare/reanalyze a sample only once to demonstrate that poor surrogate recovery is due to matrix effect, unless the analyst believes that the repeated out of control results are not due to matrix effect.

If the surrogates are out of control for the sample, matrix spike, and matrix spike duplicate, then matrix effect has been demonstrated for that sample and re-preparation/reanalysis is not necessary. If the sample is out of control and the MS and/or MSD is in control, then reanalysis or flagging of the data is required.

Re-analysis is not necessary if obvious matrix effect is shown in the chromatograms (e.g. a large co-eluting peak with the same quantitation ion, or non-target interferences) or were noted in sample prep (e.g. high percent moisture content without moisture correction). A non-conformance memo is generated stating the reason for not re-analyzing the affected sample.

NOTE: For LaMP client samples, if the surrogate percent recovery fails, the recovery must be confirmed by re-extraction and reanalysis with the following exceptions:

- The lab has unequivocally demonstrated a sample matrix effect and informed the LaMP client representative.
- The recovery exceeds control limits and all target analytes in the sample are non-detect.

18.5 Laboratory Control Samples and Laboratory Control Sample Duplicates (LCS/LCSD)

An LCS is analyzed for each batch. The LCS is analyzed after the calibration standard and normally before any samples. The LCS contains all of the analytes of interest (see Table 6) and must contain the same analytes as the matrix spike.

Acceptance Criteria: The LCS recovery and RPD for the control analytes must be within established control limits. Unless otherwise specified in a reference method or project requirements, the control limits are set at ± 3 standard deviations around the mean of the historical data or based on project/program limits. An LCS that is determined to be within acceptance criteria effectively demonstrates that the analytical system is in control and validates system performance for the samples in the associated batch. Recovery limits are updated at a set frequency by QA and are stored in the LIMS.

If there are a large number of analytes in the LCS, then a specified number of results may fall beyond the LCS control limit (3 standard deviations), but within the marginal exceedance (ME) limits, which are set at ± 4 standard deviations around the mean of historical data. Marginal exceedances are recognized and allowed by NELAC. The number of marginal exceedances is based on the number of analytes in the LCS, as shown in the following table:

# of Analytes in LCS	# of Allowed Marginal Exceedances
> 90	5
71 – 90	4
51 – 70	3
31 – 50	2

11 – 30	1
< 11	0

If more analytes exceed the LCS control limits than is allowed, or if any analyte exceeds the ME limits, the LCS fails and corrective action is necessary. Marginal exceedances must be random. If the same analyte repeatedly fails the LCS control limits, it is an indication of a systematic problem. The source of the error must be identified and corrective action taken.

For non-DoD projects, if the LCS recovery is high and there are no detections in the associated samples for the affected analytes the data may be reported with qualifiers. For DoD projects the data may only be reported with qualifiers if approval has been received in writing (method notes will contain "3HR" or "Std Var App" to indicate approval has been received).

Note: For DOD projects, all exceedances of LCS Control Limits, are subject to corrective action. Therefore, all instances of LCS failures including the high bias but not detected in the associated samples scenario, must be investigated. For example and as noted above, the randomness of these failures can be evaluated or the spike solution can be re-verified. When the source of the problem is identified, corrective action is taken or variance from the QSM is requested.

Corrective Actions: If any analyte or surrogate is outside established control limits as described above, the system is out of control and corrective action must occur. Corrective action will normally be re-preparation and reanalysis of the batch.

If the batch is not re-extracted and reanalyzed, the reasons for accepting the batch must be clearly presented in the project records (via NCMs and the case narrative) and in the final report. Examples of acceptable reasons for not reanalyzing might be that the matrix spike and matrix spike duplicate are acceptable, and sample surrogate recoveries are good, demonstrating that the problem was confined to the LCS. This type of justification should be reviewed and documented with the client before reporting.

If re-extraction and reanalysis of the batch is not possible due to limited sample volume or other constraints, the LCS is reported, all associated samples are flagged, and appropriate comments are made in a narrative to provide further documentation.

18.6 Matrix Spike and Matrix Spike Duplicate (MS/MSD)

For each QC batch, analyze a matrix spike and matrix spike duplicate when sample volume permits. Spiking compounds and levels are given in Table 6. The selection of the spike solution is dependent on client program requirements. The matrix spike/duplicate must be analyzed at the same base dilution as the unspiked sample, even if the matrix spike compounds will be diluted out. Dilutions (beyond the base dilution if necessary) of MS/MSD analyses are not required unless there are specific client instructions to do so. If necessary, this requirement will be passed to the laboratory through the PM by means of the mechanisms described in section 18.1.3 of this SOP.

Acceptance Criteria: The MS/MSD recovery for the control analytes must be within established control limits. Unless otherwise specified in a reference method or project requirements, the control limits are set at ± 3 standard deviations around the mean of the historical data. The relative percent difference (RPD) between the MS and the MSD must be less than the established RPD limit, which is based on statistical analysis of historical data. MS/MSD recovery and RPD limits are updated at a regular frequency by QA and are stored in the LIMS.

Corrective Actions: If any individual recovery or RPD falls outside the acceptable range, corrective action must occur. The initial corrective action will be to check the recovery of that analyte in the LCS. Generally, if the recovery of the analyte in the LCS is within limits, then the laboratory operation is in control and analysis may proceed. The reasons for accepting the batch must be documented.

If the recovery for any component is outside QC limits for both the matrix spike/matrix spike duplicate and the LCS, the laboratory is out of control and corrective action must be taken. Corrective action will normally include reanalysis of the batch, except in cases where a high bias is indicated and no target is detected above the reporting limit in any associated sample.

If an MS/MSD is not possible due to limited sample, then a LCS duplicate (LCSD) should be analyzed. The RPD between the LCS and LCSD is compared to the established acceptance limit.

18.7 Internal Standards

Internal standards are components similar in nature to the analytes of interest. These are added to every sample (including QC aliquots) and standard analyzed. The purpose is to enable calculations based on internal standard methodology. Internal standard recoveries are monitored to verify that instrument performance is acceptable. Criteria for calibration standards are delineated in Section 10. If the internal standard data indicate instrument failure, the samples may require reanalysis. If not, the impact on sample data is evaluated and the data is flagged appropriately.

Acceptance Criteria: Any samples that do not meet the internal standard criteria for the continuing calibration must be evaluated for validity. If the change in internal standard response is a matrix effect confined to an individual sample, reanalysis is not necessary. If the change in internal standard response is due to instrumental problems, all affected samples must be reanalyzed after the problem is corrected.

18.8 If batch QC samples or trip blanks are re-analyzed to confirm a recovery or result, and an improvement in results would cause the re-analysis to be reported, then the associated client samples must also be re-analyzed. The only exception to this protocol would be if an obvious analytical problem occurred during the initial analysis (i.e. no internal standard added, bent autosampler needle, etc).

18.9 Any extra QC that is analyzed in a batch or sequence must be evaluated using the same criteria as the corresponding QC above.

19) List of Attachments:

Table 1 Eurofins Frontier Global Sciences Primary List Reporting Limits for 8260D SIM
Table 2 8260D SIM Additional Analyte List Reporting Limits
Table 3 Typical Calibration Levels
Table 4 Internal Standards
Table 5 Surrogate Standards
Table 6 Full List LCS and Matrix Spike Standard
Table 7 BFB Key Ion Abundance Criteria
Table 8 Poorly Performing Compounds
Table 9 Summary of QC Requirements
Table 10 8260D Guidance Relative Response Factor Criteria
Table 11 Characteristic Ions

Appendix I Example Sequence and Process Flow

Table 1

EFGS Primary List Reporting Limits for 8260D SIM

Compound	CAS Number	Reporting Limits[1]	
		Water (µg/L)	Soil (µg/kg)
1,1,1,2-Tetrachloroethane	630-20-6	0.5	5
1,1,2,2-Tetrachloroethane	79-34-5	0.5	10
1,1,2-Trichloroethane	79-00-5	0.5	5
1,1-Dichloroethene	75-35-4	0.5	5
1,2-Dichloroethane	107-06-2	0.5	5
1,4-Dichlorobenzene	106-46-7	0.5	5
2-Hexanone	591-78-6	0.5	30
Benzene	71-43-2	0.5	5
Bromoform	75-25-2	0.5	5
Bromomethane	74-83-9	0.5	5
Chlorodibromomethane	124-48-1	0.5	5
Chloroform	67-66-3	0.5	5
cis-1,2-Dichloroethene	156-59-2	0.5	5
cis-1,3-Dichloropropene	10061-01-5	0.5	5
Dibromomethane	74-95-3	0.5	5
Dichlorobromomethane	75-27-4	0.5	5
Ethylene Dibromide (EDB)	106-93-4	0.5	5
Hexachlorobutadiene	87-68-3	0.5	*10*
Naphthalene	91-20-3	0.5	*20*
Tetrachloroethene	127-18-4	0.5	5
trans-1,3-Dichloropropene	10061-02-6	0.5	5
Trichloroethene	79-01-6	0.5	5
Vinyl chloride	75-01-4	0.5	20

1 Reporting limits listed for soil/sediment are based on wet weight. The reporting limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher.

Table 2

8260D SIM Additional Analyte List Reporting Limits

Compound	CAS Number	Reporting Limits[1]	
		Standard Level Water µg/L	High Soil µg/kg
Butadiene	106-99-0	0.5	5
Isopropyl alcohol	67-63-0	2	70

1 Reporting limits listed for soil/sediment are based on wet weight. The reporting limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher.

Table 3

Typical Calibration Levels

Standard level water, Methanol preserved soil purge	***Calibration Levels, µg/L***								
	0.02	*0.05*	*0.1*	*0.5*	*1*	*5*	*10*	*25*	*50*

Table 4

Internal Standards

Internal Standard	Standard Concentration (mg/L)	Quantitation Ion
1,4-Dichlorobenzene-d4	25	152
Chlorobenzene-d5	25	117
Fluorobenzene	25	96
Tert-butanol-d9	500	65

Table 5

Surrogate Standards

Surrogate Compounds	Standard Concentration (mg/L)
1,2-Dichloroethane-d4	25
4-Bromofluorobenzene	25
Dibromofluoromethane	25
Toluene-d8	25

NOTES:

1) Recovery and precision limits for the surrogates are generated from historical data and are maintained by the QA department.

Table 6

Full List LCS and Matrix Spike Compounds

Compound	Standard Concentration (mg/L)
1,1,1,2-Tetrachloroethane	50
1,1,2,2-Tetrachloroethane	50
1,1,2-Trichloroethane	50
1,1-Dichloroethene	50
1,2-Dichloroethane	50
1,4-Dichlorobenzene	50
2-Hexanone	250
Benzene	50
Bromoform	50
Bromomethane	50
Butadiene	50
Chlorodibromomethane	50
Chloroform	50
cis-1,2-Dichloroethene	50
cis-1,3-Dichloropropene	50
Dibromomethane	50
Dichlorobromomethane	50
Ethylene Dibromide (EDB)	50
Hexachlorobutadiene	50
Isopropyl alcohol	500
Naphthalene	50
Tetrachloroethene	50
trans-1,3-Dichloropropene	50
Trichloroethene	50
Vinyl chloride	50

NOTES:

1) Recovery and precision limits for the LCS, MS, and MSD are generated from historical data and are maintained by the QA department.

Table 7

BFB Key Ion Abundance Criteria

Mass	Ion Abundance Criteria
95	50-200% of Mass 174

Table 7

BFB Key Ion Abundance Criteria

Mass	Ion Abundance Criteria
96	5 to 9 % of Mass 95
173	Less than 2 % of Mass 174
174	50 to 200 % of Mass 95
175	5 to 9 % of Mass 174
176	Greater than 95 %, but less than 105 % of Mass 174
177	5 to 10 % of Mass 176

Table 8
Poorly Performing Compounds

2-Hexanone
Bromomethane
Bromoform
Naphthalene
Isopropyl alcohol

This is not a comprehensive list and is subject to change. Each DoD projects' target analyte list should be evaluated for poor performers.

Analytes that are in bold are also represented in Table 1 Reporting Limits for Standard Analytes.

Table 9

Summary of QC Requirements

QC Parameter	Frequency	Acceptance Criteria	Corrective Action
BFB Tune	Prior to ICAL. ***For DoD requirements above and below***: At the beginning of each 12 hour period.	See Section 11.3	Retune instrument and verify. Rerun affected samples.
Minimum 5-point Initial Calibration, 6-point for quadratic curves	Initial calibration prior to sample analysis	1. Average Response Factor for specified compounds: See table 10 2. RSD for all compounds: ≤ 20% **For DOD requirements above and one option below:** Option 1: RSD for each analyte ≤ 15% Option 2: Linear regression least squares regression r^2 ≥ 0.990 Option 3: Non linear least squares regression r^2 ≥ 0.990 and 6 points must be used.	Terminate analysis; correct the problem; recalibrate. Problem must be corrected. No samples may be run until ICAL has passed.
ICV	Following initial calibration.	70-130% for non-DoD projects and 45-155% for poor performers **For DoD:** 80 - 120% recovery and 70-130% for poor performers with prior written approval	Terminate analysis; correct the problem; recalibrate.
Relative Retention Times (RRT)	With each sample	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL. Laboratory may update RTs based on the CCV to account for minor performance fluctuations or after routine system maintenance (e.g. column clipping).

QC Parameter	Frequency	Acceptance Criteria	Corrective Action
CCV	Daily before sample analysis and every 12 hours of analysis time. Initial CCV begins 12 hour window for non-DoD samples.	1. Avg RF for specified compounds: See table 10 2. %D/Drift for 80% of compounds ≤ 20%D. **For DoD:** 1. Avg RF: see method 2. Opening CCV: %D/Drift for all target compounds and surrogates ≤ 20%D. 3. Closing CCV: %D/Drift for all target compounds and surrogates ≤ 50%D.	Correct problem, then rerun CCV. If that fails, then repeat ICAL. Reanalyze all sample since the last successful CCV.
Internal Standards (IS) verification	Every field sample, standard, and QC sample	Retention time ± 30 seconds from RT of the midpoint standard in ICAL; EICP area within -50% to +100% of ICAL midpoint standard. **For DoD:** Retention time ± 10 seconds from RT of the midpoint standard in ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples while system was malfunctioning is mandatory.
Method Blank	One per batch of 20 field samples or fewer.	The result must be < RL or < 5% the amount measured in any sample or 1/10 the regulatory limit. **For DoD:** No analytes detected > ½ RL and > 10% the amount measured in any sample or 1/10 the regulatory limit. For common laboratory contaminants no analytes detected > RL.	Re-extract and reanalyze samples. Note exceptions under criteria section. See Section 9.3 for additional requirements.

QC Parameter	Frequency	Acceptance Criteria	Corrective Action
LCS	One per batch of 20 field samples or fewer.	Must be within laboratory control limits. **For DoD:** Must contain all analytes to be reported. QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	See Section 9.5 for additional requirements.
Surrogate	All field and QC samples.	Must be within laboratory control limits, unless it fails high and the sample is ND, or matrix interference is confirmed by a reanalysis or MS/MSD performed on the sample, or client specific requirements exist. **For DoD:** QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	See Section 9.4 for additional requirements.
Matrix Spike	One per lot of 20 field samples or fewer.	Must be within laboratory control limits. **For DoD:** Must contain all analytes to be reported and must use LCS control limits. MD/MSD RPD ≤20%	See Section 9.5 for additional requirements.

Table 10

8260D Guidance Relative Response Factors Criteria for Initial and Continuing Calibration Verification

Analyte	Relative Response Factor (RF) a.
Benzene	0.200
Bromodichloromethane	0.300
Bromoform	0.100
Bromomethane	0.010
Chloroform	0.300
Dibromochloromethane	0.200
1,2-Dibromoethane (EDB)	0.200
1,4-Dichlorobenzene	0.600
1,1-Dichloroethene	0.060
trans-1,2-Dichloroethene	0.100
cis-1,3-Dichloropropene	0.300
trans-1,3-Dichloropropene	0.300
Ethylbenzene	0.400
2-Hexanone	0.010
Isopropylbenzene	0.400
Methyl tert-Butyl Ether	0.100
Tetrachloroethene	0.100
Toluene	0.300
1,1,2-Trichloroethane	0.200
Trichloroethene	0.200
Vinyl chloride	0.010
m,p-Xylene	0.200
o-Xylene	0.200

a. Values in this table are referenced from the CLP Statement of Work SOM 02.4. These response factors are provided as guidance only and are not intended to be a requirement..

Table 11
Characteristic Ions

Compound	Approx Retention Time (min)	Primary	Secondary	Tertiary
Internal Standards				
TBA-d9	6.716	65	46	--
Fluorobenzene	9.612	96	77	--
Chlorobenzene-d5	12.852	117	82	--
1,4 Dichlorobenzene-d4	13.864	152	150	115
Surrogates				
Dibromofluoromethane	6.586	113	111	--
1,2-Dichloroethane-d4	4.856	65	67	--
Trifuorotoluene	10.132	146	--	--
Toluene-d8	11.216	98	100	--
4-Bromofluorobenzene	13.701	174	95	176
Target Analytes				
Vinyl chloride	4.857	62	64	--
Butadiene	5.014	54	53	39
Bromomethane	1.679	94	96	--
1,1-Dichloroethene	6.786	96	61	98
Chloroform	8.478	83	85	--
Benzene	9.451	78	77	--
1,2-Dichloroethane	9.030	62	64	98
Trichloroethene	9.988	132	95	60
Dibromomethane	9.935	174	93	81
Dichlorobromomethane	10.024	83	85	47

Table 11
Characteristic Ions

Compound	Approx Retention Time (min)	Primary	Secondary	Tertiary
cis-1,3-Dichloropropene	10.561	75	110	39
trans-1,3-Dichloropropene	10.948	75	110	49
1,1,2-Trichloroethane	11.097	97	83	61
2-Hexanone	11.395	58	43	85
Chlorodibromomethane	11.603	129	127	79
Ethylene Dibromide	11.841	107	109	81
Tetrachloroethene	11.990	164	131	166
1,1,1,2-Tetrachloroethane	12.535	131	133	117
Bromoform	13.110	173	175	171
1,1,2,2-Tetrachloroethane	13.313	83	85	131
1,4-Dichlorobenzene	13.888	146	111	75
Naphthalene	16.384	128	012	127
Hexachlorobutadiene	12.162	225	227	223

APPENDIX I: EXAMPLE SEQUENCE AND PROCESS FLOW

Example Instrument Sequence

GC/MS VOA ANALYSIS RUN LOG

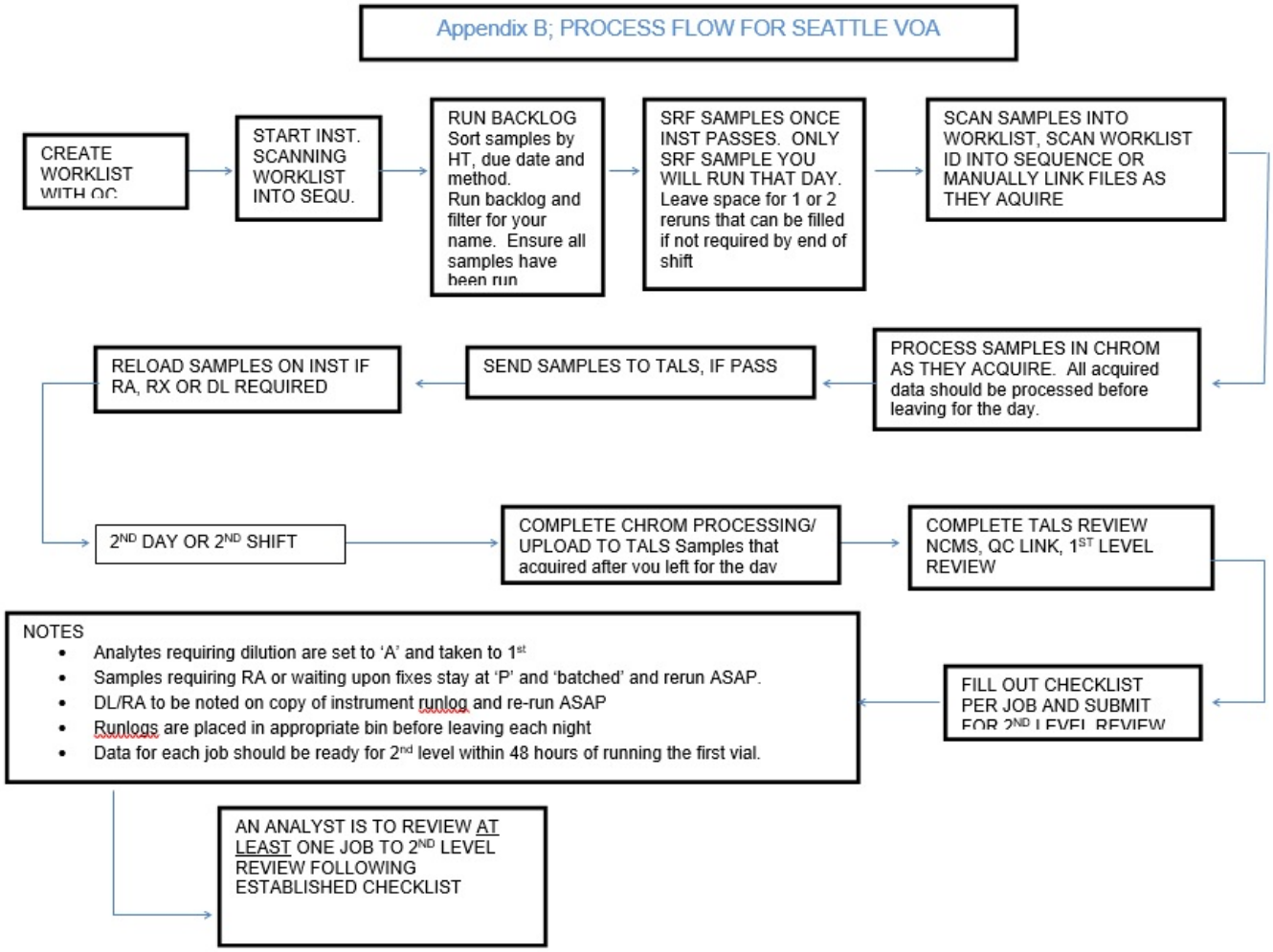
Lab Name: TestAmerica Seattle Job No.: 580-46744-1

SDG No.:

Instrument ID: TAC041 Start Date: 12/06/2014 14:01

Analysis Batch Number: 178602 End Date: 12/06/2014 23:23

LAB SAMPLE ID	CLIENT SAMPLE ID	DATE ANALYZED	DILUTION FACTOR	LAB FILE ID	COLUMN ID
RTC 580-178602/2		12/06/2014 14:01	1		ZB-624 0.32(mm)
STD15000 580-178602/3 IC		12/06/2014 14:28	1	MS00187256.D	ZB-624 0.32(mm)
STD10000 580-178602/4 IC		12/06/2014 14:55	1	MS00187257.D	ZB-624 0.32(mm)
STD5000 580-178602/5 IC		12/06/2014 15:21	1	MS00187258.D	ZB-624 0.32(mm)
STD1000 580-178602/6 IC		12/06/2014 15:48	1	MS00187259.D	ZB-624 0.32(mm)
STD500 580-178602/7 IC		12/06/2014 16:15	1	MS00187260.D	ZB-624 0.32(mm)
STD250 580-178602/8 IC		12/06/2014 16:45	1	MS00187261.D	ZB-624 0.32(mm)
STD100 580-178602/9 IC		12/06/2014 18:14	1	MS00187262.D	ZB-624 0.32(mm)
STD50 580-178602/10 IC		12/06/2014 22:56	1	MS00187263.D	ZB-624 0.32(mm)
ICV 580-178602/11		12/06/2014 23:23	1		ZB-624 0.32(mm)



12066 Chemical Hygiene Plan
2710 Class 1 Weight Calibration, Balance Verification, Calibration & Maintenance
2801 Data Review and Validation and Monthly Logbook Reviews
2812 Procedures for Nonconformance, Corrective Actions and the Control of Non-Conforming Work
2814 Personnel Training and Demonstration of Capability Procedures
2991 Waste Disposal Procedures for Client Sample Waste
41035 Percent Moisture/Percent Solids [Method SM 2540 G]
41889 Quality Control Program
41891 Storage Blank Handling and Analysis
41922 Receipt, Preparation, Storage and Verification of Standards and Reagents and Traceability Protocols
5805 Quality Assurance Manual

End of document

eurofins	Always check on-line for validity. **Determination of Volatile Organic Compounds by GC/MS Selected Ion Monitoring [Methods 8260D]**	Level: **Standard Operating Procedure**
Document number: **EFGS-T-VOA-SOP41108**		
Old Reference: **TA-MV-0315**		
Version: **1**		Organisation level: **4-Business Unit**
Approved by: **KOJ6, YQB8** Effective Date: **11-JUN-2021**	Document users: **EFGS_VOA**	Responsible: **EFGS_VOA_M**

Version history

Version	Approval	Revision information	
1	11.JUN.2021		

eurofins	Always check on-line for validity. **VOCs and GRO by GC/MS in Soils and Solids by EPA 8260C/D**	Level: **Work Instruction**
Document number: **T-VOA-WI8236**		
Old Reference: **1-P-QM-WI-9013077**		
Version: **10**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **11-MAY-2022**	Document users: **6_EUUSLA_GC/MS Volatiles_GC/MS Auditors/Verifiers, 6_EUUSLA_GC/MS Volatiles_Management, 6_EUUSLA_GC/MS Volatiles_SW846 8260B/C Soil**	Responsible: **5_EUUSLA_GC/MS Volatiles_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Calibration Calculations
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table 1
Table 2
Table 3

Revision Log

	Revision: 10	**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per G-DC-SOP16244	Removed revision logs up to the previous version
Procedure NOTE	Current process	Addition of client specific compositing performed by the analyst upon request.
Attachment 7	Current process	Addition of client specific compositing performed by the analyst upon request.

	Revision: 9	**Effective Date:** 23-APR-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per G-DC-SOP16244	Removed revision logs up to the previous version

	Revision: 9	**Effective Date:** 23-APR-2021
Section	**Justification**	**Changes**
Cross Reference	Update	Added reference to QA SOP for information regarding LLOQ
Reagents and Standards B.7.e	Enhancement	Added reference to Figure 1 for preparation
Quality Assurance/ Quality Control	Enhancement	Added reference to QA SOP for LLOQ procedure
Table 2	Clarification	Added note concerning alternative ion selection for quantitation
Figure 1-6	Update	Added Figure # to header

Reference

1. Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), SW-846 Method 8260C, August 2006.

2. Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), SW-846 Method 8260D, June 2018.

3. Determinative Chromatographic Separations, SW-846 Method 8000D, March 2018.

4. Test Methods for Evaluating Solid Wastes, SW-846 Method 5030B, December 1996.

5. Test Methods for Evaluating Solid Wastes, SW-846 Method 5030C, May 2003.

6. Test Methods for Evaluating Solid Wastes, SW-846 Method 5035, Revision 0, December 1996.

7. Test Methods for Evaluating Solid Waste, SW-846, Method 5035A, July 2002.

8. *Total Petroleum Hydrocarbons Analysis-Gasoline Method*, California Department of Health Services, LUFT Task Force.

9. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
S-SS-WI10682	GC/MS - Bulk Solid Matrix Sample Preparation
S-SS-WI11170	Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035
T-VOA-WI7619	GC and GC/MS Instrumentation Maintenance
T-VOA-WI7629	GC/MS Volatile Standards Traceability
T-VOA-WI7692	Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles
T-VOA-WI8373	GC/MS Volatiles Audit Process
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is suitable for the determination of target compounds listed and maintained in the Laboratory Information Management System (LIMS) for soil and solid matrices. Samples consist of soils/solids collected or submitted in bulk in glass containers with Teflon-lined screw-caps or in field core sampling/storage containers (i.e., EnCore or equivalent). Associated MDLs/LOQs are listed in the LIMS under the analysis numbers and/or Project Information lists.

Theoretical Standard Calibration (TSC) Sheets are included in the Appendix (Figures 1-6). These TSC sheets are to serve as examples only and may not reflect most current version in use. Non-target volatile compounds in the sample can be tentatively identified (TIC) using a mass spectral reference library comparison. This analysis must be performed by or under the direct supervision of an operator experienced in the analysis of volatile organics by purge and trap GC/MS methodologies and skilled in mass spectral interpretation. Using this method, the TICs are quantitated with an estimated concentration.

Compounds other than those listed in the LIMS for this group of master scans may be analyzed using USEPA SW-846 Method 8260C. Selected Ion Monitoring (SIM) parameters can be used to detect, identify and quantitate volatile organic compounds in methanol extracts of soils/solids, if lower quantitation limits are required (project- or client-specified) and/or matrix interferences are anticipated. Attachment I describes the proper analysis procedure for Gasoline Range Organics in soils and solids. Due to poor purging efficiency or poor chromatography, some analytes require calibration at higher levels and/or higher practical quantitation limits (PQLs). Any additional compounds must be added to the theoretical standard concentrations (TSC) sheet. Standards containing additional analytes must be prepared as described in the Standards section of this document. Both secondary stock solutions and matrix spike solutions must be prepared for use in analyzing additional compounds.

Basic Principles

The soil sample is prepared according to analysis *S-SS-WI10682* and *S-SS-WI11170* for 8260C. The sample is purged with an inert gas and the effluent gas passed through a sorbent trap where the volatile organics are trapped. After purging, the sorbent trap is rapidly heated and backflushed onto the head of a gas chromatographic column held at the appropriate initial temperature for the column in use. The gas chromatographic column is temperature programmed to separate the volatile compounds, which are subsequently detected and identified using mass spectrometric techniques.

When a compound reaches the MS, it is bombarded by high energy electrons (70 eV). This causes the compound to fragment and form ions. The positive ions are focused into a quadrupole mass analyzer, where the ions are separated according to their mass/charge ratios during rapid repetitive scans. These ions are then amplified and detected with an electron multiplier.

The resulting time/intensity/mass spectra data are stored and processed by a computer. Target compounds are identified on the basis of relative retention times and mass spectral matches to standards, which are injected every 12 hours on the same system. The internal standard method is used for quantitation.

The GRO analysis is typically performed in conjunction with the analysis of other volatile target compounds by SW-846 Method 8260C. The GRO quantitation range is 0.1 minutes before the peak apex of C6 (hexane) to 0.2 minutes after the peak apex of C12 (dodecane); however, other ranges can be established. By establishing a (C12) GRO window to 0.2 minutes following the elution of dodecane, the areas from a trio of unresolved peaks eluting near to the upper limit of the range must consistently be included in the total GRO area. In addition, the range remains tight enough to ensure that no C13 or greater compounds can be included in the total GRO area. The C4 range retention time is determined by selecting the first peak after the air and/or artifact peak minus 0.1 minutes in the first level of standard analyzed with the ICAL. The C5 range retention time is 0.1 minutes before the peak apex of pentane.This analysis must be performed by or under the direct supervision of an operator experienced in the analysis of volatile organics by GC/MS purge and trap methodologies. The area of the total ion chromatogram for the GRO range is determined. The area of the internal standards and surrogate standards are found and subtracted from the total area of the chromatogram within the desired time range. The resulting area is then quantitated versus the internal standard, fluorobenzene.

Interferences

Contaminant sources are volatile compounds in the laboratory environment, impurities in the inert purging gas, carryover from samples containing high concentrations of volatile organic compounds and dirty glassware. The analyst must demonstrate that the system is free from interferences (by producing acceptable method blank data) before analyzing a batch of samples. Matrix effects from heavily contaminated soils and solids can interfere with the internal standard responses, target analytes and surrogate recoveries, thereby hindering accurate quantitation. See Section 4.0 of SW-846 Method 8260C for further discussion.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity of each reagent used has not been precisely determined. However, each reagent must be treated as a potential health hazard. Safety measures would include the use of fume hoods, safety glasses, lab coats, and gloves when working directly with reagents. Refer to the *Chemical Hygiene Plan* for specific details.

Personnel Training and Qualifications

Education Requirement: A 4–year Baccalaureate Degree from an accredited College or University in one of the physical sciences and/or 1 – 3 years of relevant gas chromatography experience.

Analysts must be trained in the proper method of volatile organic sample preparation and analysis as determined by the supervisor(s). All training and education relating to volatile organic sample preparation and analysis must be documented by each analyst in their training record. Specifically, each new chemist must train with an experienced chemist for the first 12 weeks depending on the individual and their previous experience. The first 12 weeks are spent working one-on-one with the trainer. This time may be less if the new chemist has prior relevant experience in GC/MS and analytical chemistry background.

During the training period, the new chemist must learn daily maintenance, calibration techniques, data and library search review, and forms generation. They are also required to read all relevant SOPs and EPA methods. All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP. Each analyst must perform an Initial Demonstration of Capability to measure proficiency. Thereafter, an annual Demonstration of Capability is performed and maintained in the analyst's training records.

NOTE: A separate Demonstration of Capability for GRO is required.

Sample Collection, Preservation, and Handling

Soils are either collected/submitted in bulk in glass containers with Teflon-lined screw-caps, in field core sampling/storage containers (i.e., EnCore or equivalent), or preserved in the field before submittal to the laboratory. Samples for low level volatiles analysis are frozen with reagent water at ≤ 10 °C, and may be preserved with sodium bisulfate. Samples for high level volatiles analysis are preserved in methanol. Refer to the volatiles preservation SOPs *S-SS-WI10682* and *S-SS-WI11170* for further information. All samples must be analyzed within 14 days of collection.

Apparatus and Equipment

1. Gastight micro syringes – 10-µL and larger
2. 5-mL gastight syringes
3. Analytical balance, capable of accurately weighing ±0.0001 g
4. Top-loading balance capable of weighing ±0.01 g
5. Glassware
    a. Class A Volumetric flasks with ground-glass stopper
    b. Vials, 1.5-mL, 15-mL, and 40-mL screw cap, with Teflon/silicone septa
    c. Mininert vials, 1-mL, 2-mL, and 5-mL

6. Purge and trap device – Consisting of the sample purger, the trap, and desorber; the OI Analytical 4560, OI Analytical 4660, or equivalent meets the requirements of this method. The purging chamber must have the purge gas passing through the sample as finely divided bubbles and minimize the headspace between the sample and the trap to <15 mL.

7. Autosampler – OI Analytical 4551, Archon, or equivalent meets the requirements of this method. The Archon has the capability to purge solid samples directly in the 40-mL vial (needed for samples prepared by analysis 8389).

8. Spiker units (optional) – OI Analytical Model 4551 SIM/Spiker or equivalent. One or two automated syringe spikers can be added to the OI Analytical Model 4551 autosampler to automatically introduce 10 µL of internal standard (ISTD), surrogate standard, and/or matrix spiking solutions to the sample as it is being transferred to the sparge vessel. The Archon has a groove that can deliver 1 µL of appropriate standards.

9. GC/MS system – The HP 5890GC/5972 MSD, HP 6890GC/5973MSD, HP 6890GC/5975MSD, and Shimadzu GC/MS QP5000 meet the requirements for this method.

10. Data System/Computer/Software– this is interfaced to the GC/MS system, which continuously acquires and stores data during the analysis, and can process/reduce data to generate the appropriate forms and supporting data. The software used for acquisition is HP Chemstation®, and data reduction is accomplished using Target® software.

11. GC Columns

a. Column 1 – 30M × 0.25 mm ID DB624 capillary column with a 1.4-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

b. Column 2 – 20M × 0.18 mm ID DB624 capillary column with a 1.0-µm film thickness from Agilent, or equivalent (to be used with the Shimadzu QP5000 or the Agilent 5972, 5973 and 5975 MSDs)

Different sampling/analysis combinations are used based on how the sample was collected, expected level of VOCs in the sample, possible matrix interferences, list of target compounds, whether TICs were requested, the required quantitation limits and the type of equipment/instrumentation available.

NOTE: Refer to *T-VOA-WI7619* for instrumentation maintenance and troubleshooting.

Reagents and Standards

A. Reagents

1. Reagent water is defined as water in which an interferant is not observed at or above the reporting limit for parameters of interest. In general, the deionized water supplied at the taps in the laboratory must meet these criteria. If the reagent water does not meet the requirements, see your supervisor for further instructions.

2. Purge and Trap grade Methanol or equivalent

3. Sodium bisulfate – ACS grade

4. Sand- Ottawa Standard

B. Standards

See *T-VOA-WI7629* for standards traceability.

1. Stock standard solutions – Stock solutions must be prepared in methanol. Standards are prepared from ampulated and neat compounds obtained from suppliers that indicate the purity of the compound. No correction for purity is made if the purity is listed as ≥96%. Pre-made solutions can be used if the supplier documents the concentrations of the solutions. All ampulated standards are stored at ≤-10°C until the expiration date indicated by the vendor or for 1 year if no expiration date is provided.

NOTE: For most of the target compounds, the stock standard solutions are purchased from a vendor as custom mixes (V for calibration and Q for separate source quality control). The internal and surrogate standards are purchased from a vendor, as well as the target compounds that are gases at room temperature. These gaseous standards have a 1-week expiration date, starting from the date they are opened.

2. Surrogate stock standard solution (for high level soils) – a 2500 µg/mL stock standard solution of dibromofluoromethane, toluene-d8, 4-bromofluorobenzene, and 1,2-dichloroethane-d4 is prepared in methanol by a commercial supplier

3. 8260A Internal standard spiking solution (8260IS) – a 2500 µg/mL stock standard solution of fluorobenzene, chlorobenzene-d5, 1,4-dichlorobenzene-d4, and 12500 µg/mL deuterated tertiary butyl alcohol (tBA-d10) is prepared in methanol by a commercial supplier. Deuterated tertiary butyl alcohol (tBA-d10) is used sometimes as an auxiliary ISTD. If an autosampler is used, dilute the stock to 250 µg/mL (1250 µg/mL for tBA-d10) in methanol. This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained (50 µg/kg).

4. GRO calibration standard – a 5500-µg/mL stock unleaded gasoline composite prepared in methanol by a commercial supplier.

5. GRO QC standard – a 20,000-µg/mL stock unleaded gasoline composite prepared in methanol by a commercial supplier

6. To prepare stock standards from neat compounds:

a. Place about 9.8 mL methanol or an equivalent solvent into a tared 10.0-mL glass-stoppered volumetric flask. Weigh the flask to the nearest 0.1 mg.

b. Add the liquids using a syringe or pipette by adding 2 or more drops of the assayed material to the flask, being careful that no drop hits the side of the flask. Reweigh the flask, record/note the amount, dilute to volume, stopper, and mix by inverting the flask at least 3 times. Calculate the concentration of the standard.

c. The stock standard solutions are stored in Teflon-sealed screw-capped vials at ≤-10°C. The compound name, concentration, date prepared, expiration date, preparer name and storage conditions must appear on the bottle.

d. Replace in house prepared stock standard solutions every 6 months.

7. Secondary dilution standards – Using the stock standard solutions, prepare secondary stock solutions in methanol containing the desired compounds. These standards are prepared by calculating the volume of each stock standard required producing a given volume of a mixed working standard with a known concentration of each analyte. When custom mixes are used, these may be diluted down individually, or combined together with other mixes. The working standard is tested according to *T-VOA-WI7629*. The verified working standard is poured into Teflon-lined screw-capped GC vials or mininert vials and stored at ≤-10°C. A designator indicating the standard, month, and preparation date must be on the standard vials. The designator and all data pertaining to the working standard preparation are to be recorded in the standards logbook. Replace secondary dilution standards every 2-4 weeks (1 week for standards containing gases) unless otherwise indicated.

a. 1,4-Bromofluorobenzene (BFB) standard – Prepare a 50-µg/mL solution of BFB in methanol by diluting the stock standard (prepared from neat material) with methanol to a final volume of 100 mL. The volume of stock standard used varies, depending on the actual stock concentration.

b. Surrogate standard spiking solution (high level only) – Prepare the surrogate standard spiking solution from the stock standard solutions at a concentration of 25 or 250 µg/mL in methanol. The requested soil preparation method dictates what concentration of surrogates are required for analysis.

c. Internal standard (IS) solution (high level only) – fluorobenzene, chlorobenzene-d5, 1,4-dichlorobenzene-d4, and tert-Butyl Alcohol-d10. One mL of 8260IS is diluted with methanol to a total volume of 10 mL to give a final concentration of 250 µg/mL (1250 µg/mL for tBA-d10). This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained (50 µg/kg).

d. IS/SS spiking solution (low level only)– Dilute 1 mL of 8260IS and 1 mL of 8260SS with methanol to 10-mL final volume (resulting in a concentration of 250 µg/mL, 1250 µg/mL for tBA-d10). This is assuming a 1-µL groove in the autosampler. If the groove is determined to be other than 1 µL, the standard preparation must be adjusted so that appropriate final concentration is obtained 50 µg/kg).

e. Calibration spiking solution – Prepare solutions in methanol that contain the compounds of interest at known concentrations. Suggested calibration levels are 4, 10, 20, 50, 100, and 300 (µg/kg). Replace the calibration spiking solution every 2-4 weeks (1 week for standards containing gases). See Figure 1 for preparation information.

f. Matrix spiking solution – Prepare solutions in methanol that contain the compounds of interest at known concentrations. These solutions serve as both the matrix spiking solution and the laboratory control sample solutions. Matrix spikes also serve as duplicates; therefore, two aliquots of the same sample need to be spiked for analysis with these solutions. Replace the matrix spiking solution every 2-4 weeks (1 week for standards containing gases). See Figures 2-5 for preparation information.

g. Store all standard solutions at ≤-10°C and protected from light.

Calibration

A. Instrument Conditions:

1. The purge and trap device must have the trap conditioned for at least 10 minutes at 180° to 220°C at a flow rate of 20 to 60 mL/min prior to initial use.

2. An example of purge and trap conditions are listed below:

Purge gas	Helium
Purge flow	35 – 40 mL/min
Purge temperature	40°C for low level soils and ambient temp. for medium/high level soils
Purge time	11 min
Desorb temperature	190°-220°C
Desorb time	0.5 to 4 minutes **
Bake temperature	180°-220°C
Bake time	8 min (±3 min)

** - Range as suggested by the purge and trap instrument manufacturer

NOTE: Purge and trap conditions may be changed to optimize instrument operations. A record of actual purge and trap conditions for each instrument may be found in the appropriate instrument maintenance log.

3. The suggested gas chromatographic operating conditions are listed in the table below, depending on the column used:

	Column 1	**Column 2**
Column liquid phase	DB-624	DB-624
Carrier gas	Helium	Helium
Carrier gas flow	0.8 mL/min	0.6 mL/min
Make-up gas flow	None	None
Initial temperature	45°C	45°C
Initial hold time	4.5 min	2.5 min
Temperature ramp	12°/min to 100°C then 25°/min to 240°C	12°/min to 100°C then 25°/min to 235°C
Final temperature	240°C	235°C
Final hold time	None	.02 min

4. Recommended mass spectrometer (MS) operating conditions:

Ions	Positive
Electron energy	70 volts
Mass range	35 – 300 amu

H-P systems Scan time:

Number A/D Samples	22 (4)
Integration Time/Sample	50 microsec
Total Scan Time	0.6 sec

B. Tuning:

Tune the GC/MS system to meet the criteria in Table 1 following a 50-ng injection of BFB. The chromatographic conditions must be the same as those under which the samples are analyzed except that the temperature ramp may be increased and the initial temperature and flow rate may be different. The BFB tune must be verified every 12 hours.

The tune must be evaluated by taking the average of the three scans across the BFB peak apex with a background subtraction of a scan within 20 scans prior to the start of the BFB peak.

NOTE: All standards, samples, and associated quality control samples must be analyzed with the same mass spectrometer parameters as those used to obtain a successful tune.

C. Initial Calibration:

1. Perform the initial calibration by analyzing at least six distinct levels of analyte concentration. For high level soils, the surrogates are also analyzed at each distinct level. Response factors for each analyte are determined from these levels. Six levels are required if second order regression fits are used. Calibration for GRO consists of analyzing six distinct levels of GRO area in order to produce a response factor for the GRO quantitation range of interest using the internal standard, fluorobenzene. The relative standard deviation of the response factor determines the suitability of the average relative response factor for calculation of the GRO concentration. Refer to Figure 1 for the preparation of calibration standards and Figure 6 for preparation of GRO standards. The relative standard deviation of the response factors determines the suitability of the average relative response factor for calculation of the analyte or GRO concentration. Prior to the analysis of any calibration level, retention time markers must be run for the GRO range of interest. The retention time markers are hexane (C6) and Dodecane (C12). Other markers can be used if different ranges are required by a project.

NOTE: 5 levels are required by the method.

2. A method detection limit (MDL) standard must be analyzed with each initial calibration. This standard is prepared at or near the departmental MDL and is not to be included in the calibration curve. All compounds must be detected at or below MDL standard.

3. For medium/high level soils, methanol is added to all calibration standards. For low-level soils prepared according to EPA Method 5035, 1 scoop (approximately .50 -.75 grams) of sodium bisulfate is added to all calibration standards.

4. When using an autosampler, blanks and standards are prepared and poured into 40-mL vials with Teflon-lined septa. For the high-level method, 5 mL is withdrawn from the vial and transferred to the sparge vessel along with the appropriate amount of the internal standard spiking solution. For the low-level method, the autosampler transfers 5 mL of reagent water along with the appropriate amount of IS/SS spiking solution to the 40-mL vial.

5. Purge and desorb according to conditions listed in Calibration A.2.

6. Collect GC/MS data until the end of the GC run.

7. Empty and rinse the purging chamber at least twice with reagent water prior to loading another sample into the vessel, to minimize the possibility of carryover contamination.

8. Each level is analyzed as described above. Next, tabulate the area response of the characteristic ions (Table 2) against concentration for each analyte, surrogate standard, and internal standard and calculate relative response factors (RRF) for each compound (see Calculation section). The following table describes the guidelines for an acceptable initial calibration:

Frequency	Acceptance Criteria	Corrective Action

Frequency	Acceptance Criteria	Corrective Action
Initially and then when analytes in the daily calibration standard fail criteria.	1. % RSD of ≤20% is required for all analytes. 10% of the analytes may fail this criteria. 2. All compounds of interest must be detected in the MDL standard. 3. The relative retention times of the target compounds must agree within 0.06 relative retention time (RRT) units. The exception would be in the case of system maintenance. 4. Minimum response factors must be met for select compounds. See Table 3.	1. Any target analyte with a %RSD of ≤20% must use the average RRF for quantitation. For any analyte in which the %RSD >20%, a first-degree linear regression can be used (providing that the correlation coefficient [CC] is ≥0.995). A quadratic fit ** (using 6 stds) can also be used (provided the coefficient of determination [CD] is >0.99). If the linear fit and quadratic fit pass the criteria for any given analyte, then use the line/curve with the smallest positive y-intercept. If the y-intercept quantifies to be greater than the LOQ, consult your supervisor immediately or recalibrate. If CC or CD is <0.995 for linear or <0.99 for quadratic, recalibrate. Supervisory approval is required for exceptions to these guidelines. If >10% target analytes fail, recalibration is required. If a linear or quadratic curve fit is used for a target analyte, the calibration data must be refit back into the calibration model for all calibration levels. Percent error between the calculated and expected amounts of an analyte should be ≤ 30% for all standards. For some data uses, ≤ 50% may be acceptable for the lowest calibration point. NOTE: Quadratic regression cannot be used for South Carolina compliance samples. 2. If a compound is not detected in the MDL standard, then report to the level of the lowest standard detected. 3,4. Perform system maintenance and recalibrate.

**Consult USEPA method 8000D for non-linear curve fitting techniques/guidelines

9. Each GRO level is analyzed as described above. Next, tabulate the area response for the GRO quantitation range minus the peak areas for the internal and surrogate standards that elute within the GRO range. Calculate the relative response factor (RRF) for GRO (see Calculation section) using the internal standard peak area for Fluorobenzene. Although four internal standard compounds are spiked for the 8260C analysis, only Fluorobenzene, is used for the quantitation of the GRO result.

10. Calculate the average relative response factors for the GRO quantitation range of interest. The calibration levels are evaluated on the basis of the relative standard deviation of the RRF values (%RSD). The %RSD for the GRO range of interest must be ≤20%. If the calibration meets this requirement, then the average RRF is used to calculate sample concentrations. If the %RSD is >20% then re-analysis of one or more levels can be necessary before the calibration is valid.

D. Initial Calibration Verification:

Following the calibration, an Initial Calibration Verification (ICV) standard must be run. The ICV is prepared according to the TSC sheet in Figure 5. The ICV acts as a second source standard to check against the initial calibration. All analytes must meet ICV acceptance windows of 70%-130%. If the ICV does not meet the aforementioned criteria, a second ICV is analyzed before invalidating the initial calibration. Upon failure of the second ICV, the system must be recalibrated after proper corrective action is taken.

For the GRO analysis, the ICV is prepared according to the TSC sheet in Figure 6 (QC prep). The ICV acts as a second source standard to check against the initial calibration. Results must quantitate within the 70-130% window. If the ICV does not meet the aforementioned criteria, a second ICV can be run before invalidating the initial calibration. Upon failure of the second ICV, the system must be recalibrated after proper corrective action is taken.

E. Continuing Calibration:

Continuing Calibration Verification (CCV) – The CCV is performed by analyzing a 50-ppb calibration standard (prepared daily due to aqueous nature) in subsequent tune periods after an initial calibration. The CCV is considered valid when the criteria listed below are met:

Frequency	Acceptance Criteria	Corrective Action

Frequency	Acceptance Criteria	Corrective Action
Every 12 hours.	1. % Drift of ≤20% is required for all analytes. No more than 20% of analytes may fail this criteria if not detected in proceeding samples. 2. The relative retention times (RRT) of the target compounds must agree within 0.06 RRT units. The exception would be in the case of system maintenance. 3. The extracted ion current profile (EICP) area for each internal standard must fall within the window of –50 % to +100 % from the mid-level standard area produced during the last initial calibration. 4. Minimum response factors must be met for select compounds. See Table 3.	1. - 4. In the event that the continuing calibration verification (CCV) standard fails any of these criteria, sample analysis must be suspended and the CCV must be re-analyzed. If the re-analysis fails any of the criteria then adjustments are to be made to the analytical system to return it to its original condition, followed by the analyses of 2 consecutive CCVs at the same level that failed. If both CCVs pass the criteria, then sample analysis can continue. Otherwise, the system must be recalibrated and the samples reanalyzed, or the data can be qualified.

A 1100-ppb standard is analyzed for the GRO analysis. The calibration is considered valid if the percent drift is ≤20%. Also, the internal standard peak area of fluorobenzene for the CCV is monitored against the mid-point standard of the initial calibration and must be –50% to +100% of the area counts. If any criteria listed above fails, the CCV is considered invalid. In the case where two consecutive CCVs fail, corrective action must be taken which can include re-analysis of the calibration check, instrument maintenance, and/or recalibration. If the criteria are met, the selected quantitation method from the initial calibration is used for blank and sample calculations until the end of the 12-hour period.

F. MDL Sensitivity Check- A MDL Sensitivity Check must be analyzed in cases where compounds fail to meet the % drift criteria in the CCV and have decreased sensitivity (-20% drift or greater). Affected compounds can be reported as non-detects if it is demonstrated that there is adequate sensitivity to detect the compound at the MDL. If the failed compound is detected, the concentration must be reported as an estimated value.

Calibration Calculations

1. Calculation of the relative response factor (RRF):

$$RRF = \frac{[A(x) \times C(is)]}{[A(is) \times C(x)]}$$

Where:

A(x) = Characteristic ion area for the compound being measured

A(is) = Characteristic ion area for the specific internal standard

C(x) = Concentration of the compound being measured

C(is) = Concentration of specific internal standard

2. Regression equations:

1st Order (linear) regression: $Y = Mx + B$

2nd order (quadratic) regression: $Y = Cx2 + Mx + B$

Where:

x = Area(Std) /Area(Istd)

Y = Conc.(Std)/Conc.(Istd)

M = 1st degree slope

C = 2nd degree slope

B = Y-intercept

3. Percent relative standard deviation (%RSD):

$$\%\ RSD = \frac{Standard\ Deviation}{Mean} \times 100$$

4. Calculation of the percent drift:

$$\%\ Drift = \frac{C(i) - C(c)}{C(i)} \times 100$$

Where:
C(i) = Calibration check compound standard concentration
CI = Measured concentration using selected quantification method

Procedure

A. Method Blank:

Analyze the method blank as described above for the initial calibration standards using reagent water. Refer to table in QA/QC section for specific requirements. The method blank is examined for interfering peaks. Any target compound peaks are calculated as described under the Calculations section of this procedure. All compounds must be less than the reporting limit for the associated samples. If the blank values exceed these values, corrective action must be taken and the method blank reanalyzed until the criteria are met. The method blank must be analyzed before processing any samples.

B. Laboratory Control Sample/ Duplicate and Matrix Spike/Duplicate: Refer to table in QA/QC section for specific requirements.

NOTE: Per client request, the analyst may perform a compositing procedure prior to analysis. See Attachment 7, or the specific procedure provided by the client for this process.

C. Qualitative Analysis:

Sample analysis for soil, solids, and nonaqueous matrices proceeds as described in the Calibration section. The aqueous matrix is replaced by the soil sample, which is prepared according to *S-SS-WI10682* and *S-SS-WI11170*. A compound is identified by comparison of the following parameters with those of a standard of this target compound (standard reference spectra). In order to verify identification, the following criteria must be met:

1. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other.

2. The compound relative retention time must compare within ±0.06 RRT units of the RRT of the standard.

3. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

4. The relative intensities of the characteristic ions must agree within 30% of the relative intensities of these ions in the reference spectrum. Analyst discretion is used to determine compound identification. (Example: for an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

5. The above criteria apply to hits greater than or equal to the LOQ. For hits between the MDL and the LOQ, both the above criteria and analyst discretion are used to determine compound identification.

6. The analyst must account for peaks that are greater than 10% relative intensity in the sample mass spectrum, but not present in the standard mass spectrum. Also, if a compound fails any of the criteria listed above but in the judgment of the mass spectral interpretation specialist is a correct identification, the identification is used and the quantitation of the peak is performed. The primary and secondary ions can be found in Table 2.

7. For the GRO analysis, the Total Ion Chromatogram (TIC) is reviewed to insure proper integration around the 8260 surrogates and internal standards. Also the TIC is checked to make sure all major peaks are integrated.

D. Quantitative Analysis:

Once a compound has been identified, quantitation of identified priority pollutant compounds is performed using the equations listed in the Calculations section of this SOP. The primary ions listed in Table 2 are used for quantitation. A secondary ion may be used if there is interference with the primary ion. All calculations must report concentrations in values of µg/kg. Any analyte with a calculated concentration above the highest standard must be reanalyzed at a dilution that brings the concentration in the solution within the calibration curve. It is desirable to have the dilution fall within the top half of the calibration curve, but it is not required.

The quantitation of the GRO range is performed using the equations listed in the Calculations section of this procedure. All calculations must report concentrations in values of µg/L. In the case where the total GRO concentration exceeds the calibration range, the sample is re-analyzed at a dilution that brings the GRO concentration within the calibration range of the GC/MS system.

Calculations

A. Analyte Concentration

1. Low level

$$\text{Concentration } (\mu g/kg) \frac{(Ax)(Is)}{(Ais)(RRF)(Ws)}$$

Where:

Ax = Area of the quantitation ion peak for the compound to be measured
Ais = Area of the quantitation ion peak for the appropriate internal standard
Is = Amount of internal standard added in nanograms
Ws = Weight of sample purged
RRF = Relative response factor from the initial calibration

2. Medium/high level

$$Concentration\ (\mu g/kg)\ \frac{(Ax)\,(Is)\,(Vt)}{(Ais)\,(RRF)\,(Ws)\,(Vi)}$$

Where:

Ax = Area of the quantitation ion peak for the compound to be measured
Ais = Area of the quantitation ion peak for the appropriate internal standard
Is = Amount of internal standard added in nanograms
Vt = Volume of the total extract in microliters
Vi = Volume of the extract used for purging in microliters
Ws = Weight of sample extracted
RRF = Relative response factor from the initial calibration

B. QC Calculations:

$$\%\ Recovery\ =\ \frac{SSR - SR}{SA}\ \times\ 100$$

Where:

SSR = Spiked sample result

SR = Sample result

SA = Spike added

C. Relative percent difference (RPD)

$$RPD\ =\ \frac{MSR\ -\ MSDR}{(1/2)\ \ (MSR\ +\ MSDR)}\ \times\ 100$$

Where:

MSR = Matrix spike measured concentration

MSDR = Matrix spike duplicate measured concentration

Statistical Information/Method Performance

The LCS must contain 80% to100% of the compounds in the calibration mix. LCS, MS, and surrogate recoveries and RPD are compared to the limits stored on the LIMS. These limits are statistically derived but must fall within 70% to 130% recovery for South Carolina compliance samples. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated on an annual basis in accordance with 40 CFR Part 136. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor. The department database is updated via a download from the LIMS.

Quality Assurance/Quality Control

Each analysis batch must contain a method blank, a laboratory control sample (LCS), and either an unspiked background sample (US), a matrix spike (MS), a matrix spike duplicate (MSD), or a laboratory control sample/laboratory control sample duplicate (LCS/LCSD). Additional QC samples may be required to meet project or state certification requirements. For South Carolina, an LCS duplicate (LCSD) is only necessary per client request, or

when adequate sample volume is not provided to prepare a matrix spike and matrix spike duplicate (MS/MSD). It is not appropriate to prepare and analyze an LCSD with each batch of samples if adequate sample volume has been provided for a MS/DUP or MS/MSD. Every sample or QC analysis must contain internal standards and surrogate compounds.

The laboratory will establish the Lower Limit of Quantitation (LLOQ) at concentrations where both quantitative and qualitative requirements can consistently be met for 8000D. The LLOQ is the lowest concentration at which the laboratory has demonstrated target analytes can be reliably measured and reported with a certain degree of confidence, which must be ≥ the lowest point in the calibration curve. The LLOQ/LLOQVs (Limit of Quantitation Verifications) are analyzed once per instrument per quarter. See SOP *QA-SOP11892*.

The GC/MS system must be tuned to meet the criteria in Table 1 following BFB injection. The chromatographic conditions must be the same as those under which the samples are analyzed except that the rate of temperature ramping may be increased and the initial temperature and column flow may be different. The BFB tune must be verified every 12 hours.

Quality Control Item	Acceptance Criteria	Corrective Action
Internal Standards • Added to every sample, standard, method blank or QC sample	1. Peak areas within -50% to +100% of the area in the associated reference standard. 2. Retention time (RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then reanalyze samples. 2. If re-injecting meets the criteria, report this analysis. 3. If this reanalysis still shows the same problem, report results from first analysis and qualify data with a comment.
Surrogates • Added to every sample, standard, method blank or QC sample	All % recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis.	If non-compliant, check for calculation or preparation errors. If no errors are found, check system for problems and reanalyze. If this reanalysis still shows the same problem, report first analysis and qualify data with a comment. If recoveries are outside of specification high and no target compounds are detected then a reanalysis or comment is not required.
Method Blank (MB) Performed during each tune period after the initial calibration or CCV (minimum of 1 MB per 20 samples) • 1 scoop of Sodium Bisulfate is added if the preservative was added to the initial calibration. • Approximately 5 grams of sand is required for low level analysis.	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. Quantitative results for all target compounds must be less than the reporting limit for the associated samples.	1,2. Inspect system for possible problems and reanalyze. 3. If the MB contains target analytes and the associated samples do not, then no corrective action is required. If the target compounds in the MB are also in the associated samples, then they must be reanalyzed after a clean MB is obtained (certain projects may allow some exceptions for common laboratory contaminants like methylene chloride and acetone up to 5X the LOQ)

Quality Control Item	Acceptance Criteria	Corrective Action
Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) • LCS analyzed with each batch of ≤ 20 samples • LCSD analyzed if MS/MSD unavailable • Approximately 5 grams of sand is required for low level analysis. • 1 scoop of Sodium Bisulfate is added if the preservative was added to the initial calibration. • See Figures 2, 3 and 4 for preparation info.	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All % recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis.	1,2. If non-compliant, check for calculation or preparation errors. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD re-analysis still fails, perform appropriate system maintenance and restart the tune period. Only with an LCS % recovery failing high (for the requested target compounds) with targets non-detected in the sample, can the results be reported. Otherwise, the sample must be analyzed with a compliant LCS.
Matrix Spike/Matrix Spike Duplicate (MS/MSD) • MS/MSD analyzed with each batch of ≤ 20 samples (if sufficient sample volume available) • See Figures 2 and 3 for preparation info.	1. % Recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis 2. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries and/or RPDs outside of QC limits, consult the supervisor.

The method blank must meet all the above criteria for internal standard recoveries and surrogate recoveries. In addition, the method blank may not contain any target compound above the reporting limit for the associated samples. All method blanks must meet these criteria; otherwise, the system is considered out of control and corrective action must be taken.

If sufficient sample volume is not available to perform MS/MSD, LCS/LCSD are prepared and analyzed and must meet the above-mentioned criteria.

NOTE: Prior to release from the analytical laboratory, all data is reviewed in accordance with *T-VOA-WI8373*.

The sample is analyzed using the same instrumental conditions as the standard (whether ICAL or CCV), tune and method blank. If the QA criteria are satisfied and no target compounds are detected at concentrations above the calibration range, the results can be reported. To avoid possible matrix effects, sample carryover and re-analyses, an initial dilution may be performed if:

1. Prescreening indicates a high volatile organic content in the sample

2. Historical data (or lack thereof) and/or sample appearance indicate a need for dilution

If target compounds are detected in the sample at concentrations above the calibration range, a dilution must be performed (see *T-VOA-WI7692* for information on when cleaning blanks must be run). See method SW-846 8260C for the recommended dilution procedures.

Table 1

BFB Key Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15% to 40% of mass 95
75	30% to 60% of mass 95
95	base peak, 100% relative abundance
96	5% to 9% of mass 95
173	less than 2% of mass 174

174	greater than 50% of mass 95
175	5% to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5% to 9% of mass 176

Table 2

Primary and Secondary Ions

Compound Name	Primary Ion	Secondary Ion
Chloromethane	50	52
Vinyl Chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
1,1-Dichloroethene	96	61, 63
Acetone	43	58
Carbon Disulfide	76	78
Methylene Chloride	84	49, 86
1,1-Dichloroethane	63	65, 83
trans-1,2-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 63
2-Butanone	43	72
Chloroform	83	85
1,2-Dichloroethane	62	98
1,1,1-Trichloroethane	97	61, 99
Carbon Tetrachloride	117	119
Benzene	78	
Trichloroethene	95	130, 132
1,2-Dichloropropane	63	76
Bromodichloromethane	83	85
cis-1,3-Dichloropropene	75	77, 110
trans-1,3-Dichloropropene	75	77, 110
1,1,2-Trichloroethane	97	83, 85
Dibromochloromethane	129	127
Bromoform	173	175
4-Methyl-2-pentanone	43	58
Toluene	92	91
Tetrachloroethene	166	131, 164
2-Hexanone	43	58
Chlorobenzene	112	77
Ethylbenzene	91	106
Xylene (total)	106	91
Styrene	104	78
1,1,2,2-Tetrachloroethane	83	85, 131
Dibromofluoromethane	113	111
1,2-Dichloroethane-d4	102	104
Fluorobenzene	96	70
Toluene-d8	98	100
Chlorobenzene-d5	117	82
4-Bromofluorobenzene	95	174
1,4-Dichlorobenzen-d4	152	115

Continued
Primary and Secondary Ions

Compound Name	Primary Ion	Secondary Ion

Compound Name	Primary Ion	Secondary Ion
Chloromethane	50	52
Vinyl Chloride	62	64
Bromomethane	94	96
Chloroethane	64	66
1,1-Dichloroethene	96	61, 63
Acetone	43	58
Carbon Disulfide	76	78
Methylene Chloride	84	49, 86
1,1-Dichloroethane	63	65, 83
trans-1,2-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 63
2-Butanone	43	72
Chloroform	83	85
1,2-Dichloroethane	62	98
1,1,1-Trichloroethane	97	61, 99
Carbon Tetrachloride	117	119
Benzene	78	
Trichloroethene	95	130, 132
1,2-Dichloropropane	63	76
Bromodichloromethane	83	85
cis-1,3-Dichloropropene	75	77, 110
trans-1,3-Dichloropropene	75	77, 110
1,1,2-Trichloroethane	97	83, 85
Dibromochloromethane	129	127
Bromoform	173	175
4-Methyl-2-pentanone	43	58
Toluene	92	91
Tetrachloroethene	166	131, 164
2-Hexanone	43	58
Chlorobenzene	112	77
Ethylbenzene	91	106
Xylene (total)	106	91
Styrene	104	78
1,1,2,2-Tetrachloroethane	83	85, 131
Dibromofluoromethane	113	111
1,2-Dichloroethane-d4	102	104
Fluorobenzene	96	70
Toluene-d8	98	100
Chlorobenzene-d5	117	82
4-Bromofluorobenzene	95	174
1,4-Dichlorobenzene-d4	152	115

NOTE: Alternative ions may be used for quantitation due to response factor, ion interference or analytical needs.

Table 3
Minimum Relative Response Factors For ICAL and CCV

Volatile Compounds	Minimum Response Factor
Dichlorodifluoromethane	0.100
Chloromethane	0.100
Vinyl Chloride	0.100
Bromomethane	0.100
Chloroethane	0.100
Trichlorofluoromethane	0.100
1,1-Dichloroethene	0.100
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100
Acetone	0.100
Carbon Disulfide	0.100
Methyl Acetate	0.100
Methylene Chloride	0.100
trans-1,2-Dichloroethene	0.100
cis-1,2-Dichloroethene	0.100

Methyl tert-Butyl Ether	0.100
1,1-Dichloroethane	0.200
2-Butanone	0.100
Chloroform	0.200
1,1,1-Trichloroethane	0.100
Cyclohexane	0.100
Carbon Tetrachloride	0.100
Benzene	0.500
1,2-Dichloroethane	0.100
Trichloroethene	0.200
Methylcyclohexane	0.100
1,2-Dichloropropane	0.100
Bromodichloromethane	0.200
cis-1,3-Dichloropropene	0.200
trans-1,3-Dichloropropene	0.100
4-Methyl-2-pentanone	0.100
Toluene	0.400
1,1,2-Trichloroethane	0.100
Tetrachloroethene	0.200
2-Hexanone	0.100
Dibromochloromethane	0.100
1,2-Dibromoethane	0.100
Chlorobenzene	0.500
Ethylbenzene	0.100

Table 3 Continued

Volatile Compounds	Minimum Response Factor
m&p-Xylene	0.100
o-Xylene	0.300
Styrene	0.300
Bromoform	0.100
Isopropylbenzene	0.100
1,1,2,2-Tetrachloroethane	0.300
1,3-Dichlorobenzene	0.600
1,4-Dichlorobenzene	0.500
1,2-Dichlorobenzene	0.400
1,2-Dibromo-3-chloropropane	0.050
1,2,4-Trichlorobenzene	0.200

Attachment:
Attachment 7 (.doc)
Figure 1 (.doc)
Figure 2 (.doc)
Figure 3 (.doc)
Figure 4 (.doc)
Figure 5 (.doc)
Figure 6 (.doc)

10682 GC/MS - Bulk Solids Matrix Sample Preparation
11170 Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035 and Method 5035A
11892 Determining Method Detection Limits and Limits of Quantitation
7619 GC and GC/MS Instrumentation Maintenance
7629 GC/MS Volatile Standards Traceability
7692 Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles
8373 GC/MS Volatiles Audit Process

End of document

Version history

Version	Approval	Revision information	
8	26.MAR.2020		
9	09.APR.2021		
10	11.MAY.2022		

eurofins	Always check on-line for validity. **Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS**	Level: **Work Instruction**
Document number: **T-MET-WI8636**		
Old Reference: **1-P-QM-WI-9015160**		
Version: **27**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **01-JUL-2022**	Document users: **6_EUUSLA_Metals_ICP Prep, 6_EUUSLA_Metals_ICP Prep Verifiers, 6_EUUSLA_Metals_ICP-MS Prep, 6_EUUSLA_Metals_ICP-MS Prep Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Purpose
Scope
Basic Principles
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Procedure
Block Digestor Instructions
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 27	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Basic Principles and Procedure	Clarification	Added notes about sample splitting process

	Revision: 26	**Effective date:** 11.MAY.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version

	Revision: 26	**Effective date:** 11.MAY.2021
Section	**Justification**	**Changes**
LIMS ID	Enhancement	Added TALS method codes
Cross Reference	Enhancement	Added Data Verification SOP
Definitions	Clarification	Removed redundant definitions; added SQAR
Apparatus and Equipment	Reflects current procedure	Removed reference to LLENS
Procedure	Reflects current procedure	Removed reference to the LLENS
Quality Assurance/Quality Control	Reflects current procedure	Removed reference to individual analysis SOPs; added in reference to Data Verification SOP

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3050B, December 1996.

2. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI11933	Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A (aqueous, solid, tissue) and EPA 200.8 (aqueous)
T-MET-WI11931	Metals by Inductively Coupled Plasma Atomic Emissions Spectroscopy for SW-846 Methods 6010B/C (aqueous, solid, tissue) and EPA 200.7(aqueous)
T-MET-WI9082	Working Instructions for Prep Solutions and Standards
T-MET-WI35797	Metals Data Verification Process

Purpose

This digestion procedure is for the preparation of solid samples for analysis by ICP and ICP/MS following SW-846 protocol.

Scope

This method is used for preparation of metals in solid samples for analysis by ICP and ICP/MS.

Basic Principles

Soil and solid samples are mixed and aliquoted during soil sample splitting by Sample Administration staff or by metals staff. Full homogenization must be requested additionally by clients.

A representative sample is digested with repeated additions of nitric acid (HNO_3) and hydrogen peroxide (H_2O_2). Hydrochloric acid (HCl) is added to the initial digestate and the sample is refluxed. The resultant digestate is diluted and analyzed.

This method is not a total digestion technique for most samples; it is a very strong acid digestion that dissolves almost all elements that could become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure.

Definitions

1. SQAR = Sludge Quality Assurance Regulations

Interferences

When analyzing sample by ICP-MS using this digestion procedure we follow the instrument manufacturer's guidelines to eliminate polyatomic interferences typically caused by Chlorine. The process we follow involves the use of a collision/reaction cell on the ICP-MS. Below is a description of how the collision/reaction cell works.

Reaction Process - The primary method of interference removal is through a reaction event. When using a reaction gas, either the target interference is more reactive than the target analyte, leading to preferential removal of the interferent or (less commonly) the target analyte is more reactive and is converted to a new species at a different mass which is free from any existing or newly-formed overlap.

Collision Process - The primary method of interference removal is through a non-reactive event. This process of interference removal is kinetic energy discrimination (KED). Energy Discrimination is most commonly used with an inert gas, which means the interference removal process is not affected by reactions in the cell.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO3) – This acid can cause skin burns. Add nitric acid to samples in a hood or use the designated dispensing equipment to avoid exposure to toxic fumes.

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCI with concentrated H2SO4 to avoid a violent reaction. Always use in a fume hood or use the designated dispensing equipment.

Hydrogen peroxide (H2O2) - This is a strong oxidizing agent and causes severe burns. Avoid contact with skin.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds.
Samples that contain dust may be hazardous. Open in a fume hood.

When a hazardous flag is added indicating possible cyanide, special precautions are required to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water. Spill

pillows and SPILL-X-A are stored on the prep room shelf.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each employee performing this digestion procedure must work with an experienced employee for a period of time until they can independently set up batches and perform the necessary steps outlined in this procedure. Proficiency is measured through documentation of the critical steps in this procedure, over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four LCSs that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four LCSs or one blind sample.

Sample Collection, Preservation, and Handling

Solid samples require no chemical preservation.

Samples must be submitted in glass or plastic containersand stored at 0° to 6°C, not frozen, prior to digestion. Samples must be analyzed within 6 months of sample collection.

Digested samples are stored in polypropylene bottles at room temperature.

Apparatus and Equipment

1. Polypropylene containers and covers (digestion vessels) - certified clean and Class A equivalent

2. Whatman No. 41 filter paper or equivalent

3. Funnels

4. Environmental Express HotBlock (block digestor) - adjustable and capable of maintaining a temperature of 90 to 100°C

5. Balance capable of reading 0.01 g

6. Chemware Ultra-Pure PTFE boiling stones, or equivalent.

7. Computer and software TALS

8. Sieves size depending upon client request

Reagents and Standards

For reagent preparation, shelf life, and storage conditions, see Form *T-MET-WI9082*.

1. Nitric acid (HNO3) – Fisher, Trace Metal Grade, or equivalent. Store at room temperature. Re-evaluate annually.

2. Nitric acid (1:1) – Add 500 mL of HNO3 to 500 mL of reagent water. Store in polypropylene at room temperature. Expires 6 months from date of preparation. (Different volumes are acceptable but ratios must stay the same.)

3. Hydrogen peroxide, 30% (H_2O_2) – Fisher, Certified ACS or equivalent. Store at room temperature. Re-evaluate annually.

4. Hydrochloric acid (HCl) – Baker Instra-Analyzed, or equivalent. Store at room temperature. Re-evaluate annually.

NOTE: It is acceptable to prepare using multiples of indicated weights and volumes if ratios are maintained.

Procedure

A. Soil Sample Digestion

1. Turn block digestor on and allow block to reach the Control Point setting that provides 90° to 95°C sample temperature. (The block temperature setting is not necessarily the sample temperature.) See below for **Block Digestor Instructions** section.

   Note: Soil samples for metals typically go through soil splitting. Mixing and aliquoting is performed in soil splitting, and splits are delivered to the metals preparation laboratory in the digestate tube. Solids are mixed. Full homogenization must be requested additionally by the client.

2. Collect samples and batch from the split bins. If a sample is not located in split bin, weigh 1.00 to 1.50 g (to the nearest 0.01 g) of a well-mixed sample into a polypropylene digestion vessel. (If the sample is watery use 5.00 to 5.50 grams for analysis. Additional information on non-standard matrices is found at the end of the procedure section.) Add 1.00 to 1.49 g of Chemware Ultra-Pure PTFE boiling stones to the digestion vessel for the blank and LCS. Enter the blank and LCS weight as 1.0000 to 100.0000 final volume in theworksheet tab of the TALS prep batch. In the Notes field, record the true weight measured.For sample batch spiking procedures see *T-MET-WI9082*. All spiking must be performed prior to starting the digestion procedure.

3. Add 10mL of (1:1) HNO_3, swirl to mix, and cover with a polypropylene cover.

4. Place sample vessel in block digestor. Heat (reflux) the sample at 90°to 100°C for 10 to15 minutes without boiling.

5. Add 5 mL of concentrated HNO_3. Add 20 mL of reagent water. Replace cover, return vessel to digestion block and heat for 30 minutes.

6. **NOTE**: If brown fumes are generated (indicating oxidation of the sample by HNO_3) continue the process of adding 5mL HNO_3 and heating until no brown fumes are given off by the sample. This indicates that the reaction with HNO_3 is complete. Add the same amount of HNO_3 to the entire digestion batch.

7. With cover on, heat at 90° to 100°C without boiling for 2 hours. Maintain a covering of solution over the bottom of the vessel at all times (add reagent water if necessary).

8. Remove vessel from digestion block and allow sample to cool.

9. Add 2 mL of reagent water and 3 mL of 30% H_2O_2. With cover on, return vessel to digestion block and heat until effervescence subsides. Care must be taken to ensure that losses do not occur due to excessively vigorous effervescence.

10. Continue to add 30% H_2O_2 in 1 mL aliquots with warming until the effervescence is minimal or until the general sample appearance is unchanged.

11. **NOTE:** Do not add more than a total of 10mL 30% H_2O_2.

12. With cover on, continue heating the acid-peroxide digestate at 90°to 100°C without boiling for 2hours. Maintain a covering of solution over the bottom of the vessel at all times (add reagent water if

necessary).

13. Remove sample vessel from digestion block and allow to cool.
14. Add 10 mL of HCl. With the cover on, return vessel to digestion block and heat at 90°to 100°C for 15 minutes.
15. Remove sample vessel from digestion block.
16. If floating particulate is evident after digestion, the sample must be filtered.
    a. Filter through Whatman No. 41 filter paper into a polypropylene container.
    b. Wash sample vessel, residue, and paper thoroughly with reagent water.
    c. If any samples are filtered, the MB and LCS must also be filtered.
17. Adjust volume to the 100 mL mark on the digestion vessel with reagent water and mix. Seal vessel with a screw cap. The sample is now ready for analysis.

NOTE: When special limits of quantitation are required by the client, use more sample weight.

B. For wipe samples:

When wipes are digested by this method, one blank media each must be used for the batch preparation blank, the LCS, and the LCSD. Refer to Form *T-MET-WI9082* for the spiking of the LCS and LCSD. Digest wipes in their own batch. Use reagent water to rinse any particulate matter from the wipe container into the vessel containing the wipe before digesting. If brown fumes are evolved during wipe sample digestion, perform only two 5 mL HNO_3 additions with 30-minute refluxing each; add the same amount of HNO_3 to the entire batch. Proceed with digestion.

C. For tissue samples:

When fish tissues or other tissue samples are digested by this method, refer to Form *T-MET-WI9082* for the spiking of the LCS, LCSD (if needed), matrix spike (MS), and matrix spike duplicate (MSD). Add 1.00 to 1.49g of Chemware Ultra-Pure PTFE boiling stones to the digestion vessel for the blank and LCS. Digest tissue samples in their own batch.

D. For soil samples that need to be dried and sieve prior to digestion.

1. Lay out sample on a clean surface of either glass or aluminum foil.
2. Allow sample to dry. When sample is done drying, but is dried in a large chunk take appropriate clean tools to break down the large chunk in order to sieve the sediment.
3. Pour entire sample that has been laid out to dry into the appropriate sieve size defined by client and shake sieve to get sample to fall through.
4. Take the sieved sample and place into the appropriate bottle needed for analysis.
5. Rinse the sieve and the sieve filter with reagent water until no particulate is left on sieve.
6. Dry sieve in open air or in an oven until no reagent water is present.

Block Digestor Instructions

1. Turn block digestor on by pressing rocker switch located on the cord.

2. Wait about 8 seconds until controller display indicates current block temperature.

3. PRESS and hold STAR (*) key.

4. The display shows Control Point temperature.

5. The digits can be changed to the desired value by pressing the up and down arrow keys while holding the (*) key.

6. Confirm Control Point temperature is set to the block temperature that provides 90° to 95°C.

NOTE: See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used. If necessary, adjust Control Point temperature to the proper setting as instructed below.

NOTE: Polypropylene containers must not be heated above 130°C.

Calculations
Not applicable.

Statistical Information/Method Performance
Not applicable to this procedure. See analysis method.

Quality Assurance/Quality Control

For sample batch spiking instructions see form *T-MET-WI9082*. Refer to ICP section when prepping ICP analysis. Refer to ICP/MS section when prepping ICP/MS analysis. Prepare a method blank, sample duplicate, MS, MSD, and LCS with every digestion batch (20 samples or less). Each piece of batch QC is digested following the procedure in this SOP. If any samples are filtered the prep blank and LCS must also be filtered.

Any extra digestion step done on one sample in a batch must be done to batch QC as well. Example if 1 mL of H_2O_2 is added to a sample it must also be added to the batch QC.

Refer to *T-MET-WI35797* for sample batch quality control requirements, acceptance criteria and corrective action.

11931 Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)
11933 Metals by ICPMS by Methods SW-846 6020/6020A/6020B(waters, solid, tissue) and EPA 200.8 (waters)
35797 Metals Data Verification Process
9082 Working Instructions for Prep Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
25	06.MAR.2019		
26	11.MAY.2021		
27	21.JUN.2022		

eurofins	Always check on-line for validity. **Sample Preparation of Waters for Analysis of Total Recoverable Metals by ICP-OES and ICP-MS**	Level: **Work Instruction**
Document number: **T-MET-WI8639**		
Old Reference: **1-P-QM-WI-9015133**		
Version: **19**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **24-AUG-2021**	Document users: **6_EUUSLA_Metals_ICP Prep, 6_EUUSLA_Metals_ICP Prep Verifiers, 6_EUUSLA_Metals_ICP-MS Prep, 6_EUUSLA_Metals_ICP-MS Prep Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Block Digestor Instructions
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 19	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure A	Reflect current protocol	Added procedure for leachate samples

	Revision: 18	**Effective date:** 13.MAY.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout documents	Reflects current protocol	Added references to ICP-MS

	Revision: 18	**Effective date:** 13.MAY.2021
Section	**Justification**	**Changes**
Scope	Reflects current protocol	Removed reference to 3010

Reference

1. *Test Methods for Evaluating Solid Waste*, SW-846 Method 3005A, July 1992.

2. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI11931	Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7(aqueous)
T-MET-WI11933	Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A/6020B(aqueous, solid, tissue) and EPA 200.8 (aqueous)
T-MET-WI9082	Working Instructions for Prep Solutions and Standards
QA-SOP11178	Demonstrations of Capability

Scope

This acid digestion procedure is used to prepare wastewater, surface water, and groundwater samples for measurement of total recoverable metals by inductively coupled plasma optical emission spectroscopy (ICP-OES) and inductively coupled plasma mass spectrometry following SW-846 protocol.

Basic Principles

Samples are heated with nitric and hydrochloric acids with a substantial reduction in volume during digestion to dissolve metals.

Reference Modifications

1. A 50-mL sample aliquot and final volume is used instead of 100-mL to improve digestion throughput, conserve sample usage, and limit waste generation. Because all reagents are also adjusted so that concentrations are equivalent to a 100-mL aliquot, there is no impact on the data.

2. Ribbed watch glasses or reflux caps are not used during evaporation; samples are heated without watch glasses in non-metallic hoods to speed evaporation. No contamination trends have been observed in prep blanks evaporated without using watch glasses.

3. Samples are heated at 90° to 95°C on hot plates or HotBlocks.

Interferences

Not applicable to this procedure.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO_3) – This acid can cause skin burns. Add nitric acid to samples in a hood to avoid exposure to toxic fumes or use the designated dispensing equipment.

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCl with concentrated H_2SO_4 to avoid a violent reaction. Always use in a fume hood or use the designated dispensing equipment.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds.

Samples that contain dust may be hazardous. Open in a fume hood.

When a hazardous flag is added indicating possible cyanide, special precautions are required to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water. Spill pillows and SPILL-X-A are stored on the prep room shelf.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and a documented Demonstration of Capability for this or an equivalent procedure.

Initially, each employee performing this digestion procedure must work with an experienced employee for a period of time until they can independently set up batches and perform the necessary steps outlined in this procedure. Proficiency is measured through documentation of the critical steps in this procedure, over checking of data as well as an IDOC.

The IDOC and the DOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Refer to *QA-SOP11178* for specific requirements. A DOC is performed annually and is maintained in the analyst's training records.

Sample Collection, Preservation, and Handling

Samples are collected in plastic containers and preserved to a pH of <2 with HNO_3. (Samples to be analyzed for soluble metals requiring filtration at the lab must be submitted unpreserved. The sample is run through a 0.45 micron filter within 5 days of receipt and then preserved.) The pH is checked upon receipt and adjusted as necessary by Sample Support; samples that are pH adjusted at the lab must not be digested for a minimum of 24 hours. If samples fail to maintain a pH of <2 the Client Service Representative is notified for further direction. Samples are stored at 0° to 6°C, but not frozen, prior to digestion. Samples must be digested within 6 months of collection. Digested samples are stored in plastic at room temperature and have a 6 month holding time.

Apparatus and Equipment

1. Polypropylene containers (digestion vessels) – certified clean and Class A equivalent
2. 250-mL beakers, 400-mL beakers (or other volumes as appropriate)
3. 100-mL graduated cylinders (or other volumes as appropriate)
4. 100-mL Class A volumetric flasks (or other volumes as appropriate)
5. 125-mL Nalgene bottles (or other volumes as appropriate)
6. Hot plates or HotBlocks adjustable and capable of maintaining a temperature of 90° to 95°C

Reagents and Standards

For reagent preparation, shelf life, and storage conditions, see *T-MET-WI9082*.

1. Nitric acid, HNO_3 - Fisher, Trace Metal Grade, or equivalent. Store at room temperature and re-evaluate annually.

2. Hydrochloric acid, HCl - Fisher, Trace Metals Grade, or equivalent. Store at room temperature and reevaluate annually.

3. Nitric acid (1:1) – Add 500 mL of HNO_3 to 500mL of reagent water. Store at room temperature. Expires in 6 months.

4. Hydrochloric acid (1:1) – Add 500 mL of HCl to 500 mL of reagent water. Store at room temperature. Expires in 6 months.

NOTE: It is acceptable to prepare solutions using multiples of indicated volumes if exact ratios are maintained.

Calibration

Not applicable to this method.

Procedure

This SOP has been set up to outline the procedures for HotBlock, hot plate, and auto-digester (see below). Choose the procedure that corresponds to the sample heating technique being used for sample digestion.

A. HotBlocks

NOTE: It is acceptable to reduce the volume of sample being analyzed as long as the sample reagent ratios are maintained.

NOTE: If the sample contains high solids, use a smaller aliquot of the sample and bring sample to final volume as stated in this procedure. Make appropriate acid, reagent, and spike volume adjustments based on sample final volume.

NOTE: When insoluble matter is present after digestion, allow it to settle by gravity or filter prior to introduction to the instrument. If any samples are filtered, the MB and LCS must also be filtered.

NOTE: For soluble metals analysis, filter unpreserved sample through 0.45-micron filter paper. Adjust the filtered sample to pH <2 with nitric acid preserving solution. Measure the volume of sample, as stated in this procedure, and digest as normal. The MB and LCS must also be prepared with filtered reagent water.

See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used for digestion. If necessary, adjust control point temperature to the proper setting as instructed below.

1. Shake sample well. For non-leachate samples, transfer 50 mL of well-mixed sample into a 68-mL digestion vessel. For leachate samples, transfer 5-mL of well-mixed sample into a 68-mL digestion vessel and bring to 50-mL using DI water. After the sample has been poured, add the spiking solution. For sample batch spiking procedures, see *T-MET-WI9082*. For sample batch quality control requirements see *T-MET-WI11931*. LCS/LCSD and MS/MSD samples for leachate batches use 5 mL of SPLP or TCLP fluid brought to 50-mL with DI water.

2. Add 2 mL of (1:1) HNO_3 and 5 mL of (1:1) HCl.

3. Heat the solution in a HotBlock at about 90° to 95°C until sample volume is reduced to between 15 and 20 mL, making certain the sample does not boil.

4. Allow to cool.

5. Adjust volume to the 50-mL mark on the digestion vessel with reagent water, cap, and mix.

6. The sample is now ready for analysis.

B. Hot Plates:

NOTE: If boron (B) is requested on a sample, use Teflon vessels.

NOTE: It is acceptable to reduce the volume of sample being analyzed as long as the sample reagent ratios are maintained.

NOTE: When insoluble matter is present in the digested sample, allow it to settle by gravity or filter prior to introduction to the instrument. If any samples are filtered, the MB and LCS must also be filtered.

NOTE: For soluble metals analysis, filter unpreserved sample through 0.45-micron filter paper. Adjust the filtered sample to pH <2 with nitric acid preserving solution. Measure the volume of sample, as stated in this procedure, and digest as normal. The MB and LCS must also be prepared with filtered reagent water.

NOTE: If the sample contains high solids, use a smaller aliquot of the sample and bring sample to final volume as stated in this procedure. Make appropriate acid, reagent, and spike volume adjustments based on sample final volume.

1. Shake sample well. Transfer 50-mL of well-mixed sample into a 68-mL digestion vessel. After the sample has been poured, add the spiking solution. For sample batch spiking procedures see *T-MET-WI9082*. For sample batch quality control requirements see *T-MET-WI11931*.

2. Add 2 mL of (1:1) HNO_3 and 5 mL of (1:1) HCl.

3. Heat the solution on a hot plate at 90° to 95°C until sample volume is reduced to between 15 and 20 mL, making certain the sample does not boil.

4. Allow to cool.

5. Transfer the solution to a 50-mL volumetric flask. Adjust volume to the 50-mL mark with reagent water and mix.

6. Transfer the solution to a 125-mL Nalgene container and cap.

7. The sample is now ready for analysis.

Block Digestor Instructions

1. Turn block digestor on by pressing rocker switch located on the cord.

2. Wait about 8 seconds until controller display indicates current block temperature.

3. Press and hold Star (*) key.

4. The display shows the Set Point Temperature.

5. The digits can be changed to the desired value by pressing the up and down arrows keys while holding the (*) key.

6. Confirm Control Point temperature is set to the block temperature that provides 90° to 95°C.

NOTE: See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used for digestion. If necessary, adjust Control Point temperature to the proper setting.

NOTE: Polypropylene containers must not be heated above 130°C.

Calculations

Not applicable to this procedure.

Statistical Information/Method Performance

Not applicable to this procedure.

Quality Assurance/Quality Control

A method blank, sample duplicate, sample matrix spike, sample matrix spike duplicate, and laboratory control sample must be performed for every SW-846 digestion batch. A batch is 20 samples or less.

Each piece of batch QC is digested following the procedures in this SOP.

For sample batch quality control requirements see *T-MET-WI11931* for ICP and *T-MET-WI11933* for ICP-MS

11178 Demonstrations of Capability
11931 Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)
11933 Metals by ICPMS by Methods SW-846 6020/6020A/6020B(waters, solid, tissue) and EPA 200.8 (waters)
9084 Preparation of Mercury Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
17	30.NOV.2020		
18	13.MAY.2021		
19	16.AUG.2021		

eurofins	Always check on-line for validity.	Level:
Document number: **T-PEST-WI9232**	**Analysis of Pesticides by 8081B in Solid Samples using GC-ECD**	**Work Instruction**
Old Reference: **1-P-QM-WI-9015108**		
Version: **8**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **25-FEB-2022**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_OC Pesticide C**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Extraction
Gas Chromatographic Conditions
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision: 8	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Removed references to old LIMS analyte names
Throughout Document	Reflects current practice	Removed references to obsolete work instruction T-PEST-WI10011
Personnel Training and Qualifications	8000D	Added 8000D IDOC criteria (4 LCS)

Revision: 7	**Effective Date:**	31-MAR-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Removed references to old LIMS analysis numbers
Throughout Document	Reflects current practice	Removed references to obsolete work instructions T-PEST-WI10016 and T-PEST-WI10022
Apparatus and Equipment	Reflects current practice	Removed Restek columns
Reagents and Standards	New LIMS	Removed references to the standards database and replaced with references to the reagents module in the LIMS

Revision: 7	**Effective Date:**	31-MAR-2021
Section	**Justification**	**Changes**
Calibration J.	Reflects current practice	Removed step to set up aroclor calibration in the custom datalog program
Calibration J.3.b.(2)	Superfluous	Six points are already prepared and analyzed as part of the calibration curve – removed 'prepare a sixth point somewhere within the established calibration range listed in the standards preparation section.'
Calibration J.4.c.	Superfluous	All information contained here matched the information contained in J.3. so removed all steps and referred the reader to step 3 of the initial calibration section.

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 8081B, February 2007 (Update IV).
2. Determinative Chromatographic Separations, SW-846, Method 8000C, March 2003
3. Determinative Chromatographic Separations, SW-846, Method 8000D, July 2014
4. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-PEST-WI10926	Microwave Extraction Method 3546 for Pesticides in a Solid Matrix
T-OE-PEST-WI10939	Ultrasonic Extraction for Pesticides in a Solid Matrix by Method 3550
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-PEST-WI9954	Interpretation of Chromatographic Data
T-PEST-WI10007	Preventative and Corrective GC Maintenance
T-PEST-WI9980	Monitoring of QC Data Acceptance Limits
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is used for identifying and quantitating the following Pesticides in solid samples by SW846 Method 8081B. Solid matrices other than soil can also be analyzed as long as the sample can be handled through the sonication or microwave technique for extracting. Typically solids are reduced to small pieces for extracting (e.g. concrete, wood, other plant material etc.). Tissue samples are ground and homogenized prior to extracting. Tissue samples may be whole fish, filets, or other miscellaneous species (usually aquatic, but not necessarily). Standards for the PCBs are run during this analysis since some of the PCB peaks may coelute or overlap with the pesticide peaks of interest. The information is used for proper identification and interpretation of the peaks observed for each sample. Quantitation of the same peak as a pesticide and PCB can be avoided.

Compound	LOQ (µg/kg)
alpha-BHC	0.83
beta-BHC	1.0
delta-BHC	0.90
heptachlor	0.83
aldrin	0.83
heptachlor epoxide	0.83
endosulfan I	0.83
endosulfan II	1.7
endosulfan sulfate	1.7
dieldrin	1.7
endrin	1.7
4,4'-DDE (*p,p*)	1.7
2,4'-DDE (*o,p*)	1.7
4,4'-DDD (*p,p*)	1.7
2,4'-DDD (*o,p*)	1.7

Compound	LOQ (µg/kg)
4,4′-DDT (*p,p*)	1.7
2,4′-DDT (*o,p*)	1.7
endrin aldehyde	1.7
endrin ketone	1.8
methoxychlor	6.7
chlordane	17
Cis-chlordane (alpha-chlordane)	0.83
Trans-chlordane (gamma-chlordane)	0.83
toxaphene	33.
kepone	7
mirex	1.7
Isobenzan (telodrin)	1.2
hexachlorobenzene(HCB)	0.83
Total Endosulfan (I + II)	0.83
Total DDTs	1.7

The following Pesticides in tissue samples are also identified and quantitated: **NOTE**: based on an initial sample volume of 15g to final volume 10mL

Compound	LOQ (µg/kg)
alpha-BHC	1.7
beta-BHC	3
delta-BHC	5
gamma-BHC (lindane)	7.5
heptachlor	1.7
aldrin	1.7
heptachlor epoxide	1.8
endosulfan I	1.7
endosulfan II	3.4
endosulfan sulfate	3.4
dieldrin	3.4
endrin	3.4
4,4′-DDE (*p,p*)	3.4
2,4′-DDE (*o,p*)	5
4,4′-DDD (*p,p*)	3.6
2,4′-DDD (*o,p*)	5
4,4′-DDT (*p,p*)	3.4
2,4′-DDT (*o,p*)	5
endrin aldehyde	3.4
endrin ketone	3.4
methoxychlor	13
Chlordane	34
Cis-chlordane (alpha-chlordane)	1.7
Trans-chlordane (gamma-chlordane)	1.7
toxaphene	34
mirex	4
hexachlorobenzene(HCB)	3

Limit of Quantitations (LOQs) are based on annual statistical evaluation of laboratory data and are subject to change. The current Method Detection Limits (MDLs) and LOQs are maintained in the LIMS.

HCB, Isobenzan, and Kepone are additional compounds offered by special request.

Basic Principles

The sample is extracted using sonication or microwave with 50% hexane/acetone. The extract is dried, concentrated, and exchanged to hexane. The pesticides are then identified and quantitated using gas chromatography with an electron capture detector (GC-ECD). Florisil, GPC, or copper cleanups may be employed to reduce matrix interferences which introduce large, unresolvable peaks into the chromatogram, specifically elemental sulfur.

Reference Modifications

Gas Chromatography conditions differ from those listed in 8081. However, all quality control (QC) criteria are met.

Interferences

1. Avoid contact with any plastic material during the extraction and analysis procedures to minimize interferences from phthalate esters.
2. Scrupulously clean all glassware to minimize interferences caused by laboratory contaminants.
3. An electron capture detector is very sensitive to compounds that contain halogens and will also respond to many other compounds and materials including oxygenated organics, unsaturated organics, and elemental sulfur.
4. Extracts may require further cleanup if interferents are present. Refer to *T-OE-PEST-WI10281* for details on each cleanup procedure. Interfering materials can introduce large, unresolvable peaks into the chromatogram.
    a. Use Florisil cleanup to reduce organics that can interfere (polar compounds).
    b. Use GPC to remove sulfur and higher molecular weight organics.
    c. Use copper cleanup to remove elemental sulfur.
5. For solid samples, a 1:1 mixture of methylene chloride/acetone has been shown to introduce many extraneous interfering peaks due to reactions that occur between the solvents during the heated concentration process. Therefore, hexane/acetone is used for extraction.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management,and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

Gloves, lab coats, and safety glasses must be worn when preparing standards. Lab coats and safety glasses must be worn around the GC where solvents and sample extracts are handled.

All GC vials and vials containing extracts are placed in a hazardous waste container for lab pack disposal. There is a satellite container in the laboratory that is then emptied into the main laboratory waste collection drums. All solvent waste is disposed of in solvent waste containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst’s training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the chromatography data system to set up sequences, perform the calculations, interpret chromatograms, perform instrument maintenance, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation (per EPA 8000D, the statistical LCS window and RPD </= 20%)). Various options are available for a DOC and can include four laboratory control samples or one blind sample.

Sample Collection, Preservation, and Handling

Samples are collected in wide-mouth glass containers with Teflon™-lined caps and kept cool at 0° to 6°C, not frozen. The extraction must be performed within 14 days of collection, and sample analysis must be performed with 40 days of extraction. Extracts are stored at ≤-10ºC.

Apparatus and Equipment

1. HP 6890 gas chromatograph equipped with dual electron capture detectors or equivalent
2. Columns:
    a. Phenomenex MR1 30 m × 0.32 mm × 0.5 µm
    b. Phenomenex MR2 30 m × 0.32 mm × 0.25 µm
    c. RTX– CLPesticides – 30 m × 0.32 mm × 0.5 µm
    d. RTX – CLPesticides II – 30 m × 0.32 mm × 0.25 µm
3. Integrating system such as Chrom Perfect® by Justice Laboratory Software, or equivalent. Chrom Perfect® is a data system capable of storing and reintegrating chromatographic data and determining peak areas using a forced baseline, area summation, baseline projection, and performing baseline compensation as required.
4. Various sizes of Class A volumetric flasks, pipettes, and syringes

Reagents and Standards

A. Reagents

1. Hexane for autosampler rinse vials. Stored at room temperature for up to 1 year.
2. UPC (ultra pure carrier) helium for carrier gas
3. UPC nitrogen for detector make-up gas
4. UPC hydrogen for carrier, either bottled or from a generator

B. Standards

1. All standards are prepared using Class A volumetric pipettes, syringes, and flasks.
2. All weights are made on an analytical balance.
3. Unopened ampules are stored according to the manufacturer's instructions and are stable until the expiration date provided by the manufacturer.
4. All prepared standard solutions are stored at ≤-10°C, except as noted.
5. See the reagents module of the LIMS for the compound lists and concentrations contained in the various mixes.
6. Mix A – Restek Catalog #32292. Equivalent to the CLP (SOW OLMO3.2) Mix A and B, contains all single component pesticides and surrogates in the TCL and PPL organochlorine lists.
7. Mix E – Restek Custom Mix #55992. Contains additional organochlorine pesticides such as kepone, the 2,4 isomers of DDT, DDD, DDE, mirex, Isobenzan, and hexachlorobenzene.
8. Toxaphene stock – Restek Catalog #32005 at 1,000,000 ppb. Prepare an intermediate by placing 2 mL into a 25-mL volumetric and bring to volume with hexane.
9. Chlordane stock (CAS # 57-74-9) – Restek 32021(1,000,000 ppb in hexane).
10. Surrogate Stock (SS) – Supelco #861284 containing Decachlorobiphenyl (DCB) and Tetra-chloro-meta-xylene (TCX) at 200,000 ppb each in acetone.
11. Pest MS stock – Supelco Catalog #48796, #48196. All compounds in Mix A (#7 above)
12. PEM stock – Ultra Scientific CLP-25D. Equivalent to CLP performance evaluation mix (PEM).
13. ICV stocks – These must always be from different lot numbers (or vendors) than the working calibration standards.

a. Accustandard Cat. #M-8081-SC and Accustandard Cat. #P-064S-10x for Methoxychlor. Prepare an intermediate by diluting 0.1 mL of stock into a 10 mL volumetric flask with hexane using the M-8081-SC stock.

14. Instrument Blank (PIBLK) – surrogate stock (SS) – Restek 32000 containing Decachlorobiphenyl (DCB) and Tetrachlorometaxylene (TCX) at 200,000 ppb each in acetone.

15. Prepare working standards using the reagents module of the LIMS as a guide.

    a. In the reagents module, first enter the reagents in this section as 'source' reagents.

    b. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing, or create a new standard if the working standard has not yet been prepared in LIMS.

    c. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The standards are prepared in hexane. All standards are stored in glass bottles with Teflon™-lined caps in the freezer at ≤-10ºC. The working standards have an expiration date of 6 months.

    d. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level. The CCV and ICV are at the level 4 concentration of the ICAL. The MDL standard is prepared at 2 to 5 times below the low level standard of the ICAL.

    e. The following table is used for the preparation scheme of the matrix spike solution and the surrogate solution used during the extraction. The SS standard is prepared in a volumetric flask and stored in 8 separate 250 mL clear glass bottles in the standard refrigerator at 0º to 6°C, not frozen. The MS standard is prepared in a volumetric flask and stored in 9 separate 12 mL amber vials in the standard refrigerator at 0º to 6°C, not frozen.

Standard Name	Parent Solution	Aliquot (mL)	Final Volume (mL)	Solvent	Description
SW-846 SS	SS Stock	3.0	2000	Acetone or methanol	SW-846 Water Surrogate – identical to that prepared for PCB analyses
SW-846 MS	MS Stock	2.0	100	Acetone or methanol	SW-846 Water spike for single component organochlorines in TCL/PPL list

16. Standards for the PCBs are run during this analysis since some of the PCB peaks may coelute or overlap with the pesticide peaks of interest. The information is used for proper identification and interpretation of the peaks observed for each sample. Quantitiation of the same peak as a pesticide and PCB can be avoided.

Extraction

See organic extraction work instructions T-OE-Pest-WI10939 for sonication extraction and T-OE-Pest-WI10926 for microwave extraction.

Gas Chromatographic Conditions

The conditions listed serve as a guideline only and are typically the optimum operating conditions. The analyst may make changes to the chromatographic conditions to improve the speed of analysis, linearity, sensitivity and/or improve the separation if initial and continuing calibration criteria and quality assurance criteria listed within this analysis document are met.

Detector	ECD
Detector Temp	330°C
Oven Temp	140°C, no hold, 25°C/min to 250°C, then 22ºC/min to 300ºC, hold 3 min
Carrier Gas	Hydrogen at constant flow of 3.4 ml/min Helium may also be substituted
Makeup Gas	N2 at 55 mL/min
Injection Size	1 µL, direct injection
Injector Temp	225°C

Calibration

A. The pesticide analysis is run as a dual column approach. One injection is split onto two analytical columns. All initial and continuing calibration criteria listed below applies to both analytical columns.

B. Fill the autosampler rinse vials with clean solvent or replace vials that appear dirty.

C. Prepare a sequence using the following recommended order of injections:

1. Conditioner
2. PEM (evaluation)
3. PIBLK (instrument blank)
4. IC MIXA1
5. IC MIXA2
6. IC MIXA3
7. ICRT MIXA4
8. IC MIXA5
9. IC MIXA6
10. IC Mixe1*
11. IC MIXE2*
12. IC MIXE3*
13. ICRT MIXE4*
14. IC MIXE5*
15. IC MIXE6*
16. IC TOX1
17. IC TOX2
18. IC TOX3
19. ICRT TOXA4
20. IC TOX5
21. IC TOX6
22. IC CHL1
23. IC CHL2
24. IC CHL3
25. ICRT CHL4
26. IC CHL5
27. IC CHL6
28. ICV MIXA
29. ICV MIXE
30. ICV TOX
31. ICV CHL
32. ICVL MIXA (MDL std for Mix A)
33. ICVL MIXE
34. ICVL TOX
35. ICVL CHL
36. AR 164
37. AR 2154
38. AR 484
39. Blank
40. LCS
41. 1234567
42. 1234567ms
43. 1234567msd
44–54. Continue running samples for a 12-hour period from last standard
55. PEM
56. CCV MIXA (CCV)
57. CCV MIXE4* (CCV)
58. CCV TOXA4 (CCV)
59. CCV CHLD4 (CCV)

D. The conditioner injection is usually a standard or sample that has already been injected.

1. The conditioner is used to prime the system.

2. It is best utilized when the GC has not been running and there is a gap in time prior to starting a set of injections.

E. Hexane blanks can also be injected to allow the GC to go through some temperature programs and/or check the cleanliness of the system.

F. Inject initial instrument blank (PIBLK) after the conditioners and PEM but before the initial calibration. It is used to determine that the instrument is free of background noise or contamination.

G. Run a breakdown evaluation standard (PEM) at the start of an ICAL to ensure the breakdown of DDT and endrin meets the method acceptance criteria.

1. Sample analysis cannot be performed if the breakdown exceeds 15% for either DDT or endrin.
2. Breakdown check is run ongoing throughout the run after every 12 hours.
3. The sum of the peak heights of DDE, and DDD divided by the total peak heights of DDT/DDD/DDE cannot exceed 15%.
4. The sum of the peak heights endrin aldehyde and endrin ketone divided by the total peak heights of endrin/endrin aldehyde/endrin ketone cannot exceed 15%.

H. *MIX E is only needed when analyzing for additional pesticide including 2,4-DDE, 2,4-DDD, 2,4-DDT, kepone, mirex, HCB, and Isobenzan.

I. The order of injections for the Aroclor multi-components is not critical as long as they are all run before sample analysis. Aroclors are only used to identify possible PCB patterns which may interfere with the pesticide detections.

J. Initial Calibration (ICAL)

1. Calibrate using the 5-6 levels of the single component pesticides contained in MIX A and E. Run 5-6 levels for chlordane and toxaphene.
2. An external standard calibration is used with average calibration factor (AVGCF) for all analytes where the %RSD is ≤20%.
3. If the RSD is > 20%, use a calibration curve.
   a. Attempt a linear fit first. Use this fit if the correlation coefficient is >0.99.
   b. If the correlation coefficient is less than 0.99, a quadratic fit will be tried.
      (1) A six-point calibration must be run to use quadratic.
      (2) Quadratic fit can not be used to extend the calibration range or bypass instrument maintenance
      (3) For samples from South Carolina, a quadratic fit may not be used.
   c. For either curve type, extrapolate or force to zero is not allowed. Set the zero to ignore.
   d. The criteria for % error of standard levels at or below the LOQ is +/- 50%. The criteria for % error of all other standard levels is +/-30%.
   e. If the 0.99 curve coefficient cannot be met:
      (1) Inspect the data points to see if one or more calibration levels appear to be off.
      (2) Reinject or remake the standard if a specific calibration level has concentrated due to solvent evaporation, or degraded over time.
      (3) Perform instrument maintenance as needed. See *T-PEST-WI10007* for troubleshooting linearity problems.
   f. Curve types and criteria can be altered to meet client or project specific requirements as well as any regulatory agency requirements that may differ from those listed here.
4. Set up the toxaphene and chlordane calibration data.
   a. The retention time of the peaks to use for identifying and quantifying these multi-component pesticides are entered into the calibration file along with the corresponding peak heights and concentrations.
   b. Each individual peak used for Toxaphene and chlordane must meet the 20% RSD criteria.
   c. Alternatively, when these criteria are not met (RSD is >20%), a linear fit or quadratic fit is used.
   d. A linear fit will be tried first. Use this fit if the correlation coefficient is >0.99.
   e. If the correlation coefficient is less than 0.99, a quadratic fit will be tried.
      (1) Quadratic fit cannot be used to extend the calibration range or bypass instrument maintenance.
      (2) For samples from South Carolina, a quadratic fit may not be used.
   f. For either curve type, extrapolate or force to zero is not allowed. Set the zero to ignore.
5. Ensure the peaks in the standards are labeled properly, including the surrogates in all injections that contain them.

6. Set the scaling of chromatograms and peak integration parameters so that the peaks for each compound of interest are detected and integrated at the concentration of the MDL. This ensures that the LOQ and MDL can be met.

K. Initial Calibration Verification (ICV)

1. Verify the calibration curve using the ICV mixtures injected directly after the corresponding curve.
2. The % difference of the concentrations for these must be within 20% difference of the nominal concentration.

L. Continuing Calibration Verification (CCV)

1. Analyze a set of check standards after each set of injections in a 12-hour period, or 20 samples, whichever comes first (samples, QC, blanks, etc.).
   a. Use a mid level single component standard to evaluate the response of single component analytes.
   b. Use a mid level standard for toxaphene and chlordane.
   c. Run the breakdown evaluation mix (PEM). Analysis cannot proceed if either compound exceeds 15%.
2. The concentration quantitated for the continuing calibration check standards must be within 20% difference (%D) of the nominal concentration.
3. Samples must be bracketed by compliant standards.
4. When confirmation of target analytes is needed, the initial calibration criteria must be met and the second column should meet the 20% continuing calibration criteria.
5. When a continuing calibration verification standard (CCV) fails to meet the QC criteria, all samples that were injected after the last CCV that passed must be re-injected.
   a. Exception: If the CCV fails high and those targets are not detected in the associated samples, the samples can be reported.
   b. If two consecutive/sequential CCVs fail, corrective action must be taken, which can include performing injection port maintenance, baking the instrument or other types of maintenance. Two consecutive/sequential CCVs must meet the criteria or an initial calibration must be performed before sample analysis can continue.
6. The instrument blank (PIBLK) may be injected after each set of continuing calibration verifications.
   a. This is optional but frequently requested for projects.
   b. It must be evaluated as a water matrix against the water MDL/LOQs.
   c. The PIBLK must not have any target compounds above the reporting limits.

      (1) If a target analyte is detected in the PIBLK, any associated samples with a detection for that same target must be evaluated.

      (2) Unless the concentration in the sample is more than 10x the PIBLK value, the sample must be reinjected

      (3) Instrument maintenance, like baking the system or injection port maintenance is usually necessary to clean up the instrument.
7. Retention time (RT) windows
   a. Established as 3× the standard deviation determined over 72 hours, or at no less than .02 minutes, applied to the initial calibration standard, usually Level 3.
   b. If the RTs for a continuing calibration standard fall outside the RT window, update the midpoint RT using that standard.

      (1) Save this under the appropriate name to indicate an update has occurred.

      (2) RTs cannot be updated more than once per day. All subsequent standards run within a 24-hour period must be within this window.

      (3) If RTs are not consistent, the cause must be investigated and corrective action taken.

Procedure

1. Make injections via an auto sampler.
2. Samples are analyzed according to the sequence in the calibration section above.
3. Retention times of peaks in the samples are compared to the standard RT windows. Peaks present on both columns (and that are also in the correct ratios to represent an aroclor) are quantitated and the high value is reported unless there are chromatographic anomalies. See *T-PEST-WI9954*.
4. There are several compounds that coelute on one column and not the other; whether a compound coelutes or not is instrument and column dependent. Compounds known to coelute are contained in different standards. One standard is named MIXA and the other standard is MIXE. Refer back to the ICAL to note which compounds coelute and on which column they coelute before evaluating the sample data. If there is a detection for one of the coeluting compounds on the column where this compound does not coelute and the detection is greater than the MDL, look at the other column and note if the coeluting compound is present. If the coeluting column is present and within the +/-0.02 retention time units of the detected coleluting compound from the other column, calculate the concentration using the appropriate response factor. Calculate the RPD between the two columns and report as per routine protocol.
5. Continue running groups of samples/injections followed by check standards every 12 hours or every 20 injections, whichever comes first.
6. If significant interference is present, schedule florisil cleanup. If elemental sulfur is present, copper cleanup the extract or have it put through GPC cleanup. If these techniques do not reduce the matrix problems, dilute the extract, analyze, and adjust the LOQs accordingly.
7. Report the results for the least dilute sample where the concentration measured is within the acceptable calibration range.

Calculations

A. See *T-PEST-WI9847* for details on all calculations/equations used to evaluate the initial and continuing calibration.

B. Calculation of results is performed according to the following procedures:

1. Single-component compounds

a. Using AVGCF from initial calibration

$$\frac{Sample\ Height}{AVG\ CF\ (CF)} \times \frac{FV}{IW} \times DF = \mu g/kg\ as\ received$$

b. Using linear curve from initial calibration:

$$[(Sample\ Height - Y - intercept)/Slope] \times \frac{FV}{IW} \times DF = \mu g/kg\ as\ received$$

Where:

FV = final volume (in mLs)

IW = initial weight (in grams)

DF = dilution factor, as needed

2. Multi-component compounds

The peak heights generated by the integration system are used to calculate the calibration factors (CF) for peaks of interest for each quantitation peak used for toxaphene and chlordane.

Usually the five major peaks are chosen for quantitation. Include cis-chlordane and trans-chlordane as two of the five major peaks for the calibration of chlordane. Sample concentrations are calculated per peak using Average Calibration Factor (AVG CF).

$$\frac{Sample\ Height}{AVG\ CF\ (CF)} \times \frac{FV}{IW} \times DF = \mu g/kg\ as\ received$$

Where:

FV = final volume (in mLs)

IW = initial weight (in grams)

AF = additional factor, based on cleanups (i.e., 2 mL extract florisiled to 25 mL = 12.5)

DF = dilution factor, as needed

The final result that is reported is determined as the average of the result for each peak chosen for quantitation:

$$(Result\ 1 + Result\ 2 + \ldots + Result\ n) / n = Average\ Result$$

3. A breakdown mix (PEM) containing 4,4-DDT and Endrin is run to check for breakdown. The breakdown must not exceed 15% for either compound. Breakdown is calculated as:

$$\%\ Breakdown\ for\ p,p'\text{-}DDT = \frac{pk\ ht\ (area)\ of\ p,p'\text{-}DDE + p,p'\text{-}DDD}{pk\ ht\ (area)\ of\ p,p'\text{-}DDE + p,p'\text{-}DDD + p,p'\text{-}DDT} \times 100$$

$$\%\ Breakdown\ for\ Endrin = \frac{pk\ ht\ (area)\ of\ Endrin\ Aldehyde + Endrin\ Ketone}{pk\ ht\ (area)\ of\ Endrin\ Aldehyde + Endrin\ Ketone + Endrin} \times 100$$

If breakdown fails, injector maintenance must be performed. Analysis cannot proceed until breakdown check passes.

Statistical Information/Method Performance

LCS, MS, and RPD are compared to the limits stored in the LIMS. The limits for LCS and MS are statistically derived. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Acceptance limits are generated according to *T-PEST-WI9980*. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the manager. The department database is updated via a download from the LIMS.

Quality Assurance/Quality Control

Each extraction batch (up to 20 samples) must contain a method blank, a laboratory control spike sample (LCS), and either an unspiked background sample (US), a matrix spike (MS), a matrix spike duplicate (MSD) or an LCS/LCSD.

The TCL single-component pesticides of interest for each analysis are routinely spiked. Mirex, 2,4-DDE/DDD/DDT, Isobenzan, kepone, and HCB are not spiked since this would result in co-elution with the other spiked compounds. These can be spiked at a client's request for special projects, within our scope of accreditation.

DCB and TCX are added as surrogates to each sample and QC to monitor the efficiency of the extraction, the operation of the autosampler, and to monitor retention times throughout the GC run.

QC limits for surrogates, LCS/LCSD, and MS/MSD are established through statistical analysis of historical data. The limits are evaluated every 6 months and updated as needed. The limits are maintained in the LIMS for the relevant analysis numbers.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed.

10007 Preventative and Corrective GC Maintenance
10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10926 Microwave Extraction Method 3546 for Pesticides in a Solid Matrix
10939 Ultrasonic Extraction for Pesticides in a Solid Matrix by Method 3550
11892 Determining Method Detection Limits and Limits of Quantitation
9847 Common Equations Used During Chromatographic Analyses
9954 Interpretation of Chromatographic Data
9980 Monitoring QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information	
6	29.MAR.2018		
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Document number: **T-PEST-WI9238**	**Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD**	**Work Instruction**
Old Reference: **1-P-QM-WI-9015109**		
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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Extraction
Gas Chromatographic Conditions
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Appendix I

Revision Log

Revision: 8	**Effective Date:**	31 March 2021
Section	**Justification**	**Changes**
Throughout Document	SOP obsolete	Removed all references to T-PEST-WI9980
Personnel Training and Qualifications	Clarifications	Add 8000D reference for IDOC LCSs
Reagents and Standards	Enhancement	Add calibration standard scheme. Update 'or near' RL to 'or below' RL for low level standard
Statistical Information/Method Performance	TNI2016 requirements are more stringent.	Removed 8000D specific language.

Revision: 7	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Replaced all references to old LIMS with references to new LIMS
Throughout Document	SOPs obsolete	Removed references to T-PEST-WI10016 and T-PEST-WI10022

Reference

1. T*est Methods for Evaluating Solid Waste*, SW-846, Method 8082A, February 2007.

2. Determinative Chromatographic Separations, SW-846, Method 8000D, July 2014

3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-PEST-WI10920	Separatory Funnel Extraction by Method 3510C, 608, 608.3 or 622 for Pesticides and PCBs in a Wastewater
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-PEST-WI10011	QC Data Acceptability and Corrective Action
T-PEST-WI9954	Interpretation of Chromatographic Data
T-PEST-WI10007	Preventative and Corrective GC Maintenance
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses

Scope

This method is useful for identifying and quantitating the following polychlorinated biphenyls (PCBs) as Aroclors in aqueous matrices:

Compound	LOQ (µg/L)
Aroclor 1016	0.5
Aroclor 1221	0.5
Aroclor 1232	0.5
Aroclor 1242	0.5
Aroclor 1248	0.5
Aroclor 1254	0.5
Aroclor 1260	0.5

The following aroclors can also be analyzed for upon request by the client, usually on a project basis. Since aroclors 1262 and 1268 contain peaks that elute much later than 1260, the GC run time needs to be extended to ensure the entire pattern has eluted.

Compound	LOQ (µg/L)
Aroclor 1262	0.5
Aroclor 1268	0.5
Aroclor 5422	1.0
Aroclor 5432	1.0
Aroclor 5460	1.0

See Appendix I for GC operating conditions and calibration information when analyzing for Aroclor 5422, 5432, and/or 5460.

Limits of Quantitiation (LOQs) are based on annual statistical evaluation of laboratory data and are subject to change. The current Method Detection Limits (MDLs) and LOQs are maintained in the LIMS.

Basic Principles

A portion of an aqueous sample is extracted serially with methylene chloride. The volume of sample extracted can be adjusted depending on the physical appearance of the sample and the amount sent for analysis. The extract is dried, concentrated, and exchanged into hexane. The PCBs are then identified and quantitated using gas chromatography (GC) with an electron capture detector (ECD). The extract may require further cleanup (by florisil, sulfuric acid, or copper) to reduce matrix interferences that introduce large, unresolvable peaks in the chromatogram (due to interferents such as phthalates, oxygenated organics, unsaturated organics, or elemental sulfur).

Reference Modifications

Gas Chromatography conditions are different than those listed in Method 8082A however, all QC criteria are met.

Interferences

1. Avoid contact with any plastic material during the extraction and analysis procedures to minimize interferences from phthalate esters.

2. Scrupulously clean all glassware to minimize interferences caused by laboratory contaminants.

3. An electron capture detector (ECD) is very sensitive to compounds that contain halogens and will also respond to many other compounds and materials including oxygenated organics, unsaturated organics, and elemental sulfur.

4. Extracts may require further cleanup if interferents are present. Refer to *T-OE-PEST-WI10281* for details on each cleanup procedure. Interfering materials can introduce large, unresolvable peaks into the chromatogram.

    a. Use Florisil cleanup to reduce organics that can interfere (polar compounds).

    b. Use GPC to remove sulfur and higher molecular weight organics.

    c. Use copper or TBA cleanup to remove elemental sulfur.

5. Common single component pesicides such as DDT, DDD, and DDE may cause interference with the aroclor pattern. To ensure that the analyst is aware of this, a standard containing DDE/DDD/DDT will be run with each initial calibration.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

Gloves, lab coats, and safety glasses must be worn when preparing standards. Safety glasses must be worn around the GC where solvents and sample extracts are handled.

GC vials are disposed of in the designated lab container and subsequently lab packed for final disposal. All solvent waste is placed in designated containers in the laboratory then taken to the lab-wide facility by personnel trained in hazardous waste disposal.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the chromatography data system to set up sequences, perform the calculations, interpret chromatograms, perform instrument maintenance, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples (LCS) that are carried through all steps of the analysis and meet the LCS acceptance criteria, per EPA 8000D section 9.3.3.2. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four LCSs, one blind sample, or one ICAL with 4 ICVs and/or CCVs.

Sample Collection, Preservation, and Handling

Samples are collected in 1 L or 250 mL amber glass containers with Teflon-lined caps and kept cool at 0° to 6°C, not frozen.

PCBs have no maximum recommended holding time for the extraction. Some agencies or projects may require a specific hold time for the extraction. If the hold time is specified in the project, this hold time must be followed. Sample analysis must be performed with 40 days of extraction. Extracts are stored in the freezer at ≤-10°C.

Apparatus and Equipment

1. HP 7890 gas chromatograph equipped with an electron capture detector, or equivalent

2. Columns:

   a. Phenomonex MultiRes I – 30 m × 0.32 mm × 0.5 µm, or equivalent

   b. Phenomonex MultiRes II – 30 m × 0.32 mm × 0.25 µm, or equivalent

3. Integrating system such as Chrom Perfect® by Justice Laboratory Software, or equivalent. Chrom Perfect® is a data system capable of storing and reintegrating chromatographic data and determining peak areas using a forced baseline, area summation, baseline projection, and performing baseline compensation as required.

4. Various sizes of Class A volumetric flasks, pipettes, and syringes

Reagents and Standards

A. Reagents

1. Follow manufacturer's guidelines for storage conditions.

2. Hexane for autosampler rinse vials. Stored at room temperature up to 1 year.

3. UPC (Ultra Pure Carrier) helium for carrier gas.

4. UPC nitrogen for detector make-up gas.

5. UPC hydrogen carrier gas, either bottled or from a generator.

B. Standards

1. All standards are prepared using Class A volumetric pipettes, syringes, and flasks.

2. All weights are made on an analytical balance.

3. Unopened ampules are stored according to the manufacturer's instructions and are stable until the expiration date provided by the manufacturer.

4. All prepared standard solutions are stored at <-10° C in labeled containers for up to 6 months. If comparison with check standards indicates a problem prior to expiration date, the standards must be replaced.

5. Aroclor 1016 stock – Restek 32006 at 1,000,000 ppb in hexane. Prepare an intermediate by diluting 1 to 10 mL of hexane.

6. Aroclor 1016/1260 stock – Restek 32039 at 1,000,000 ppb in hexane. Prepare an intermediate by diluting 1 to 10 mL of hexane.

7. Aroclor 1221 stock – Restek 32007 at 100,000 ppb in hexane. Two separate lots are kept on hand to provide a second source.

8. Aroclor 1232 stock – Restek 32008 at 100,000 ppb in hexane. Two separate lots are kept on hand to provide a second source.

9. Aroclor 1242 stock – Restek 32009 at 100,000 ppb in hexane. Two separate lots are kept on hand to provide a second source.

10. Aroclor 1248 stock – Restek 32010 at 1,000,000 ppb in hexane. Prepare an intermediate by diluting 1 to 10 mL of hexane. Two separate lots are kept on hand to provide a second source.

11. Aroclor 1254 stock – Restek 32011 at 1,000,000 ppb in hexane. Prepare an intermediate by diluting 1 to 10 mL of hexane. Two separate lots are kept on hand to provide a second source.

12. Initial calibration Verification standard (ICV) Stocks:

a. Aroclor 1016 - Accustandard cat # C-216S-H-10X at 1,000,000 ppb

Aroclor 1260 Accustandard Cat# C-260S-H-10x at 1,000,000 ppb

Prepare an intermediate by diluting 1mL of each to 10 mL of hexane.

b. Aroclor 1248 - Accustandard cat# C-248S-H-10X at 1,000,000 ppb.

Prepare an intermediate by diluting 0.5 mL to 5 mL of hexane

c. Aroclor 1254 – Accustandard cat#C-254S-H-10X at 1,000,000 ppb.

Prepare an intermediate by diluting 0.5 mL to 5mL of hexane.

13. Surrogate stock (SS) – Supelco 861284 containing DCB/TCX at 200,000 ppb in acetone.

14. 1016/1260 Matrix spike (MS) stock: Restek 32039. Each at 1,000,000 ppb in hexane. Also used as a second source stock. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

15. Aroclor 1262 stock – Restek #32409 at 1,000,000 ppb in hexane. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

16. Aroclor 1268 stock – Restek #32410 at 1,000,000 ppb in hexane. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

17. Instrument Blank (IBLK) – Surrogate Stock (SS) – Supelco #861284 containing Decachlorobiphenyl (DCB) and Tetrachlorometaxylene (TCX) at 200,000 ppb each in acetone.

18. Prepare working standards using the reagent module in the LIMS as a guide.

a. In the reagent module, first enter the reagents in this section as 'source' reagents.

b. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing, or create a new standard if the working standard has not yet been prepared in TALS.

c. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The working standards have an expiration date of 6 months.

d. The calibration scheme begins at or below the reporting limit through a 20 fold of the initial calibration level:

Calibration Standard	**INT standard 10,000 ug/L Vol. (mL)**	**Surrogate GCS_ARpestssr Vol. (mL)**	**Final Vol. (mL)**	**Aroclor conc. (ug/L)**	**DCB/TCX Conc. (ug/L)**
GCS_AR161 (1016/1260)	0.025	0.025	100	25	2.0
GCS_AR162 (1016/1260)	0.05	0.05	100	50	4.0
GCS_AR163 (1016/1260)	0.1	0.25	100	100	20
GCS_AR164 (1016/1260)	0.2	0.5	100	200	40
GCS_AR165 (1016/1260)	0.5	0.76	100	500	61
GCS_AR166 (1016/1260)	1.0	1.0	100	1000	80

Standard Name	**Parent Solution**	**Aliquot (mL)**	**Final Vol. (mL)**	**Final Conc. (ug/L)**	**Solvent**	**Description**
GCS_MD16	GCS_AR1660ING	0.01	200	5.0	Hexane	1016/1260 MDL Standard
	GCSARpestssr	0.01		0.4		
GCS_IC16	GCS_IC16INT	1.0	200	200	Hexane	Second Source ICV Check Standard
	GCS_ARpestssr	0.4		40		
GCS_IBLKpcb	GCS_PESTSUR	0.05 mL	500	20	Hexane	SW-846 Water Surrogate - identical to that prepared for the Pesticides/PCBs analysis

e. For 1L preps (3510C):

Standard Name	**Parent Solution**	**Aliquot (mL)**	**Final Vol. (mL)**	**Final Conc. (ug/L)**	**Solvent**	**Description**
OP_PCB_MS	Aroclor 1016/1260 stock	1.25	250	5000	Acetone or methanol	PCB Spike used for extraction

Standard Name	Parent Solution	Aliquot (mL)	Final Vol. (mL)	Final Conc. (ug/L)	Solvent	Description
OP_SW_SS	Pest Surr mix	3	2000	300	Acetone or methanol	SW846 surrogate standard used for extraction
OP_PCB_MS	stock	1.25	250	5000	Acetone or methanol	PCB Spike used for extraction

f. For 250mL preps (3510C_LVI):

Standard Name	Parent Solution	Aliquot (mL)	Final Vol. (mL)	Final Conc. (ug/L)	Solvent	Description
OP_SW_SS	Pest Surr mix	3	2000	300	Acetone or methanol	SW846 surrogate standard used for extraction
OP_MINIPCB_MS	OP_PCB_MS	12.5	50	1250	Acetone or methanol	PCB Spike used for extraction
OP_SW_SS	Pest Surr mix	0.375	1000	75	Acetone or methanol	SW846 surrogate standard used for extraction

The MS and SS working solutions are stored <-10°C.

19. An initial calibration verification standard must also be prepared at a concentration at the mid-point of the calibration for 1016, 1260, 1248, 1254 using a stock solution purchased from a different vendor or different lot than that used for the calibration standards.

20. Additional standards and preparations are listed in Appendix I for Aroclor 5442, 5432, and 5460 (PCT analysis).

Extraction

See organic extraction procedure *T-OE-PEST-WI10920*.

Gas Chromatographic Conditions

The conditions listed are usually the optimum operating conditions but can vary to improve the sensitivity, linearity, and overall chromatography or shorten run times on each GC system.

A Merlin microseal can be used in place of traditional septum.

Detector	ECD
Detector Temperature	330°C
Oven Temperature	110°C 40°C/min. to 250°C 20°C/min. to 280°C 30°C/min to 330°C Hold until DCB elutes ~ 2 min.
Column A	MR I
Column B	MR II
Carrier	Hydrogen at 12 psi, 5ml/min constant flow. (Can be substituted with Helium)
Makeup gas	N2 at 80 mL/min. for Agilent GCs
Injection size	1 µL, direct injection
Injection Temperature	225°C

Calibration

A. Fill the autosampler rinse vials with clean solvent or replace vials that appear dirty.

B. Prepare a sequence using the following order of injections:

1. Conditioner
2. IBLK
3. EVAL
4. AR161
5. AR162
6. AR163
7. AR164
8. AR165
9. AR166
10. AR481
11. AR482
12. AR483
13. AR484
14. AR485
15. AR486
16. AR541
17. AR542
18. AR543
19. AR544
20. AR545
21. AR546
22. AR214
23. AR324
24. AR424
25. AR624
26. AR684
27 AR16X
28. MD16 (MDL)
29. IC16X (ICV)
30. IC48X (ICV)
31. IC54X (ICV)
32. Blank
33. LCS
34. 1234567
35. 1234567ms
36. 1234567msd
37.- 47. Continue running samples
48. AR164 (CCV)
49. IBLK

1. Note for our routine PCBs: The AR21, AR32, and AR42 are level 4s in the ICAL and are entered as AR214 and AR424 in the ICAL. Also the AR62 and AR68 are both level 4s and are listed as AR624 and AR684 in the sequences.

2. A single point of Aroclor 1016 is analyzed with the calibration to aid in better pattern recognition in the samples. Aroclor 1016 and 1242 have similar patterns with the exception of the smaller trailing peaks at the end of the Aroclor 1242 pattern. This is identified in the sequence as AR16X.

3. A DDT/Endrin breakdown standard is run with each ICAL in order to provide the retention times of p,p-DDE, p,p-DDD, and p,p-DDT which may interfere with the pattern for aroclor 1254, 1248, and 1260.

4. See Appendix I for a sequence example when the analysis of PCTs (Aroclors 5442, 5432, and 5460) is requested.

D. Continue running groups of samples/injections. Each bracket must contain no more than 20 samples/injections and last no more than 12 hours for Method 8082A. Each bracket is followed by the continuing calibration check standard and an instrument blank (IBLK).

E. The conditioner injection is usually a standard or sample that has already been injected.

1. The conditioner is used to prime the system.

2. It is best utilized when the GC has not been running and there is a gap in time prior to starting a set of injections.

F. Hexane blanks can also be run to allow the GC to go through some temperature programs and/or to check the cleanliness of the system.

G. Instrument blanks (IBLK) may also be run with the continuing calibration standards. This is optional but frequently requested for projects.

1. The instrument blank (IBLK) is injected after the conditioners but before the initial calibration.

2. It is used to determine that the instrument is free of background noise or contamination.

H. For projects where a known aroclor is present and at the request of clients other aroclors can be run for the continuing check standard. For instance, a set of continuing standards can be AR484, AR164, and IBLK.

I. Aroclor 1262 and 1268 can be analyzed when requested. A full six point curve can also be run, depending on the project requirements.

J. Initial Calibration (ICAL)

1. Calibrate for the aroclors using the six levels of 1016, 1260, 1248, and 1254. Use the single point for 1221, 1232, 1242, 1262, and 1268 when needed. As an option, 1248 and 1254 can use a single point calibration.

2. An external standard calibration based on the average calibration factor (AVG CF) for all analytes is used for quantitation where the %RSD is ≤20%.

3. The surrogate standards are calibrated using the AR16 levels using AVGCF unless the %RSD is >20%.

4. If the RSD is > 20%, use a calibration curve.

a. Use a linear fit.

b. The correlation coefficient must be >0.99 to be a valid fit.

c. Extrapolate or force to zero is not allowed. Set the zero to ignore.

When 8000D is referenced and curve fits are used in the initial calibration, percent error (%E) must be calculated for each calibration level. Standard levels at or below the LOQ must meet +/- 50%, standards above the LOQ must meet +/-30%. (%error = (true concentration - calculated concentration)/true concentration)*100). All individual peaks used to calculate the aroclor pattern must meet the %E criteria.

5. If the 0.99 curve coefficient cannot be met:

a. Inspect the data points to see if one or more calibration level became concentrated due to solvent evaporation or degraded over time.

b. Reinject or remake the standard if a specific calibration level has concentrated due to solvent evaporation, or degraded over time..

c. Perform instrument maintenance as needed. See *T-PEST-WI10007* for troubleshooting linearity problems.

6. The calibration range for the aroclors is 50ug/L to 1000 µg/L. Level 1 is equivalent to the Limit of Quantitation.

7. Set up the aroclor calibration data in LIMS. The retention times of the peaks to use for identifying and quantifying the aroclors are entered into the calibration file along with the corresponding peak heights and concentrations.

8. Ensure the peaks in the standards are labeled properly, including the surrogates in all injections that contain them.

9. Set the scaling of chromatograms and peak integration parameters so that the size of the peaks for each compound of interest are approximately 2 to 3 mm in height at the concentration of the method detection limit (MDL).

a. Ensure all peaks in the MDL standard are integrated.

b. By running the 1016/1260 MDL standard, the majority of peaks of all aroclors are represented.

K. Initial Calibration Verification (ICV)

1. Verify the calibration curves using the ICV mixtures injected directly after the full ICAL.

2. The % difference of the concentrations for these must be within 20% difference of the nominal concentration. All the individual peaks used in the ICAL for the PCB pattern must meet this criteria.

a. If this criteria is not met, reinject the ICV.

b. If the criteria is not met again, then prepare a new standard.

c. If the criteria is not met after analyzing the new ICV standard, then a recalibration is performed.

L. Continuing Calibration Verification (CCV)

1. Calibration verification is performed after each set of twenty injections (samples, QC, blanks, etc.) or 12 hours, whichever comes first.

2. Use AR16 to evaluate the calibration of the aroclors (or other aroclors as requested for particular clients or projects).

3. Other aroclors can also be used along with AR16. This must be done if a site has prior history of containing a specific aroclor, or as requested for client projects or to meet other regulatory requirements.

4. The concentration quantitated for the continuing calibration check standards must be within 20% difference (%D) of the nominal concentration for each compound. All the individual peaks used in the ICAL for the PCB pattern must meet this criteria.

5. Samples must be bracketed with compliant standards.

a. Exception: If the standard following a sample is outside the ±20% but exhibits increasing response, the samples before it do not have to be reinjected if the target analytes are not detected. A comment must be added to the analytical report.

b. If two consecutive/sequential CCVs fail, corrective action must be taken, which can include performing injection port maintenance, baking the instrument or other types of maintenance. Two consecutive/sequential CCVs must meet the criteria or an initial calibration must be performed before sample analysis can continue.

c. If confirmation of target analytes is needed, then the second column should meet the 20% continuing calibration criteria, as well as all initial calibration criteria. if either of these are not met, a comment must be added to the analytical report.

6. The instrument blank (IBLK) is injected after each set of continuing calibration verifications when requested.

a. It must be evaluated as a water matrix against the water MDL/LOQs.

b. The IBLK must not have any target compounds above the reporting limits.

(1) If a target analyte is detected in the IBLK, any associated samples with a detection for that same target must be evaluated.

(2) Unless the concentration in the sample is more than 10x the IBLK value, the sample must be reinjected after another compliant IBLK.

(3) Instrument maintenance, like baking the system or injection port maintenance is usually necessary to clean up instrument.

7. Retention time (RT) windows

a. Established as 3× the standard deviation determined over 72 hours or at no less than ±0.02 min, applied to the mid-point initial calibration standard.

b. If the RTs for a CCV fall outside the RT window, update the mid-point RT using that standard.

(1) Save this under the appropriate name to indicate an update has occurred.

(2) RTs cannot be updated more than once per day. All subsequent standards run within a 24-hour period must be within this window.

(3) If RTs are not consistent, the cause must be investigated and corrective action taken.

Procedure

1. Make injections via an auto sampler.

2. Samples are analyzed according to the sequence in the calibration section above, along with the appropriate check standards.

3. Retention times of peaks in the samples are compared to the standard RT windows.

Peaks present on both columns that are also in the correct ratios to represent an aroclor are quantitated and the high value is reported unless chromatographic anomalies are observed. See *T-PEST-WI9954*.

4. Use a minimum of three to six peaks for quantitation, with the exception of certain mixes where it can be more accurate to use less peaks to avoid excessive overlap of patterns.

5. If significant interference is present, schedule florisil and/or sulfuric acid cleanup. If elemental sulfur is present, copper treat the extract. If these techniques do not reduce the matrix problems, dilute the extract with hexane, analyze, and adjust the LOQs accordingly. Also, the reporting limit for individual aroclors may be raised in instances where matrix interference hinders the recognition of an aroclor pattern in the specified retention time window. The reporting limit is calculated by averaging the concentration of at least 3 peaks in the pattern.

6. Report the results for the least dilute sample where the concentration measured is within the acceptable calibration range.

Calculations

A. See *T-PEST-WI9847* for details on all calculations/equations used to evaluate the initial and continuing calibration.

B. Calculation of results is performed according to the following procedures:

1. The peak heights generated by the integration system are used to calculate the calibration factors (CF) for peaks of interest for each aroclor. Usually, the six major peaks that are unique to each aroclor are chosen for quantitation with the exception of 1221 where only three peaks are available.

2. Sample concentrations are calculated per peak using average calibration factor (AVG CF) from the initial calibration for 1016, 1260, 1248, and 1254 where a multi-point calibration is run, single point CF for 1221, 1232, 1242, (a multi-point calibration can also be run for these as requested or necessary to meet client or regulatory agency requirements). Do not use individual peaks that have values <MDL in quantitation.

3.

$$\frac{Sample\ Height}{AVG\ CF\ (CF)} \times \frac{FV}{IV} \times DF = \mu g/L\ as\ received$$

Where:

FV = Final volume – 2 or 10 mL

IV = Initial volume – 250 or 1000 mL

DF = Dilution factor, as needed

The final result that is reported is determined as the average of the result for each peak chosen for quantitation:

4. The surrogate results are determined using either AVGRF or linear curve:

$$(Result\ 1 + Result\ 2 + \ldots + Result\ n) / n = Average\ Result$$

a. Using AVGCF from the initial calibration:

$$\frac{Sample\ Height}{AVG\ CF\ (CF)} \times \frac{FV}{IV} \times DF = \mu g/L\ as\ received$$

b. Using linear curve from the initial calibration:

$$[(Sample\ Height - Y - intercept)/Slope] \times \frac{FV}{IV} \times DF = \mu g/L\ as\ received$$

Where:
FV = Final volume – 2 or 10 mL
IV = Initial volume – 250 or 1000 mL
DF = Dilution factor, as needed

Statistical Information/Method Performance

LCS, MS, and RPD are compared to the limits stored in the LIMS. The limits for LCS and MS are statistically derived. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements, are analyzed quarterly, and are evaluated annually. Refer to *QA-*

SOP11892 for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the manager. The department database is updated via a download from the LIMS.

Quality Assurance/Quality Control

A reagent water blank and a reagent water spike (LCS) are analyzed each day with every batch of samples (batch size is 20). An MS/MSD is performed per batch as long as there is ample volume of a sample in the batch. If an MS/MSD cannot be performed, an LCSD must be extracted.

Aroclor 1016 and 1260 are routinely spiked, however, other aroclors can be spiked as requested by clients.

DCB and TCX are added as surrogates to each sample and QC to monitor the efficiency of the extraction, the operation of the autosampler, and to monitor retention times throughout the GC run.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed.

See *T-PEST-WI10011* for details on QC acceptance criteria and corrective action.

Appendix I

PCT Analysis (Aroclor 5442, 5432, and 5460)

A. Standards:

PCT-Stocks - Aroclor 5432 (Accustandard T-4325), 5442, and 5460(Accustandard T-460S) purchased as individually ampulated solutions from Accustandard at 35,000ug/L.

MS stock of Aroclor 5442 - Absolute Cat. #71791. 1000ug/mL in Methanol.

Prepare working standards using the reagent module of the LIMS as a guide.

1. In the reagents module, first enter the reagents in this section as 'source' reagents.

2. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing or create a new standard if the working standard has not yet been prepared in TALS.

3. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The working standards have an expiration date of 6 months.

4. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level.

5. The scheme for preparing the matrix and surrogate spiking solutions used in the extraction process are listed below. The MS and SS working solutions are stored at <-10° C.

Standard Name	Parent Solution	Aliquot (mL)	Final Volume (mL)	Solvent	Description
MS	5422 MS Stock	0.625	125	Acetone or methanol	PCT Water Spike
SS	SS Stock	3	2000	Acetone or methanol	PCB surrogate

B. GC Chromatographic Conditions

Detector: ECD
Detector temp: 300°C
Oven Temp: 110°C to 250°C at 40°C/min, 280ºC to 330°C at 30°C/min, hold 9 min.
Carrier: Hydrogen at 5.0 mL/min
Makeup gas: N2 at 80mL/min or equivalent
Injection size: 1-uL, direct injection
Injection temp: 225°C

The conditions listed serve as a guideline only and are typically the optimum operating conditions. The analyst may make any changes to the chromatographic conditions to improve the speed of analysis, linearity, sensitivity, and/or improve separation if initial and continuing calibration criteria and quality assurance criteria listed within this analysis document are met.

C. Sequence

1. Conditioner
2. IBLK
3. EVAL
4. AR161
5. AR162
6. AR163
7. AR164
8. AR165
9. AR166
10. AR481
11. AR482
12. AR483
13. AR484
14. AR485
15. AR486
16. AR541
17. AR542
18 AR543
19. AR544
20. AR545
21. AR546
22. PCT1
23. PCT2
24. PCT3
25. PCT4
26. PCT5
27. A4421
28. A4422
29. A4423
30. A4424
31. A4425
32. AR214
33. AR324
34. AR423
35. AR624
36. AR684
37. MD16
38 MDPCTX
39. IC16
40. IC48
41. IC54
42. Blank
43. LCS
44. 1234567

45. 1234567MS
46. 1234567MSD
47-61. Continue running samples
62. AR164
63. PCT3
64. A4424
65. IBLK

10007 Preventative and Corrective GC Maintenance
10011 QC Data Acceptability and Corrective Action
10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10920 Separatory Funnel Extraction by Method 3510C, 608, or 608.3 for Pesticides and PCBs in a Wastewater
9847 Common Equations Used During Chromatographic Analyses
9954 Interpretation of Chromatographic Data

End of document

Version history

Version	Approval	Revision information	
6	29.MAR.2018		
7	17.MAR.2021		
8	22.SEP.2021		

eurofins	Always check on-line for validity. **Standards Management in the High Resolution Mass Spectrometry Laboratory**	Level: **Work Instruction**
Document number: **T-HRMS-WI9446**		
Old Reference: **1-P-QM-PRO-9018270 SOP-SP-005**		
Version: **10**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **19-MAY-2022**	Document users: **5_EUUSLA_HRMS_Manager, 6_EUUSLA_HRMS_Analyst, 6_EUUSLA_HRMS_Data_Reviewers, 6_EUUSLA_HRMS_Management_Team, 6_EUUSLA_HRMS_Sample_Prep**	Responsible: **5_EUUSLA_HRMS_Manager**

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Revision Log
Reference
Purpose
Scope
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Procedure

Revision Log

Revision: 10		**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Header	Enhancement	Updated company name to Eurofins Lancaster Laboratories Environment Testing, LLC
Procedure 3.C.	Clarification	Removed reference to 5TDWD column performance solution. This solution is no longer used.
Procedure E	Reflects current practice	Removed Procedure E. This section described solutions used in the WHO-12 and Marker PCB analysis that is no longer performed as a separate procedure.
Procedure	Formatting	Previous SOP revision had a Procedure F which referenced Table 6, this is the new Procedure E and now references *Table 5*.
Table 5 and 6	Reflects current practice	Removed *Table 5*. Renamed Table 6 to *Table 5* and edited section headings to align with current table name.

Revision:	9	**Effective date:** 08-JUN-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure	Added Procedure F	Procedure F used for combined PCDD+F and PCB analysis.
Table 6	Reflects current practice	Added Table 6 for combined PCDD+F and PCB analysis

Reference

1. EPA Method 1613B, Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS, October, 1994.

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8290A, Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS), February, 2007, Rev 1.

3. EPA Method 1668 Revision C, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS, April 2010.

4. EPA Method 1668 Revision A, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS, August 2007.

5. *Chemical Hygiene Plan*, current version

Purpose

This SOP provides a centralized reference for all standards that are used in support of analytical operations in the high resolution mass spectrometry laboratory (HRMS).

Scope

Reference information includes identification of standard vendors, catalog numbers, instructions on how to prepare standard mixtures, and document standard composition using the TALS Reagent database application. Types of standards include initial calibration standards, continuing calibration standards, chromatographic resolution performance standards, retention time window standards, matrix spike solutions, ongoing precision and recovery spiking solutions, labeled compound spike solutions and cleanup standard spike solutions.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this SOP has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. Waste streams have been defined to handle dioxin and PCB waste from both

sample processing and expired standards.

Solvents that are used as a cleaning rinse for syringes and volumetric glassware is disposed of according to solvent disposal procedures outlined in the *Chemical Hygiene Plan*.

Personnel Training and Qualifications

Personnel preparing standard solutions must have documentation of reading, understanding and agreeing to follow this version of the SOP.

Procedure

Standards are prepared using calibrated syringes with volumes ranging from 10 µL to 1 mL. Class A volumetric flasks containing 1.00-mL through 25.0-mL are typically used to create solutions at desired concentrations. Syringes are permanently labeled with designations and are dedicated to be used with specified types of standard solutions: native solutions, labeled solutions, solvent only, and internal standards. The concentrated solution is injected below the surface of the diluting solvent in the volumetric flask prior to filling the volumetric to its calibration mark. Syringes should not be used to measure less than 20 % of their capacity. Measurement of volumes less than 5 µL of should be avoided in routine production operations. Syringes must be rinsed with clean solvent (normally hexane) prior to use and immediately after use.

Source and intermediate standard solutions are stored in labeled amber screw-top glass vials with fluoropolymer lined caps at room temperature in the dark. *Table 1* lists all current source reagents in use along with the vendor name, vendor catalog number, TALS Reagent Name, and description of the standard. *Table 2* lists the concentration of each component of all source reagents.

Expiration dates are managed through the TALS Reagent database. Source solutions transferred from sealed glass ampules to screw-top vials are given expiration dates of 1 year from opening date, or the expiration date provided by the vendor, whichever occurs sooner. Intermediate solutions are given an expiration date of 1 year from the preparation date, or the earliest expiration date from any stock solution used during preparation. Working native compound spiking solutions, labeled compound spiking solutions, and cleanup standard spiking solutions are given expiration dates up to 1 month from the preparation date.

The TALS Reagent database allows the user to edit final volume and the volume of each solution used to prepare the working standard. The database calculates final concentrations based on the stored concentrations of each spike solution component, volume of each standard used (source and intermediate solutions), and final working solution volume. When final solution volumes are different than the examples provided in this SOP, the final concentration must be reviewed to ensure that it is identical to the concentration documented in this SOP. If any standard is prepared at a different concentration than the solutions described in this SOP the concentration should be clearly documented on the extraction log or analytical sequence spreadsheet.

Working native compound spiking solutions, labeled compound spiking solutions, and cleanup standard spiking solutions are prepared with enough volume to be used for several weeks. The working solutions are stored in 2-mL or 4-mL amber glass screw-top vials in the dark at room temperature. The expiration date assigned to these working solutions should not exceed 4 weeks or exceed the expiration date of any solution used to prepare the working solution.

A. Purchased Standard Source Solutions. See attached *Table 1* for a listing of each purchased stock solution used to support analyses in the High Resolution Mass Spectrometry laboratory. *Table 2* provides the concentration of each compound in the source solutions. Equivalent standards may be substituted, if the listed standards are unavailable.

B. Log purchased standards into the TALS Reagent database system. Select the reagent type SOURCE for purchased mixes. The Reagent database has a predefined set of reagent names, use the "..." button to open the search window and locate the previous entry, open and then copy that previous entry for the new source reagent. Reagent database will then open a dialog box to confirm the new source reagent name. After selecting "ok" an incremented numeric counter assigns the unique name to the new reagent. The predefined reagent name can be overwritten with a manually created name if desired. Use

labels printed through the Reagent database to identify and track standard solutions after transfer from original ampule to storage vial.

Every source reagent must have the certificate of analysis (CoA) scanned and attached to the related documents. It is imperative that the CoA is reviewed prior to attaching to confirm the lot number of the source reagent matches the lot number of the CoA. The expiration date of the source reagent must be compared to the expiration date on the CoA. The expiration date of a source reagent is one year from opened date, or the expiration date of the CoA, whichever occurs first.

C. Preparation of PCDD/PCDF standards.

Refer to attached *Table 3* for the preparation of standards used for the calibration and analysis of PCDD/PCDF compounds. The volumes listed in *Table 3* are examples of typical preparation volume. Note that these volumes can be adjusted as needed to meet the needs of current projects. The final concentration of these standards is also listed in *Table 3*.

PCDD/PCDF column performance and retention time window analysis is performed using the TDTFWD stock mix without dilution.

1. Initial Calibration PCDD/PCDF Standards.

   a. *Table 3*.1.a. provides examples of the intermediate solution preparations for internal standards, cleanup standard, and 2378-substituted native PCDD/PCDFs as prepared from stocks. These intermediate solutions are used in preparation of initial calibration standards as well as working solutions.

   b. *Table 3*.1.b provides examples for the preparation of initial calibration solutions from source and intermediate reagents.

2. Continuing Calibration PCDD/PCDF Standards

   The calibration standard - HRM_DF_CS3_##### – is used as a continuing calibration standard. VER is generally the assigned designation in the EPA methods. Since the CS3 standard is used every 12 hours it is desirable to prepare a larger volume of this standard. For example, CS3 can be prepared as shown in *Table 3*.2.

3. PCDD/PCDF Native Compound spiking solution

   The native compound spiking solution is used in the QC batch OPR sample as a laboratory control sample, and also to spike field samples to prepare matrix spike/ matrix spike duplicates for HRMS analysis if requested by the client. The native compound spiking solutions are referred to as precision and recovery (PAR) standards. Serial dilution of the native stock solution can yield working solutions suitable for detection limit studies. Examples of the PAR solution used for batch QC, matrix spike/ matrix spike duplicate, and method reporting limit (MRL) QC are provided in *Table 3*.3.

4. PCDD/PCDF Labeled Compound spiking solution

   The labeled compound spiking solution is prepared from the purchased stock standard solution. The preparation of this solution can be scaled to generate larger volumes as required by extraction batching. *Table 3*.4 provides an example of a typical preparation of this working standard.

5. PCDD/PCDF Cleanup Standard spiking solution

   Prepare the working cleanup standard spiking solution from the primary intermediate solution described in *Table 3*.1.a. Volumes can be scaled to generate larger volumes of spiking solution as required by extraction batching. *Table 3*.5 provides an example of a typical preparation of this working standard.

6. PCDD/PCDF Injection Internal Standard spiking solution

The internal standard solution is used to spike the final sample extract immediately prior to injection on the HRMS system. *Table 3*.6 provides an example preparation of the internal standard solution.

7. PCDD/PCDF Second Source Standard

   A standard from a second source is needed to confirm the concentrations of the initial calibration standards. The second source standard is purchased from a different vendor or from a different lot number than that used for the initial calibration. *Table 3*.7 provides two examples of second source WORKING solutions.

D. Preparation of 209 Congener PCB standards.

Refer to attached *Table 4* for the preparation of standards used for the calibration and analysis of PCB congeners by method 1668. The volumes listed in *Table 4* are examples of typical preparation volume. Note that these volumes can be adjusted as needed to meet the needs of current projects. The final concentration of standards that support PCB congener analysis are listed in *Table 4*.11.

1. *Table 4*.1 provides example preparations for the intermediate standards, using purchased stocks, that are needed for the preparation of Initial Calibration standards described in section D.2 of this SOP.

2. Initial calibration for PCB congener analysis by method 1668, revisions A and C, utilizes a multi-point calibration of all 209 congeners and includes 14 additional labeled compounds to complement the labeled toxic and level of chlorination compounds identified in the EPA method. The initial calibration standards are prepared from both source and intermediate reagents. *Table 4*.2 provides the example preparation of these standards.

   Note: The low level calibration standard is prepared at 0.5 ng/mL to meet Delaware River Basin Commission (DRBC) requirements for PCB congeners by EPA method 1668A.

3. Continuing Calibration 209 Congener PCB standard – HRM_209_CS3_##### – is used as a continuing calibration standard for routine PCB congener analysis. Since the CS3 standard is used every 12 hours, it is desirable to prepare a larger volume of this standard. For example, CS3 can be prepared as shown in *Table 4*.3.

4. 1668 Secondary source standard (ICV) is prepared to meet the requirements of EPA method 1668 for the Tox/LOC congeners. *Table 4*.4 provides the example preparation of this standard.

5. 1668 Precision and recovery (PAR) working solutions

   a. The native compound PAR spike solution is used to generate batch QC samples for matrix spike/ matrix spike duplicate analysis, and monitoring ongoing performance and recovery (OPR). This solution contains only the Tox/LOC congeners. *Table 4*.5 provides an example preparation of this solution from stock. The preparation of this solution can be scaled to generate larger volumes as required by extraction batching.

   b. To satisfy testing in accordance with PALA certification the ongoing precision and recovery standard must include the 41 PCB congeners listed within domain 107. *Table 4*.5 provides the example preparation for this Canada specific PAR solution.

   c. When performing detection limit studies the full set of 209 PCB congeners is required. Examples of solutions containing the full set of 209 native PCB congeners are provided in *Table 4*.6. These reagents can be scaled as needed to provide sufficient volume to perform detection limit studies.

6. 1668 Labeled compound spiking solution. This working solution is added to every sample prior to extraction. The example provided in *Table 4*.7 can be scaled to generate larger volumes of spiking solution as required by extraction batching.

7. 1668 Internal standard spiking solution is used to spike the final sample extract immediately prior to injection on the HRMS system. The typical preparation of this solution is provided in *Table 4*.8.

8. 1668 Cleanup standard spiking solution is prepared from the purchased stock solution. Volumes can be scaled to generate larger volumes of spiking solution as required by extraction batching. *Table 4*.9 provides an example preparation of the cleanup standard solution.

9. GPC performance check solution is prepared in Dept 4026. Small aliquots are generally available to Dept 4037 for use in the PCB cleanup process. *Table 4*.10 provides an example of the preparation from stock solution.

E. Preparation of combined PCDD+F and PCB standards for food and feed testing.

The purchased stock standards required for analysis of dioxins, furans, dioxin-like (WHO-12) and indicator (Marker) PCBs are listed in *Table 1* and the concentrations of the purchased stock standards are listed in *Table 2*. These solutions are used in the 1613B_1668_MOD analysis and within the department are referred to as combined food and feed standards.

Refer to attached *Table 5* for the preparation of standards used for the calibration and analysis of the PCDD+F and PCB. The volumes listed in *Table 5* are examples of typical solution preparations. Note that these volumes can be adjusted as needed to meet the needs of current projects. The final concentration of these solutions is provided in *Table 5*.7 and *Table 5*.8.

1. 1613B_1668_MOD Initial Calibration standards – *Table 5*.1.a provides examples of the intermediate solutions, prepared from source reagents, required to prepare the initial calibration standards. *Table 5*.1.b provides the examples for initial calibration standard solutions.

2. The calibration standard - HRM_FF_CS3_##### - is used as a continuing calibration standard. Since the CS3 standard is used every 12 hours it is desirable to prepare a larger volume of this standard. For example, CS3 can be prepared as shown in *Table 5*.2.

3. 1613B_1668_MOD Native Compound spiking solution is used to generate batch QC samples for matrix spike/ matrix spike duplicate analysis, and monitoring ongoing performance and recovery (OPR). Serial dilution of the native stock and intermediate solutions can yield working solutions suitable for detection limit studies. Volumes can be scaled to meet the needs of current projects. *Table 5*.3 provides an example of a typical PAR working solution.

4. 1613B_1668_MOD Labeled Compound spiking solution is prepared from the purchased stock standard solution. The preparation of this solution can be scaled to generate larger volumes as required by extraction batching. *Table 5*.4 provides an example of a typical preparation of this working standard.

5. 1613B_1668_MOD Cleanup Standard spiking solution is prepared from the purchased stock solution. The preparation of this solution can be scaled to generate larger volumes of spiking solution as required by extraction batching. *Table 5*.5 provides an example of a typical preparation of this working standard.

6. 1613B_1668_MOD Injection Internal Standard spiking solution is used to spike the final sample extract immediately prior to injection on the HRMS system. An example preparation of the internal spiking solution is provided in *Table 5*.6.

Attachment:
T-HRMS-WI9446 Table 1 (.docx)
T-HRMS-WI9446 Table 2 (.docx)
T-HRMS-WI9446 Table 3 (.docx)
T-HRMS-WI9446 Table 4 (.docx)
T-HRMS-WI9446 Table 5 (.docx)

Attachment: T-HRMS-WI9446 Table 1 (docx)
Attachment: T-HRMS-WI9446 Table 2 (docx)
Attachment: T-HRMS-WI9446 Table 3 (docx)
Attachment: T-HRMS-WI9446 Table 4 (docx)
Attachment: T-HRMS-WI9446 Table 5 (docx)

End of document

Version history

Version	Approval	Revision information	
8	11.FEB.2021		
9	08.JUN.2021		
10	19.MAY.2022		

eurofins	Always check on-line for validity.	Level:
Document number: **T-HRMS-WI9476**	**Determination of Tetra- Through Octa- Chlorinated Dioxins and Furans in water/solid/food/feed samples using HRGC/HRMS by EPA 1613B or SW-846 Method 8290A**	**Work Instruction**
Old Reference: **1-P-QM-WI-9015119**		
Version: **16**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **21-JUL-2022**	Document users: **5_EUUSLA_HRMS_Manager, 6_EUUSLA_HRMS_Analyst, 6_EUUSLA_HRMS_Data_Reviewers, 6_EUUSLA_HRMS_Management_Team**	Responsible: **5_EUUSLA_HRMS_Manager**

A redacted version of this SOP is available in G-DC-FRM23907 due to the proprietary nature of its contents.

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Revision Log
Reference
Cross Reference
Purpose
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision: 16		**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Header	Enhancement	Updated company name to be Eurofins Lancaster Laboratories Environment Testing, LLC
Cross Reference	Enhancement	Add *G-DC-FRM23907*
Sample Collection, Preservation, and Handling	Clarification	Updated to use standardized wording.
Apparatus and Equipment	Reflects current practice	Updated instrument software to current versions
Reagents and Standards	Reflects current practice	Updated documentation of COA in LIMS Reagent
Reagents and Standards	Reflects current practice	Supplier change for Nonane solvent. Acros Organics is now sold under Thermo Fisher Scientific branding.
Reagents and Standards	Reflects current practice	Removed 5TDWD solution, exclusively using TDTFWD
Procedure	Clarification	Replaced DB-5ms column information with ZB-Dioxin details. ZB-Dioxin is now the primary column in use. DB-5ms could still be used if needed so this information is included in current SOP revision.
Procedure 7	Enhancement	Added details for final extract concentration and dilutions.

Revision:	16	**Effective date:** This version
Section	**Justification**	**Changes**
Procedure 8	Clarification	Where poly-chlorinated diphenyl ether interference is suspected the corresponding dibenzofuran signal is reported as non-detect.
Attachment 2	Enhancement	Added example mass descriptor when using FC-43 reference gas.
Attachment 3	Enhancement	Updated MID time windows example to more closely match the windows for ZB-Dioxin column.

Revision:	15	**Effective date:** 30-JUL-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout document	Reflect current practice	Replace T-HRMS-WI9433 with *QA-SOP11186*
Throughout Document	Reflects current practice	Added ZB-Dioxin GC column and the chromatographic requirements of this column.
Throughout Document	Clarification	The TDTFWD standard is used as a Windows Defining Mix (WDM). Prior to TALS the TDTFWD was called chromatographic performance standard (CPS). In TALS this is always referred to as WDM. Throughout the document "CPS" was replaced by "WDM" and additional verbiage added to SOP as needed to clarify the purpose of this standard.
Cross Reference/scope	Enhancement	Add reference to *T-HRMS-WI9487* and *T-HRMS-WI9489*
Reagents and Standards	Reflects current practice	Added reference gas FC-43 and removed expiration date of PFK.
Reagents and Standards	Reflects current practice	Added Tetradecane solvent
Reagents and Standards	Clarification	Added acronyms for cleanup standard and windows defining mix that are used throughout document.
Procedure 1.a. and 2.b.	Reflects current practice	Added FC-43 as an alternative reference gas.
Procedure 7.c. and 10	Reflects current practice	Revised sections to address changes in procedure for data processing and review in TALS.
Table 1	Reflect current practice	CRS concentration is 100 in all levels. Updated table entry.
QA/QC 4.	Clarification	TALS uses QC type LCS instead of OPR. Added verbiage to note these terms are synonymous.
QA/QC	Reflects current practice	TALS qualifiers for EMPC results may vary depending on job formatter and client requirements. Added the possible qualifiers that TALS may assign to an EMPC result.

Reference

1. EPA Method 1613B, Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS, October 1994.

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8290A, Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS), February 2007 Rev 1.

3. Test Methods for Evaluating Solid Wastes, Determinative Chromatographic Separations, SW-846 Method 8000D, Revision 4, July 2014.

4. USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, Criteria and Procedures, Quality Assurance, Fifth Edition. (*G-EXT-FRM23905*)
5. DFS Operating Manual, Revision B - 1195600, February 2011
6. DFS Hardware Manual, Revision F - 1194840, October 2012
7. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-HRMS-WI12032	Separatory Funnel Sample Extraction Procedure for HRMS Analysis in an Aqueous Matrix
T-HRMS-WI9488	Soxhlet Sample Extraction Procedure for HRMS Analysis in a Solid Matrix
T-HRMS-WI9487	Preparation of Aqueous and Solid Samples for Food and Feed Using Microwave or Soxhlet Extraction for Analysis by HRMS
T-HRMS-WI9489	Preparation of Oils and Oleoresins for Food and Feed Analysis by HRMS
T-HRMS-WI19229	DFS HRGC/HRMS Preventative and Corrective Maintenance
T-HRMS-WI9446	Standards Management in the High Resolution Mass Spectrometry Laboratory
G-DC-FRM23907	Redacted SOPs
G-EXT-FRM23905	EPA Drinking Water Manual
QA-QP11176	Manual Integration for ELLE
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11186	Data Entry, Data Review, and Reporting

Purpose

This procedure describes the setup and calibration of a HRGC/HRMS (high resolution capillary column gas chromatography/ high resolution mass spectrometry) system to acquire sample data to identify and quantitate the 2,3,7,8-substituted tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans in various matrices.

Scope

This method is for the determination of tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) in water, soil, sediment, sludge, tissue, and other sample matrices using isotope dilution quantitation by high resolution gas chromatography/high resolution mass spectrometry (HRGC/ HRMS). The preparation and cleanup of the sample extracts is described in *T-HRMS-WI12032*, *T-HRMS-WI9488*, *T-HRMS-WI9487* and *T-HRMS-WI9489*.

For samples designated as EW (regulated drinking water), if 2378-TCDD is detected above the MCL of 30 pg/l, the client must be notified within an hour of when the violation was discovered during instrumental analysis and/or data work up. The PA DEP must also be notified within 24 hours of the finding.

Basic Principles

After sample extraction and cleanup, the extract is concentrated to near dryness. Immediately prior to injection, internal standards are added to each extract, and an aliquot of the extract is injected into the gas chromatograph. The analytes are separated by the GC and detected by a high-resolution (>10,000) mass spectrometer. Two exact m/z's are monitored for each analyte. An individual PCDD/PCDF is identified by comparing the GC retention time and ion abundance ratio of two exact m/z's with the corresponding retention time of an authentic standard and the theoretical or acquired ion-abundance ratio of the two exact m/z's. The non-2,3,7,8 substituted isomers and congeners are identified when retention times and ion-abundance ratios agree within predefined limits. Isomer specificity for 2,3,7,8-TCDD and 2,3,7,8-TCDF is achieved using GC columns that resolve these isomers from the other tetra isomers. Quantitative analysis is performed using selected ion current profile (SICP) areas, in one of three ways:

1. For the native PCDDs/PCDFs, the GC/MS system is calibrated and the concentration of each compound is determined using the isotope dilution technique.
2. For ^{13}C12 labeled compounds, the GC/MS system is calibrated and the concentration of each compound is determined using the internal standard technique.

3. For non-2,3,7,8 substituted isomers and for all isomers at a given level of chlorination (e.g., total TCDD), concentrations are determined using response factors from calibration of the PCDDs/PCDFs at the same level of chlorination.

The quality of the analysis is assured through reproducible calibration and testing of the extraction, cleanup, and GC/MS systems.

Interferences

Method interferences may be caused by impurities in solvents, reagents, and glassware, or other hardware used in the processing of samples. All glassware is solvent rinsed before use and a method blank is performed with each extraction batch to demonstrate that potential contamination of the extraction and analysis system is in control.

Coextracted organics such as polychlorinated biphenyls, polychlorinated diphenyl ethers, polynuclear aromatics, and organochlorine pesticides will also contribute to analysis interference. Post extraction cleanups should eliminate or sufficiently reduce these interferences to allow reliable determination of the PCDDs/PCDFs.

Safety Precautions and Waste Handling

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound and reagent should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means are available such as fume hoods, safety glasses, lab coats, and gloves. See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. Two waste streams have been defined to handle dioxin sample processing waste:

1. Flammable Dioxin Extracts – This waste stream consists of sample extracts in GC vials.

2. Dioxin Samples Waste – This waste stream consists of empty used ampoules, disposable glass pipettes, gloves, spent column adsorbents, post extraction solid sample residue, and other incidental consumable items used in the processing of dioxin/furan samples.

Expired dioxin/furan standards are routinely collected for disposal through a lab pack process and arrangements with the lab waste disposal vendor.

Personnel Training and Qualifications

Education Requirement: Degree in science or relevant experience

Each new chemist trains with an experienced chemist for the first 12 weeks. The first 12 weeks are spent working one-on-one with the trainer. This time may be less if the new chemist has prior experience or relevant analytical chemistry background.

During the training period, the new chemist learns daily maintenance, column and source changing procedures, calibration techniques, data review, and forms generation. He/she is also required to read all relevant SOPs and EPA methods and must have completed and documented Initial Demonstration of Capability (i.e., quad study) that yielded acceptable recoveries. An IDOC that meets the criteria listed below for 1613B is sufficient to show acceptability for 8290A as well. The IDOC and DOC consist of four laboratory control samples (or alternatively, one blind sample for the DOC) that are carried through all steps of the extraction and analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

1613B IDOC is spiked at the LCS concentration and must meet the criteria listed in the EPA 1613B Method Table-6 for the IPR. (see *Attachment 1*)

In addition for the analysis of drinking waters, the IDOC includes the analysis of a 7 replicate MDL study.

Personnel performing this procedure must have documentation of reading, understanding and agreeing to follow this version of the SOP and must have completed and documented annual Demonstration of Capability.

Sample Collection, Preservation, and Handling

Samples are collected in amber glass containers. Aqueous samples are to be tested for residual chlorine and pH upon sample receipt. If residual chlorine is present, add 80 mg of sodium thiosulfate ($Na_2S_2O_3$) per liter of water. If the pH is greater than 9, adjust to pH 7-9 with sulfuric acid. This procedure is performed by the Sample Support Department. Aqueous samples are stored refrigerated at 0 - 6°C, not frozen, in the dark. Solid samples are not preserved and are stored refrigerated at 0 - 6°C, not frozen, in the dark. Tissue samples are frozen (less than or equal to -10°C) if sample preparation does not begin immediately upon receipt at the laboratory.

There are no demonstrated maximum holding times associated with PCDDs/ PCDFs in aqueous, solid, semi-solid, tissues, or other sample matrices. Therefore an internal guidance has been set such that samples are extracted within 30 days of sample collection and analyzed within 40 days of extraction. All non-tissue sample extracts are stored at 0 - 6°C, not frozen, in the dark prior to analysis. If not placed on an instrument for analysis within 24 hours of receipt, tissue sample extracts must be stored in the dark at less than or equal to -10°C.

If stored in the dark at less than or equal to -10°C, sample extracts may be stored for up to one year.

Apparatus and Equipment

1. 10-µL syringe
2. 25-µL syringe
3. Thermo Scientific TRACE GC Ultra gas chromatograph with AS TriPlus Autosampler or equivalent
4. Thermo Scientific Trace 1310 GC with TriPlus RSH Autosampler or equivalent
5. Thermo Scientific DFS high resolution mass spectrometer or equivalent
6. Dell Optiplex 960, Core 2 Duo CPU, 3.2 GB Ram computer system, or equivalent
7. ThermoScientific instrumentation software: Foundation 2.0SP1 build 57, Thermo Xcalibur 2.2 SP1 build 48, DFS Instrument Software 2.2.1.720 or current versions
8. Agilent J&W GC Column – DB-5ms, 60 m x 0.25 mm ID x 0.25 µm film thickness, part number 122-5562, or equivalent
9. Agilent J&W GC Column - DB-Dioxin, 60 m x 0.25 mm ID x 0.20 µm film thickness, part number 122-2462, or equivalent
10. Phenomenex GC Column - ZB-Dioxin, 60 m x 0.25 mm ID x 0.20 µm film thickness, part number 7KG-G045-10, or equivalent

Reagents and Standards

All stocks and standards prepared from vendor supplied ampoules are stored in the dark at room temperature in amber screw-cap vials. See *T-HRMS-WI9446* regarding preparation of working solutions.

Purchased standard stock solutions are supplied with a Certificate of Analysis/Documentation package that describes the mixture compounds and their concentrations. This standard documentation is scanned to create a .pdf and attached to each new stock solution created in LIMS Reagent.

When standard solutions are purchased as solutions, or mixtures with certification to their purity, concentration, and authenticity, or prepared from materials of known purity and composition; and the chemical purity is 98% or greater, the weight may be used without correction to compute the concentration of the standard.

Expiration dates are managed through the LIMS reagent database. Stock solutions transferred from sealed glass ampoules to screw-top vials are given expiration dates of 1 year from opening date, or the expiration date provided by the vendor, whichever occurs sooner. Intermediate solutions are given an expiration date of 1 year from the preparation date, or the earliest expiration date from any stock solution used during preparation. Working native compound spiking solutions, labeled compound spiking solutions, and cleanup standard spiking solutions are given expiration dates of 1 month. Working solutions may be re-certified if they are not consumed by operations prior to expiration date.

1. Perfluorokerosene (PFK) Super high boiling, TCI part number P1061 or equivalent. Store at room temperature in amber glass. Reference gasses are pure and stable liquids at room temperature, expiration dates are not applicable to this material.
2. Perfluorotributylamine (FC-43) Calibration Compound, Scientific Instrument Services (SIS) part number FC4335 or equivalent. Store at room temperature in amber glass. Reference gasses are pure and stable liquids at room temperature, expiration dates are not applicable to this material.
3. Nonane, 99%, Thermo Fisher Scientific AC129115000 (formerly Acros Organics) or equivalent. Store at room temperature for up to 1 year.
4. Tetradecane, >= 99%, Aldrich no. 172456-100G or equivalent. Store at room temperature for up to 1 year.
5. Internal Standard Spiking Solution – The following stock solutions (or equivalent) from Wellington Laboratories are required:
    a. MDD-1234 - 1,2,3,4-tetrachloro[$^{13}C_{12}$]dibenzo-*p*-dioxin, 50 µg/mL, store at room temperature in the dark until opened.
    b. MDD-123468 – 1,2,3,4,6,8-hexachloro[$^{13}C_{12}$]dibenzo-*p*-dioxin, 50 µg/mL, store at room temperature in the dark until opened.
6. Calibration and Verification Solutions – The following stock solutions (or equivalent) from Wellington Laboratories are required:
    a. EPA-1613STOCK – 17 native PCDD/PCDF compounds
    b. DF-LCS-C – 17 $^{13}C_{12}$ labeled PCDD/PCDF compounds
7. Cleanup Standard Spiking Solution (CRS) – The following stock solution (or equivalent) from Wellington Laboratories is required:

a. MDD-1278 – 1,2,7,8-tetrachloro[$^{13}C_{12}$]dibenzo-*p*-dioxin, 50 µg/mL, store at room temperature in the dark until opened.

8. Additional Verification and Test Mixtures, Wellington Laboratories, see T-SSG-WI9446

   a. TDTFWD - window defining and GC resolution verification mixture for three columns (WDM).

9. Secondary source calibration verification standard (ICV) - The following stock solution is acquired from Cambridge Isotope Laboratory:

   a. EDF-7999-10x – Method 1613 PAR stock solution, 17 native PCDD/PCDF compounds

Calibration

Initial Calibration: In general, CSL, CS1, CS2, CS3, CS4, and CS5 are included in the initial calibration.

For Method 1613B: If the %RSD for the response factors is < 20% for the native compounds and <35% for the labeled compounds, the average response factor can be used. If these requirements cannot be met corrective action must be taken until the %RSD criteria are met.

For Method 8290A: The %RSD for both native and labeled compounds must be less than or equal to 20% to use the average response factor. Curve fits are not allowed.

Routine Calibration (CPS & VER): A GC column performance standard (CPS) and calibration verification (VER) standard are analyzed every 12 hours. See procedure 6 and QA/QC section 3 for acceptance criteria.

For Method 8290A: A calibration verification (VER) is also required at the end of each 12-hour shift.

Procedure

The preventive and corrective maintenance schedules and procedures associated with the Trace Ultra gas chromatograph and DFS mass spectrometer are outlined in *T-HRMS-WI19229*.

1. DFS mass calibration and tuning

   a. Tune and calibrate the DFS such that mass resolution is >10,000 (10% valley) and the mass deviation between exact m/z and the theoretical m/z is less than 5 ppm. Perform the Resolution Check Procedure to document that the mass resolution of FC43 m/z 313.9834 (PFK m/z 304.9819) is >10,000 and mass deviation is less than 5 ppm.

   b. The mass resolution check is performed at the beginning and end of every 12 hour shift. Mass resolution is also evaluated on the lock mass of each MID during analysis. The resolution check routine documents mass resolution and exact m/z's of at least three reference peaks covering the range of each descriptor. The lock mass resolution for each descriptor must be >10,000.

   NOTE: Masses listed in EPA method 1613B and 8290A include the mass of an electron in the fragment mass. In setting up the DFS, all exact masses configured in the system use masses calculated with the mass of an electron (0.000548u) subtracted from fragment mass.

2. MID descriptors

   a. See Attachment 2 for the MID descriptors that are used for the analysis of the tetra- through octa-chlorinated PCDD/PCDFs:

   b. The resolution check procedure documents lock mass resolution and cali mass resolution for each descriptor. The procedure also documents mass resolution for all reference gas masses listed on the FC43.lua (or PFK.lua) file that exist within the mass range between lock and cali masses for each mass descriptor. At a minimum, the mass resolution of three reference gas masses is documented for each MID.

   c. MID time windows are established by the acquisition of the windows defining mix TDTFWD standard (WDM). MID start and end times must be set to allow the determination of the first and last eluting compounds in each homologue series of compounds. See *Attachment 3* for an example of the MID time windows.

3. Gas chromatographic conditions – Trace GC Ultra or Trace 1310

   a. Column – ZB-Dioxin 60 meter x 0.25 mm ID x 0.20 µm film (or DB-5ms 60 meter x 0.25 mm ID x 0.25 µm film)

   b. Injector - Split/Splitless in splitless mode. Injector temperature 270°C with vacuum compensated constant carrier flow, splitless time of 1.20 min, and split flow of 70 ml/min.

   c. Carrier Gas - Helium at 1.0 ml/min, constant flow mode.

   d. Transfer line temperature - 270°C

e. Chromatographic conditions may be adjusted to optimize retention times and attain chromatographic resolution specifications:

(1) 2,3,7,8-TCDD must be resolved from 1,2,3,9-TCDD with a % valley < 25%.

(2) The absolute retention time for $^{13}C_{12}$-1234-TCDD must be >25 minutes.

(3) When ZB-Dioxin GC Column is used 2,3,7,8-TCDF must be resolved from 2,3,4,8-TCDF with a % valley <25%.

f. Example of GC temperature program for ZB-Dioxin column

(1) Initial Temp = 170°C, hold time 2.0 minutes.

(2) Ramp 1 - 20°C/min to 220°C, hold time 15 minutes.

(3) Ramp 2 - 5°C/min to 235°C, hold time 7 minutes.

(4) Ramp 3 - 8°C/min to 320°C, hold time 5 minutes.

4. Initial Calibration

a. The Xcalibur Sequence Setup application is used to create a sequence of automated injections of initial calibration standards. In general, CSL, CS1, CS2, CS3, CS4, and CS5 are included in the initial calibration. The EPA 1613B calibration levels cover a wider calibration range when compared to the calibration levels listed in EPA 8290A and so the EPA 1613B calibration levels are used as the default levels. The concentration of the calibration standards are listed in *Table 1*. Standards that vary in concentration from these mixtures can be used if specific project requirements exist.

b. Prior to the start of initial calibration analysis, the Resolution Check procedure is used to document the HRMS system meets the >10,000 mass resolution requirement.

c. Chromatographic resolution is documented by injecting the TDTFWD standard (WDM).

(1) 2,3,7,8-TCDD chromatographic resolution must be <25%. 2,3,7,8-TCDF chromatographic resolution must also be <25% when using the ZB-Dioxin column

(2) The TDTFWD standard is also used to document that MID windows allow the determination of the first and last eluting compounds in each homologue series of compounds.

d. Calibration standards are analyzed after the HRGC/HRMS has met mass resolution and chromatographic resolution requirements. Calibration acceptance criteria are as follows:

(1) Ion abundance ratios must be within ±15% of the theoretical ion abundance ratio. *Table 2* lists the acceptable ion ratio criteria.

(2) Signal-to-noise ratio for all analytes must be >10.

(3) Retention Times

For Method 1613B the following retention criteria must be met:

- The absolute retention time for $^{13}C_{12}$-1234-TCDD must be > 25 minutes.

- Absolute retention times of $^{13}C_{12}$-1234-TCDD must be within ±15 seconds of the retention time established in the ICAL or the RT established following column maintenance.

- Relative retention times must fall within the limits listed in *Table 3*.

-The quant mass and ratio mass of a given compound must maximize within ±2 seconds of each other.

For Method 8290A:

- Native compounds must elute within -1 to +3 seconds of their labeled analog.

-The quant mass and ratio mass of a given compound must maximize within +2 seconds of each other.

e. %RSD Criteria:

(1) For Method 1613B if the %RSD for the response factors is <20% for the native compounds and <35% for the labeled compounds, the average response factor can be used. Otherwise, corrective actions must be taken until these criteria can be met.

(2) For Method 8290A the %RSD for both native and labeled compounds must be < 20% to use the average response factor. Curve fits are not allowed.

5. An ICV standard is prepared from secondary source stock standards at the same concentration as the CS3 calibration level and is analyzed following calibration, prior to the analysis of samples. The ICV must meet all criteria listed above in 4.d and the recovery of native compounds should be < ±20% of the specified amount.

6. Continuing calibration and verification of system performance

   a. The windows defining mix (WDM) standard is analyzed prior to the start of sample acquisition to confirm that the chromatographic windows for each homologue series have not shifted outside of the MID windows.

   b. The WDM standard is also used to confirm that the peak valley between 1,2,3,9-TCDD and 2,3,7,8-TCDD as well as the valley between 2,3,7,8-TCDF and 2,3,4,8-TCDF is less than 25%. If this requirement is not satisfied, system chromatographic parameters must be adjusted until the <25% criteria is satisfied so that sample analyses can continue.

   c. The CS3 standard is analyzed as the EPA 1613B VER standard, or the 8290A HRCC-3 standard.

   d. After the VER standard data acquisition is complete, process the data according to *QA-SOP11186*. The continuing calibration standard must satisfy the detection requirements for calibration standards (Procedure 4.d.) as well as the criteria stated in QA/QC section 3.

7. Sample data acquisition

   a. Water and solid samples are prepared for high resolution mass spectrometric analysis using extraction and clean-up procedures documented in this SOP. Prior to injection on the HRGC/HRMS instrument, the extracts are reduced to near dryness with purified nitrogen and reconstituted with 20 µl Tetradecane and 10 µl of Internal Standards Spiking Solution (*T-HRMS-WI9446*). Extracts are then concentrated to evaporate the 10ul of nonane from ISTD to reach a final volume of 20 µl.

   b. Xcalibur sequence setup application is used to create a sequence of automated injections of continuing verification, batch QC, and sample extracts.

   c. After the data has acquired, process the data according to *QA-SOP11186*. Data reduction criteria are outlined in the QA/QC section of this document.

   d. Target compound detections exceeding signal intensity of 5 E7 are outside of the linear range of the detector (detector saturation has occurred) and results may be biased. Where target compounds have exceeded the linear range of the detector a dilution is performed. Extracts are typically not diluted beyond 20x because labeled isotopes are not reliably detected beyond a 20-fold dilution. If the concentration of target analytes greatly exceeds the linear range of the instrument the sample should be re-extracted with sample amount of 1g. Up to 20-fold dilution may be performed on the re-extracted sample. Dilution of extracts typically results in ion abundance ratio failures for the labeled compounds. The addition of labeled compound standard during the dilution process introduces significant bias in final results and is not allowed. Therefore, it is preferable to add higher concentration of labeled isotopes prior to extraction if samples are expected to contain very high levels of target compounds. Samples that even after dilution of the 1 g extract are still exceeding the linear range of the detector must be reviewed by a Supervisor prior to reporting.

      Where detector saturation has not occurred, but the result is above the calibration range, dilutions can be performed to bring the response into the calibration range. Data is reviewed on a case by case basis to determine if re-extraction at a reduced volume is necessary.

   e. Minimum reporting limits are listed in *Table 6*.

8. Determination of Poly-chlorinated Diphenyl Ether interference

   Peaks and peak areas are examined using the Poly-chlorinated Diphenyl Ether trace chromatogram. If a significant Poly-chlorinated Diphenyl Ether peak exists at the same retention time as one of the dioxin/furan compounds, further evaluation is done.

   a. The Quant Mass (QM) area of the dioxin/furan is compared to the area of the Poly-chlorinated Diphenyl Ether peak area in order to determine if Poly-Chlorinated Diphenyl Ether is contributing to the dioxin/furan reported concentration.

   b. Determination of the contribution of Poly-chlorinated Diphenyl Ether is calculated by:

      (Poly-chlorinated Diphenyl Ether area/Target compound area) * 100.

   c. If the result of the calculation is greater than 20%, i.e., showing that Poly-chlorinated Diphenyl Ether is contributing more than 20% of the reported result, then a qualifying comment is added to the analysis report and the Dibenzofuran is reported as non-detect.

9. Second column confirmation when using DB-5ms as the primary column.

   a. If 2,3,7,8-TCDF is detected above the established LOQ in a sample, a re-analysis is required on a DB-Dioxin (60 m X 0.25 um X 0.25 mm)or equivalent confirmatory column. The process for calibration and analysis is similar to that used for the

DB-5ms column. Specific differences are listed in the following three items. If a detection of 2,3,7,8-TCDF is made on the ZB-Dioxin column no confirmatory analysis is required.

b. GC Conditions for confirmation

(1) Column – DB-Dioxin 60 meter x 0.25 mm ID x 0.25 µm film

(2) Injector – Split/Splitless in splitless mode. Injector temperature 260°C with vacuum compensated constant carrier flow, splitless time of 1.20 min, and split flow of 70 mL/min.

(3) Carrier Gas – Helium at 1.4 mL/min, constant flow mode.

(4) Transfer line temperature - 260°C

(5) Chromatographic conditions may be adjusted to optimize retention times and attain chromatographic resolution specifications:

2,3,7,8-TCDF must be resolved from 2,3,4,7-TCDF (DB-Dioxin) with a % valley < 25%.

(6) Example of GC temperature program

Initial Temp = 140°C, hold time 0.2 minutes.

Ramp 1 - 30°C/min to 230°C, hold time 28 minutes.

Ramp 2 - 20°C/min to 270°C, hold time 25 minutes.

c. Confirmation compound list

Method and client requirements will dictate what compounds must be confirmed on a second GC column. Typically, only 2378-TCDF will be confirmed. However, the system is routinely calibrated to perform confirmation analysis for 2378-TCDF, 23478-PeCDF, 234678-HxCDF, 123798-HxCDF, 12378-PeCDF, 123478-HxCDF, and 123678-HxCDF.

d. MID descriptors for confirmation analysis

(1) See *Attachment 4* for confirmation analysis MID Descriptors.

(2) See *Attachment 5* for confirmation analysis MID time window example.

10. Data Reporting

Once the data has been processed and reviewed, it is uploaded and verified in the Analyst Desktop database. The data reviewer double checks the estimated detection limit (EDL) against the limit of quantitation (LOQ) to ensure that the EDL < LOQ. An automated process also exists that alerts the data reviewer if the EDL > LOQ. If alerted, the LOQ is raised to match the EDL prior to the release of the sample results.

Calculations

1. The response factors (RF) are calculated by TargetQuan for the quantitation of PCDDs/PCDFs using the following formula:

$$RF = (SUMA * SPA_{is}) / (SUMA_{is} * SPA)$$

Where:

SUMA = sum of area of Quan Mass + area of Ratio Mass 1

SPA_{is} = specified amount of internal standard (ng/mL)

$SUMA_{is}$ = sum of area of Quan Mass + Ratio Mass 1 for internal standard

SPA = specified amount of standard (ng/mL)

2. The concentration of the native PCDDs/PCDFs in the sample are calculated using the TargetQuan software using the following equation:

$$Concentration = ((SUMA * SPA_{is})/(SUMAis * ARFA)) * hSV/hSWT * hDF$$

Where:

SUMA = sum of area of Quan Mass + area of Ratio Mass 1

SPA_{is} = specified amount of internal standard (ng/mL)

$SUMA_{is}$ = sum of area of Quan Mass + Ratio Mass 1 for internal standard

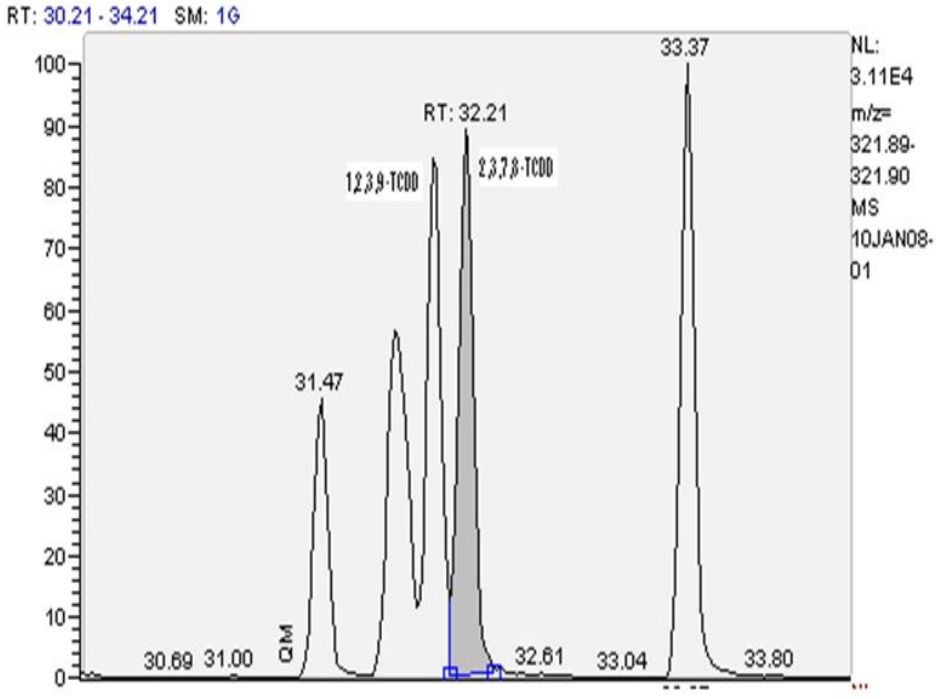
ARFA = actual RF based on area

hSV = final sample volume (µL)

hSWT = initial sample volume for waters (in liters) or initial sample weight for solids (in grams)

hDF = secondary dilution factor of extract.

3. GC resolution of 2,3,7,8-TCDD (DB-5ms and ZB-Dioxin columns) - The peak valley between 2,3,7,8-TCDD and 1,2,3,9-TCDD must be less than 25%. The TDTFWD mix is used to document chromatographic resolution.



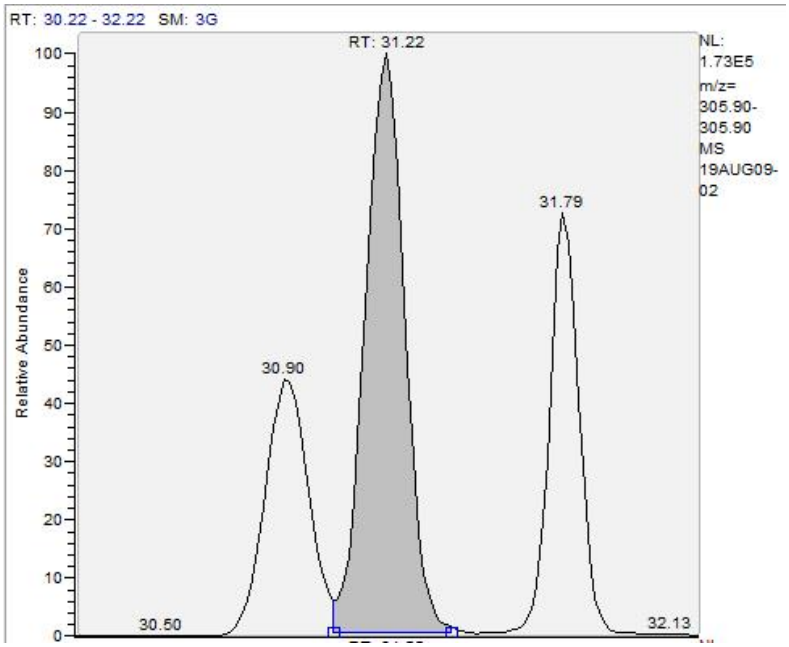
% Valley formula: 100* (QLH)/(QH)

Where:

QLH = Quan Mass left peak height

QH = Quan Mass peak height

4. GC resolution of 2,3,7,8-TCDF - The peak valley between 2,3,7,8-TCDF and 2,3,4,7-TCDF on DB-Dioxin or 2,3,7,8-TCDF and 2,3,4,8-TCDF on ZB-Dioxin column must be less than 25%. The TDTFWD mix is used to document chromatographic resolution.



% Valley formula : 100* (QRH)/(QMH)

Where:

QRH = Quan Mass right height

QMH = Quan Mass height

Statistical Information/Method Performance

The OPR should contain all compounds listed in the method. OPR, MS, labeled compound recoveries and RPD are compared to the limits stored on the LIMS. These limits are specified in the method for 1613B. Method 8290A specifies the limits for the labeled compounds. The native compounds are statistically derived for 8290A. Historical data for MS/Ds, OPRs, and measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

Quality Assurance/Quality Control

The following QA/QC procedures are used to assure that data of known quality are generated using this procedure.

1. Mass Resolution – Mass calibration and tuning of the instrument are performed prior to the start of the analysis. A static resolving power check must be done at the beginning and end of each 12 hour shift.

2. Windows Defining Mix (WDM) is analyzed at the start of every 12 hour shift to document chromatographic resolution of 2,3,7,8-TCDD and 2,3,7,8-TCDF and identify the first and last eluting congeners to establish start and stop times of each mass descriptor.

3. Ongoing/Routine Calibration Verification (VER) Standard: A calibration verification (VER) standard must be analyzed every 12 hours, following the CPS standard and prior to any other acquisitions. Preparation of the VER standard is detailed in *T-HRMS-WI9446*. The VER analyte levels are equivalent to the CS3 ICal standard (see *Table 1*). The continuing calibration (VER) standard must meet all criteria listed in Procedure 4.d as well as the following criteria:

   a. Method 1613B VER recovery limits must be within the limits listed in *Table 4*.

   b. For Method 8290A:

      (1.) The RPDs of the response factors for the native compounds must be < ±20% of the average response factors established during the ICal.

      (2.) The RPDs of the response factors for the labeled compounds must be < ±30% of the average response factors established during the ICal.

      (3.) A Calibration Verification Standard must also be analyzed at the end of each 12-hour tune period. It must meet the criteria in (1) and (2) above. If it does not meet the criteria, the samples since the last passing verification standard must be reinjected with compliant verification standards. Alternatively, if the ending check standard fails by no more than 25% RPD for the native compounds, and no more than 35% RPD for the labeled compounds, then the average RF of the beginning and ending checks can be used to calculate the concentrations of the borderline compounds.

4. Ongoing precision and recovery (OPR) analysis is conducted with every preparation batch (maximum 20 field samples). The OPR is synonymous with a laboratory control sample (LCS). The OPR is analyzed prior to the start of sample analysis. The OPR must meet ion abundance criteria listed in *Table 2* and retention time criteria listed in Procedure 4.d(3). Recovery limits for the OPR are listed in *Table 4*. Samples with a non-compliant OPR may be reported if the OPR recovery is indicative of increased sensitivity and the compound is not detected in the sample.

   Method 8290A lists a fortified blank as optional, but gives no QC limits. We have chosen to include an OPR for Method 8290A and use statistically derived QC limits for the native compounds, the Method 1613B window limits for the CRS, and the 8290A limits for the labeled compounds.

5. Method Blank analysis is performed with every batch of samples (maximum 20 field samples).

   a. The maximum acceptable level of any target PCDD/PCDF or interferent in the method blank is listed in *Table 5*.

   b. Samples associated with a non-compliant method blank are re-extracted. However, the sample data may be reported with a non-compliant method blank if the sample concentration is >10 times that of the method blank or if the compound present in the method blank is not detected in the sample.

   c. For Method 1613B and 8290A, a solvent blank must be analyzed immediately following the analysis of the OPR to prevent carryover into the succeeding sample.

   d. In sequence brackets where no OPR is analyzed, the solvent blank must be analyzed after the continuing calibration standard and before the first sample is injected onto the analytical system to prevent carryover into the succeeding sample.

6. Identification Criteria for Labeled and Non-Labeled Compounds in samples is as follows:

   a. The absolute retention time of $^{13}C_{12}$-1234-TCDD (ISTD) must be >25 minutes.

   b. Absolute retention times of $^{13}C_{12}$-1234-TCDD and $^{13}C_{12}$-123468-HxCDD (ISTDS) must be within +15 seconds of the retention times established in the ICal or within +15 seconds of the retention times established following column maintenance.

   c. Ion ratio requirements:

      (1.) The ion ratios for the $^{13}C_{12}$-labeled compounds must fall within the limits listed in *Table 2*.

      (2.) Non-labeled analytes must have their ion ratios fall within the limits listed in *Table 2* to be considered a positive detection. If all identification criteria are met, save for the mass ratio requirement, than the concentration of the peak will be considered an "Estimated Maximum Possible Concentration" and reported with an appropriate qualifier (I, R, Q qualifiers are used depending on LIMS job formatter and client requirements).

   d. Retention times must meet the criteria listed in Procedure 4.d(3).

   e. Signal-to-Noise:

      (1.) The signal-to-noise ratio of any labeled analyte must be greater than 10.

      (2.) The signal-to-noise ratio of any non-labeled analyte must be greater than 2.5.

   f. The % Recovery of the $^{13}C_{12}$-labeled compounds must fall within the limits indicated in *Table 4*.

7. Minimum reporting limits (MRL) for method 1613B and 8290A are listed in *Table 6*.

   a. For Method 8290A:

      (1.) The quant mass and ratio mass must maximize within ±2 seconds of each other for a compound to be considered a positive detection.

      (2.) Native compounds must elute within -1 to +3 seconds of their labeled analog.

      (3.) Ion ratio requirements:

         a) The ion ratios for the $^{13}C_{12}$-labeled compounds must fall within the limits listed in the Table found under Procedure D.3.A.

         b) Non-labeled analytes must have their ion ratios fall within the limits of the aforementioned table to be considered a positive detection. If all identification criteria are met, save for the mass ratio requirement, then the concentration of the peak will be considered an "Estimated Maximum Possible Concentration" and reported with an appropriate qualifier (I, R, Q qualifiers are used depending on LIMS job formatter and client requirements).

      (4.) Signal-to-Noise ratio requirements:

a) The signal-to-noise ratio of any labeled analyte must be greater than 10.

b) The signal-to-noise ratio of any non-labeled analyte must be greater than 2.5.

b. The percent recovery for all labeled compounds must be between 40% and 135%.

8. For samples analyzed with an 8290A method reference, an LLOQ (Lower Limit of Quantitation) verification will be performed annually for each matrix and on each instrument that performs the analysis. The LLOQ verification will be prepped at 0.5 to 2 times the LOQ and evaluated against the acceptance criteria of +/- 20% of the OPR windows. In addition when using linear fits, the initial calibration must have the percent error calculation performed on all curve fits. Standard levels at or below the LOQ must meet a percent error of +/-50%, standard levels above the LOQ must meet a percent error of +/-30%.

NOTE: Method 8290A does not require the use of a Clean-up and Recovery Standard (CRS). We have chosen to include its use and employ the limits of 35–197% indicated in Method 1613B Table 7.

Attachment:
Attachment 1 - IDOC Requirements (.doc)
Attachment 2 - MID Descriptor examples (.doc)
Attachment 3 - Example of MID time windows (.doc)
Attachment 4 - Confirmation Analysis MID Descriptors (.doc)
Attachment 5 - Confirmation Analysis MID time window example (.doc)
Table 1 - PCDD-PCDF Calibration Standards (.doc)
Table 2 - Theoretical Ion Abundance Ratios and QC Limits (.doc)
Table 3 - 1613B Relative Retention Times (.doc)
Table 4 - Acceptance Criteria for Performance Tests (Recovery Limits) (.doc)
Table 5 - Maximum Acceptable Levels (.doc)
Table 6 - Minimum Reporting Limits (MRL) (.doc)

11176 Manual Integration for ELLE
11186 Data Entry, Data Review, and Reporting
11892 Determining Method Detection Limits and Limits of Quantitation
12032 Separatory Funnel Extraction Procedure for HRMS Analysis in an Aqueous Matrix Using Method 1613B, 8290A, 1668A, and 1668C
19229 DFS HRGC/HRMS Preventative and Corrective Maintenance
23905 EPA Drinking Water Manual
23907 Redacted SOPs
9446 Standards Management in the High Resolution Mass Spectrometry Laboratory
9487 Preparation of Aqueous and Solid Samples for Food and Feed Using Microwave or Soxhlet Extraction for Analysis by HRMS
9488 Soxhlet Extraction Procedure for HRMS Analysis in a Solid Matrix by Methods: 1613B, 8290A, 1668C, and 1668A
9489 Preparation of Oils and Oleoresins for Food and Feed Analysis by HRMS
Attachment: Attachment 1 - IDOC Requirements (doc)
Attachment: Attachment 3 - Example of MID time windows (doc)
Attachment: Attachment 4 - Confirmation Analysis MID Descriptors (doc)
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End of document

Version history

Version	Approval	Revision information	
14	30.JUL.2020		
15	30.JUL.2021		
16	21.JUL.2022		

eurofins	Always check on-line for validity.	Level:
Document number: **T-HRMS-WI9488**	**Soxhlet Extraction Procedure for HRMS Analysis in a Solid Matrix by Methods: 1613B, 8290A, 1668C, and 1668A**	**Work Instruction**
Old Reference: **1-P-QM-WI-9038122**		
Version: **7**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **16-JUN-2022**	Document users: **5_EUUSLA_HRMS_Manager, 6_EUUSLA_HRMS_Analyst, 6_EUUSLA_HRMS_Data_Reviewers, 6_EUUSLA_HRMS_Management_Team, 6_EUUSLA_HRMS_Sample_Prep**	Responsible: **5_EUUSLA_HRMS_Manager**

A redacted version of this SOP is available in G-DC-FRM23907 due to the proprietary nature of its contents.

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Preparation of Glassware
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision:	7	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Header	Enhancement	Updated company name to be Eurofins Lancaster Laboratories Environment Testing, LLC
Cross Reference	Enhancement	Added *G-DC-FRM23907*
Sample Collection, Preservation, and Handling	Clarification	Updated to use standardized wording.

Revision:	06	**Effective date:** 02-DEC-2021
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure/cross reference	Enhancement	Add reference to *T-HRMS-WI39008*

Reference

1. EPA Method 1613B, Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS, October 1994.
2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8290A, Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High Resolution Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS), February 2007 Rev 1.
3. EPA Method 1668C, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS, April 2010.
4. EPA Method 1668 Revision A, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS, August 2007.
5. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
G-DC-FRM23907	Redacted SOPs
S-SS-WI10697	%Moisture Calculation and % Solids Calculation (Gravimetric) by SM 2450 G-1997 and SM 2540 G-2011
T-HRMS-WI9476	Determination of Tetra- Through Octa-Chlorinated Dioxins and Furans in water/solid/food/feed samples using HRGC/HRMS by EPA 1613B or SW-846 8290A
T-HRMS-WI9432	PCB Congeners by Method 1668 HRGC/HRMS in Aqueous and Solid Matrices
T-HRMS-WI12013	Determination of Percentage Lipids in Animal and Marine Tissue using EPA Method 1613B
T-HRMS-WI9446	Standards Management in the High Resolution Mass Spectrometry Laboratory
T-HRMS-WI9485	Glassware Cleaning for HRMS Extractions
T-HRMS-WI39008	HRMS Extract Cleanup Using GPC by Method 3640A

Scope

This method is suitable for the extraction of dioxins/furans and PCBs at ppt (parts per trillion) levels in soil, sediment, and solid matrices. The detection limits and quantitation levels in this method can be dependent on the level of interferences observed in the sample analysis. Refer to the LIMS for the current MDL and LOQ values.

Basic Principles

A 10-g portion of sample to be analyzed is placed into a soxhlet extractor. Isotopically labeled standards are added to each sample to monitor recovery. The sample is extracted with toluene or other suitable solvent. The extract is concentrated using a TurboVap LV concentration workstation for dioxins and furans, and a steambath for PCB congeners and cleaned using various column cleanups.

Interferences

Method interferences may be caused by interfering compounds in the sample matrix, impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware is rinsed with solvent before use and a method blank is performed with each batch of samples to demonstrate that the extraction system is in control.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. Additional precautions to those outlined in the *Chemical Hygiene Plan* are required in the laboratory used to perform the extraction analysis. Waste streams have been defined to handle dioxin and PCB sample processing waste:

A. Flammable Dioxin Extracts – This waste stream consists of sample extracts in GC vials.

B. Dioxin Samples Waste – This waste stream consists of empty used ampoules, disposable glass pipettes, gloves, spent column adsorbents, post extraction solid sample residue, and other incidental consumable items used in the processing of Dioxins/Furans samples.

C. Flammable GC Vials w/PCBs - This waste stream consists of sample extracts in GC vials

D. Samples with PCBs – This waste stream consists samples with PCBs greater than 50 ppm.

Solvents that are used as a secondary cleaning rinse for cleaned glassware is disposed of according to solvent disposal procedures outlined in the *Chemical Hygiene Plan*.

Expired Dioxins/Furans and PCB standards are routinely collected for disposal through a lab pack process and arrangements with the lab waste disposal vendor.

Lab coats are designated for dedicated use in the Dioxins/Furans sample preparation lab. These lab coats are not worn for work in other labs, and lab coats worn for work in other labs are not worn in the Dioxins/Furans sample prep lab.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability.

Initially, each chemist performing the analysis must work with an experienced employee for a period of time until they can independently perform the analysis. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consist of four laboratory control samples (or alternatively a blind sample for the DOC) that are carried through all steps of the procedure and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and the standard deviation. An IDOC that meets the criteria for 1613B is sufficient to show acceptability for 8290A as well. 1613 B IDOC is spiked at the LCS concentration and must meet the criteria listed in the 1613 B Method Table 6 for the IPR. 1668A/C IDOC is spiked at the LCS concentration and must meet the criteria listed in the 1668A/C Method Table 6 for the IPR. The criteria are included in the corresponding analysis SOPs. (See *T-HRMS-WI9432* and *T-HRMS-WI9476*.)

Sample Collection, Preservation, and Handling

Samples are collected in amber glass containers. Specific holding times are not listed in the methods. Therefore an internal guidance has been set such that samples are extracted within 30 days of sample collection and analyzed for dioxins/furans within 45 days of extraction, or analyzed for PCBs within 40 days of extraction. All non-tissue samples are stored in the dark at 0-6°C, not frozen, prior to extraction. All tissue samples are stored in the dark at less than or equal to -10°C prior to extraction. All non-tissue sample extracts are stored at 0-6°C, not frozen, in the dark prior to analysis. If not placed on an instrument for analysis within 24 hours of receipt, tissue sample extracts must be stored in the dark at less than or equal to-10°C.

Apparatus and Equipment

1. Dean Stark Soxhlet Extractor apparatus (SDS) and 500-mL round-bottom flask, Kontes, 585150-0023, or equivalent
2. Glass fiber extraction thimble – Whatman 30x100 Fisher 09-657-1C for soils (Soxtherm: cut to 30mm x 80mm using solvent rinsed scissors), Whatman 43x123, Fisher 09-657-1B for tissues, or equivalent
3. Aluminum foil
4. TurboVap LV Concentration WorkStation, Caliper Life Sciences
5. Recirculating cooler – ThermoFisher Scientific, Thermoflex 2000, or equivalent.
6. Heating mantle – Glascol combo mantle and controller, 100D RX50212, or equivalent
7. Balance – Capable of weighing to 0.001 g and 0.01g
8. Graduated cylinders – Class A, assorted sizes
9. Syringes, Hamilton gastight, assorted sizes
10. Pipettes – Disposable
11. Wash bottles – Teflon
12. Teflon boiling chips, Fisher Scientific, 09-191-20, or equivalent, rinsed with toluene before use
13. Buchner funnel (10 cm)
14. Glass fiber filter paper, type GF/C or 934-AH
15. 2-L filter flask
16. Concentrator tube, 25 mm x 150 mm with 24/40 joint and tapered bottom, Quark Enterprises, QCT-2440, or equivalent.
17. Wooden tongue depressors
18. Column adsorbent preparation tube, Quark Enterprises, QD-100-4550-ROD, Top Rodaviss Jt, 45/50, or equivalent
19. Preparation tube adapter, Quark Enterprises, QA-45-ROD, Adapter #7 Top Internal Thread with Bushing, 45/50 Male Rodaviss Joint, or equivalent
20. 2000 mL solvent reservoir, Quark Enterprises, QCH-8-7, or equivalent
21. 4 liter filter flask, Quark Enterprises, QF-7-4L-4550, or equivalent
22. Tube Furnace with controller, Lindberg Blue M Hinged Tube Furnace, Model HTF55342C, or equivalent
23. Bottle roller mixer, Wheaton, W348924-A, or equivalent
24. Glass bottle, 1 gallon, wide mouth
25. Desiccator cabinet
26. 300mm X 0.625" OD Column, Quark Enterprises, QD-300, With 24/40 outer one end and 14/20 inner other end w/ss screen
27. Cleanup Column #1, Quark Enterprises, QSGC-1-32, Version 3
28. 240 mm X 0.625" OD Column, Quark Enterprises, QD-240, with 14/20 outer at one end and 14/20 inner other end with ss/screen
29. Cleanup Column #2, Quark Enterprises, QSGC-2-32, Version 4
30. Teflon/Silicone seal ring, Quark Enterprises, QSR-32-16
31. Red Cap with hole, Quark Enterprises, QCP-32-RMD
32. Large acid silica gel column, Quark Enterprises, QD-400-10.
33. 250 mL solvent reservoir with 24/40 joint, Quark Enterprises, QCH-8-2
34. Stopcock adapter with 14/20 joints, Quark Enterprises, QA 1420T
35. Vacuum Take-Off, Quark Enterprises, QA-100, with 14/20 outer, 24/40 inner with drip tube
36. 500 mL Erlenmeyer flask with 24/40 joint, Quark Enterprises, QF-6-18
37. Beakers, assorted sizes
38. Buret clamps
39. Glass funnel with 24/40 joint
40. Glass funnel with 14/20 joint
41. 7/16” stainless steel screen disc, TWP Corporation

42. Glass fiber filter, 13 mm, Pall Corporation, 66196 or equivalent
43. Measuring spoon set, stainless steel, ¼, ½, 1 teaspoon, 1 tablespoon
44. GC vial insert, glass, 250 µl, Restek, 21776
45. Water bath – VWR/LLI Model #1127 or equivalent
46. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during the extraction
47. Chromacol GC vial, 1.1 mL Screw top with tapered tip, Chromatography Research Supplies, Inc., Item No. 123275
48. 125 mL glass separatory funnel
49. 40 mL glass vial with Teflon lined cap
50. Robo-Coupe grinder, Model RSI6Y-1 or equivalent
51. Retsch Mill, Grindomix GM200 or equivalent
52. 1-L glass bottles
53. 1-L amber glass bottle
54. Cutting board
55. Knife
56. Glass wool
57. Sonic bath, Fisher Scientific FS110 or equivalent.
58. Ceramic tile
59. Column Packer
60. Na_2SO_4 column Quark Enterprises QDC-24-2440
61. Synder column Quark Enterprises QD-5-7LAN
62. Soxhlet condensors
63. 1:1 ethylene glycol for recirculating cooler
64. 40 mL glass vial with Teflon lined cap
65. Soxtherm 416, Gerhardt or equivalent
66. Multistat, Gerhardt, orequivalent
67. boiling stones, Gerhardt Type A, 1000774, or equivalent
68. Class 1 100g-1mg weight set, NVLAP accredited certificate, Troemner, Part # 7228-1W or equivalent
69. Class 1 2kg individual weight, NVLAP accredited certificate, Troemner, Part # 7012-1W or equivalent

Reagents and Standards

All solvents, acids, and bases are stored in glass bottles in flammable proof cabinets or in pressure resistant steel drums. Solvents, acids and bases are stored at ambient temperature for up to 1 year. All non-solvents are stored according to manufacturer's storage conditions. See *T-HRMS-WI9446* for the storage and stability of the spiking solutions listed below.

1. Toluene – Fisher Scientific, T291, Omni grade or equivalent
2. Hexane – Pesticide grade or equivalent
3. Acetone – Pesticide grade or equivalent
4. Methylene Chloride ($MeCl_2$) - Pesticide grade or equivalent
5. Labeled Compound Spiking Solution – See *T-HRMS-WI9446*
6. Native Compound Spiking Solution – See *T-HRMS-WI9446*
7. Quartz Sand – Bake 450°C for 4 hours at a minimum
8. Isolute – HM-N, Biotage, 1 kg
9. Vegetable oil – commercially available soybean, canola or corn; preferably certified organic in a glass bottle
10. Nonane, Acros Organics, 99%, No.:129115000 or equivalent
11. Various standard spiking solutions, See *T-HRMS-WI9446*
12. Silica Gel, 63-200 micron particles, Fisher Scientific, 05-719-822, or equivalent
13. Sulfuric Acid (H_2SO_4), concentrated, Reagent Grade
14. Sodium Hydroxide, Reagent Grade

15. Silver Nitrate ($AgNO_3$), Reagent Grade
16. Alumina Basic Super 1, Sorbent Technologies, Cat. # 15160-05
17. Sodium Sulfate (Na_2SO_4), Reagent Grade or equivalent.
18. Sodium Chloride - reagent grade
19. Methanol - Fisher Scientific, A454, Optima grade or equivalent
20. Dry ice

Preparation of Glassware
See *T-HRMS-WI9485*.

Calibration
Not Applicable to this procedure.

Procedure

A. Preparation of Media:

All media are stored in the desiccator cabinet at room temperature for up to 1 year.

1. Clean sodium sulfate.
   a. Load approximately 1250g of sodium sulfate into a column adsorbent preparation tube. Secure Na_2SO_4 with glass wool packing.
   b. Move the tube to the solvent flushing station.
   c. With the adsorbent preparation tube in an upright position, attach it to the 4-L filter flask and attach vacuum supply line. Place 2000 mL solvent bulb on top of the adsorbent preparation tube
   d. Add 1500 mL of hexane to the solvent reservoir.
   e. Detach the 2000 mL solvent reservoir; detach the adsorbent preparation tube from the 4 L filter flask.
   f. Insert the adsorbent preparation tube into the tube furnace and attach the tube adapter with the Nitrogen (N_2) supply.
   g. Start the N_2 supply at 5 to 7 SCFH (standard cubic feet per hour),bake at 225°C in the tube furnace for a minimum of 2 hours with a stream of nitrogen flowing through the tube.
   h. Turn off the power to the tube furnace and allow the silica gel to cool
   i. Transfer the Na_2SO_4 from the adsorbent preparation tube to a 1 gallon glass bottle. Tightly close the lid on the glass bottle and store in a desiccator cabinet until further use.
   j. Store in glass jar in desiccator cabinet.
2. Clean bulk silica gel.
   a. Add 350 g of silica gel to the column adsorbent preparation tube. Secure silica gel with glass wool packing.
   b. Move the tube to the solvent flushing station.
   c. With the adsorbent preparation tube in an upright position, attach it to the 4-L filter flask and attach vacuum supply line. Place 2000 mL solvent bulb on top of the adsorbent preparation tube.
   d. Add 1500 mL of methanol to the solvent reservoir. Gently apply vacuum and draw the methanol through the silica gel.
   e. As the surface of the methanol approaches the top surface of the silica gel, add a small portion of 1500 mL of methylene chloride to the solvent reservoir. Allow the methylene chloride to be drawn into the column and then add the rest of the methylene chloride.
   f. When all the methylene chloride has been drawn into the adsorbent preparation tube, continue to draw air through the tube for an additional 15-20 minutes using vacuum to pull solvent out of the column until there is very little solvent flow exiting the column.
   g. Detach the 2000 mL solvent reservoir; detach the adsorbent preparation tube from the 4-L filter flask.
   h. Insert the adsorbent preparation tube into the tube furnace and attach the tube adapter with the N_2 supply.
   i. Start the N_2 supply at 5 to 7 SCFH (standard cubic feet per hour) and turn on the tube furnace to 180°C. Heat the silica gel for 1 hour.
   j. Turn off the power to the tube furnace and allow the silica gel to cool.
   k. Transfer the silica gel from the adsorbent preparation tube to a 1 gallon glass bottle. Tightly close the lid on the glass bottle and store in a desiccator cabinet until further use.
3. Prepare acid silica gel.
   a. Weigh out 800 g of the cleaned silica gel into a 1 gallon glass bottle.
   b. Weigh out 352 g of sulfuric acid into a 500 mL beaker.
   c. Pour portions of the sulfuric acid from the beaker into the silica gel.
   d. Frequently shake and mix the silica gel to break up any clumps that form.

e. Transfer a portion of the silica gel back to the 500-mL beaker to soak up any sulfuric acid that remains in the beaker and then transfer back to the 1 gallon glass bottle.

f. Place the 1 gallon glass bottle on the bottle roller mixer for several hours or until the silica gel is uniform and free flowing.

g. Store the acid silica gel in the tightly closed 1 gallon glass bottle in a desiccator.

4. Prepare basic silica gel.

a. Weigh out 300 g of cleaned silica gel and transfer to a 1-qt glass bottle.

b. Prepare 1N sodium hydroxide by dissolving 4 g of sodium hydroxide in 100 mL of water.

c. Measure out 90 g of 1N sodium hydroxide. Pour portions of the 1N sodium hydroxide into the silica gel. Frequently shake and mix the silica gel to break up any clumps that form.

d. Place the 1-qt glass bottle on the bottle roller mixer for several hours or until the silica gel is uniform and free flowing.

e. Store the basic silica gel in the tightly closed 1qt glass bottle in a desiccator.

5. Prepare 10% $AgNO_3$ silica gel. The preparation should be done in a manner that minimizes direct exposure to light.

a. Weigh out 350g of cleaned silica gel into a 1 liter amber glass bottle.

b. Prepare a $AgNO_3$ solution by dissolving 38.89 g of $AgNO_3$ in 150 mL of water. Be careful to ensure that the $AgNO_3$ is completely dissolved. Sonication of the solution can be used if necessary.

c. Pour portions of the $AgNO_3$ solution into the silica gel. Frequently shake and mix the silica gel to break up any clumps that form.

d. Place the 1-L glass bottle containing the $AgNO_3$ treated silica gel on the bottle roller mixer for several hours or until the silica gel is uniform and free flowing.

e. Load the $AgNO_3$ silica gel into the adsorbent preparation tube and insert tube into tube furnace and secure with glass wool packing.

f. Attach tube adapter with N_2 supply and purge tube at 5 to 7 SCFH for 30 minutes.

g. Turn on power to tube furnace and set temperature to 120°C. Purge and heat the $AgNO_3$ silica gel for at least 16 hours or overnight to activate it.

h. Turn off the power to the tube furnace and allow the $AgNO_3$ silica gel to cool under N_2 purge for 30 mins.

i. Examine the color of the $AgNO_3$ silica gel. It should be a cream to light tan color. If the $AgNO_3$ is a darker brown or gray, it must be discarded and cannot be used.

j. After the $AgNO_3$ silica gel is cool, transfer back to the 1-L amber glass bottle. Store in desiccator shielded from direct sunlight or room light.

B. Sample Preparation - Soxtherm extraction

1. Prepare native compound and labeled compound working spiking solutions and the appropriate Working Cleanup Standard Spiking Solution as per *T-HRMS-WI9446*.

2. Power up the recirculating cooler and check that the display reads approximately 10°C. Drain any solvent in the soxtherm reservoir into a solvent carboy by turning the front drain knob 1/4 turn left. Close the drain when the reservoir is empty.

3. Pre-clean the extraction apparatus.

a. Place 2-3 rinsed boiling stones into the extraction beaker. Make sure the top of the extraction beaker is free from debris. Add 100 mL of the appropriate cleaning solvent: either 1:1 hexane/acetone or toluene.

b. Slide extraction beaker into the Soxtherm port. Turn the extraction beaker to ensure a complete seal.

c. On the Multistat controller, select the soxtherm unit and the program. Do this separately for each soxtherm:

1) Arrow up or down to get to "Analysis Start." Press "Enter".
2) Select the desired soxtherm unit from U1, U2, etc. at the top of the Multistat. Press "Enter".
3) Using the up and down arrows, select "HEX-ACE-CLEAN" (1^{st} cleaning cycle) or "TOL-CLEAN" (2^{nd} cleaning cycle). Press "Enter". The unit lights should turn on.
4) When prompted, check that the 300°C Check Safety Key is attached, then press "Enter". The selected soxtherm program should start.

d. When the cycle is complete, allow the soxtherm beakers to cool. Remove beakers from the unit ports and pour the solvent to waste.

e. Repeat steps a. through d. with toluene.

f. Turn off the recirculating cooler if not continuing with the sample extraction process.

g. The pre-cleaned glassware can be prepared in advance and stored if placed in a foil lined drawer and labeled "toluene cleaned".

4. Prepare the sample for extraction.

a. Homogenize the solid/soil sample by thoroughly mix the contents of the sample container using a wooden tongue depressor prior to taking a sub sample for analysis.

b. Weigh out the sample – The weighing of the sample and pre-extraction treatment of the sample can vary based on client needs and the analysis that is scheduled for the sample.

For a soil or solid sample:

1) Place a sized small glass fiber thimble into a 250-mL beaker. Weigh out 10 g (between 10.00 g and 10.50 g, to nearest 0.01 g), wet weight basis, of sample into a small, cut glass fiber extraction thimble.

2) Based on client requirements, the wet sample weight can be adjusted to compensate for moisture in the sample. The wet weight used would be adjusted based on the moisture determination using *S-SS-WI10697*.

c. Spike the samples according to the following table. Use the appropriate calibrated, gas tight syringe. Prior to spiking each batch, clean the syringe using an aliquot of acetone or hexane.

Sample	100 µL of Working Labeled for Dioxins and Furans 1.0 mL for PCB Congeners Compound Spiking Solution	100 µL of Working Native for Dioxins and Furans 1.0 mL for PCB congeners Compound Spiking Solution
Field Sample	Yes	No
Method Blank	Yes	No
OPR	Yes	Yes

d. Add 2-3 rinsed boiling stones to a labeled soxtherm extraction beaker.

e. Pull apart a small piece of glass wool (enough to cover the sample and hold it in place) and place it in the thimble. Make sure that no piece of glass wool is outside the beaker or touching the top of the beaker, or the extraction will fail due to a faulty seal.

f. Place the thimble in the labeled extraction beaker.

g. Determine which soxtherm extraction option is required based on the analysis scheduled for the sample:

Sample Matrix	Requested Analysis	Extraction Procedure
Soil/Solid	PCDD/PCDF by *T-HRMS-WI9476*	Step 5 - Toluene

5. Toluene extraction of soil /solid.

a. Using a solvent pump, slowly transfer 100 mL of fresh toluene to the soxtherm extraction beaker, allowing the solvent to pour into and around the thimble.

b. Insert the extraction beaker into the soxtherm port. Turn the beaker about a quarter turn to ensure a seal.

c. Turn on chiller. Make sure it is set to 10°C.

d. Drain any solvent from the tanks to a waste carboy by turning the drain cock counterclockwise 90°, allowing the solvent to empty out of the tank. Turn the drain cock back to close it.

e. On the Multistat, press the up or down arrow to navigate to the "run program" main menu. Enter.

f. Press the [U1], [U2], [U3], or [U4] to select an extraction unit. The display will change from an underscore to the unit selected. Enter.

g. Follow steps below to start extraction run:

1) Press the up arrow to select the program DF Soxtherm Program A. Hit enter.

Program A parameters:
(a) 300°C
(b) Ext Temp: 260°C
(c) Reduction Interval: 6.0 min
(d) Reduction Pulse: 3 seconds
(e) Hot extraction: 4 hours
(f) Evap A: 3x Interval
(g) Rinsing Time: 1 hour 30 minutes
(h) Evap B: 1.5x interval
(i) Evap C: 0x Interval

2) A temperature safety check prompt will occur. Make sure the 300°C safety key is in place. (if it is not, an error will appear on the Multistat.)

3) When the start time appears, hit enter. The program will initiate.

h. Quantitatively transfer extract(s), using disposable glass pipets, from soxtherm glass cells into concentrator tubes.

i. Rinse the cell with hexane to ensure a complete transfer.

j. Set the temperature of the TurboVap LV water bath to 50°C and the N_2 pressure to approximately 5 psi.

k. Concentrate the toluene extracts to ~5 mL final volume, after the first 20 minutes, rinse each of the concentrator tubes with hexane.

l. If there is an extract for an associated water sample that was generated using T-HRMS-WI21528, the water extract can be combined with the toluene extract prior to cleanup.

m. Cap the concentrator tube with a glass stopper and store at room temperature until column cleanup is performed.

n. Proceed to D. Extract Cleanup Procedure.

C. Sample Preparation Soxhlet Extraction:

1. Prepare native compound and labeled compound working spiking solutions and the appropriate Working Cleanup Standard Spiking Solution as per *T-HRMS-WI9446*.

2. Pre-clean the extraction apparatus.

   a. Place a 500-mL round-bottom flask into the heating mantle and add approximately 300 mL of toluene. Add several Teflon boiling chips. Hold the apparatus upright and fill until a small amount of toluene flows into the extractor.

   b. Assemble the SDS extractor. Add a dean stark. Hold the apparatus upright and fill until a small amount of toluene flows into the extractor.

   c. Power up the recirculating cooler and check that the display reads approximately 10°C.

   d. Turn on each heating mantle and set the control knob to "9".

   e. Allow the extraction to continue for at least 3 hours.

   f. Turn off the heating mantle power. Allow the SDS extractors to cool.

   g. Disassemble the SDS extractor and reclaim the toluene in the SDS extractor. This will be used for solvent rinsing of glassware. The toluene in the round bottom flasks will be discarded. Rinse the round bottom flask with approximately 10 mL of acetone and discard.

   h. Turn off the recirculating cooler if not continuing with the sample extraction process.

   i. The pre-cleaned glassware can be prepared in advance and stored if placed in a foil lined drawer and labeled: toluene cleaned.

3. Prepare the sample for extraction.

   a. Homogenize the solid/soil sample by thoroughly mix the contents of the sample container using a wooden tongue depressor prior to taking a sub sample for analysis.

   b. Weigh out the sample – The weighing of the sample and pre-extraction treatment of the sample can vary based on client needs and the analysis that is scheduled for the sample.

      For a soil or solid sample:

      1) Weigh out 10 g (between 10.00 g and 10.50 g, to nearest 0.01 g), wet weight basis, of sample into a small glass fiber extraction thimble.

      2) Based on client requirements, the wet sample weight can be adjusted to compensate for moisture in the sample. The wet weight used would be adjusted based on the moisture determination using *S-SS-WI10697*.

      3) Proceed to step C.3.c.

      For a wet tissue sample:

      1) Weigh out 10.0 g (± 0.1g) of Isolute, into a 250-mL beaker and stir periodically with a wooden tongue depressor. Based on client requirements, 30-40 g of sodium sulfate can be substituted for the Isolute.

      2) For samples, weigh out 10 g (between 10.00 g and 10.50 g, to nearest 0.01 g), wet weight basis, into the 250-mL beaker containing the Isolute. For the associated OPR and method blank, weigh out 10g of Isolute and place into a 250-mL beaker. For the associated OPR and method blank,add 1.0 g (±0.05 g) of commercial grade vegetable oil (soybean, canola, or corn) and place into a 250-mL beaker. Record 10.00 g for the weight of both the method blank and OPR.

      3) Stir the sample with the drying agent using a wooden tongue depressor to mix. Using the depressor, transfer the sample/drying agent mixture into a large glass fiber thimble. Spike sample/drying agent mixture and associated QC according to the table in the following step. Allow to dry for a minimum period of 1 hour after spiking. This drying period can be extended to 12-24 hours based on client requirements.

   c. Spike the samples according to the following table. Use the appropriate calibrated, gas tight syringe. Prior to spiking each batch, clean the syringe using an aliquot of acetone or hexane.

Sample	100 µL of Working Labeled for Dioxins and Furans 1.0 mL for PCB Congeners Compound Spiking Solution	100 µL of Working Native for Dioxins and Furans 1.0 mL for PCB congeners Compound Spiking Solution
Field Sample	Yes	No
Method Blank	Yes	No
OPR	Yes	Yes

   d. For soils/solids, crimp the top of the glass fiber thimble. For tissue samples, place a 4.25cm glass fiber filer paper on top of the sample mixture to prevent loose particles from moving through the extractor into the round bottom flask.

Sample Matrix	Requested Analysis	Extraction Procedure
Soil/Solid	PCDD/PCDF by *T-HRMS-WI9476*	Step 4 - Toluene
Soil/Solid	PCB Congeners by *T-HRMS-WI9432*	Step 5 – MeCl2:Hexane
Tissue	PCDD/PCDF by *T-HRMS-WI9476*	Step 4 -Toluene or Step 5 MeCl2:Hexane by client request
Tissue	PCB Congeners by *T-HRMS-WI9432*	Step 5 – MeCl2:Hexane

e. Determine which soxhlet extraction option is required based on the analysis scheduled for the sample:

NOTE: PCB Congener samples for the state of Wisconsin will use the solvents listed in EPA Method 1668C for extraction.

4. Toluene extraction of soil /solid or tissue samples.

   a. Using a solvent pump, transfer 300 mL of fresh toluene to the 500-mL round-bottom flask. Add several Teflon boiling chips.

   b. Insert the glass fiber extraction thimble into the extractor body and assemble the SDS extractor. During the assembly of the dean stark to the SDS extractor on the heating mantle, hold the apparatus upright and fill the dean stark until a small amount of toluene flows into the extractor.

   c. Enclose the SDS extractor body with sleeve wrapping of aluminum foil to help maintain the proper temperature during the extraction process with toluene.

   d. Power up the recirculating cooler and check that the display reads approximately 10°C.

   e. Turn on each heating mantle and set the control knob to "9".

   f. Allow the extraction to continue for 18-24 hours.

   g. Just after a "dump" cycle has occurred in the soxhlet body, open the SDS receiver stopcock and drain the toluene into a flask.

   h. Carefully monitor the toluene that continues to reflux in the 500-mL round-bottom flask, while draining the toluene from the dean stark. When the volume of the toluene in the round bottom flask decreases to about 10 mL, raise the soxhlet extractor out of the heating mantle and slide a ceramic tile over the mantle well. Rest the soxhlet extractor on top of the ceramic tile. Turn off the heating mantle power. Allow the SDS extractors to cool.

   i. Turn off the recirculating cooler, and allow extractors to cool.

   j. Disassemble the SDS extractor and quantitatively transfer the toluene from the 500-mL round-bottom flask to a TurboVap LV concentrator tube.

   k. Set the temperature of the TurboVap LV water bath to 50°C and the N_2 pressure to approximately 5 psi.

   l. Concentrate the toluene extracts to <1 mL final volume, after the first 20 mins rinse all the concentrator tubes with toluene.

   m. If there is an extract for an associated water sample that was generated using Sep Funnel Extraction (T-HRMS-WI12032), the water extract can be combined with the toluene extract prior to cleanup.

   n. Cap the concentrator tube with a glass stopper and store at room temperature until column cleanup is performed.

5. Methylene chloride:Hexane, 1:1 extraction of soil or solid sample for PCB congeners by EPA Method 1668.

   a. Prepare 1:1 hexane:methylene chloride. Using a solvent pump or graduated cylinder, transfer 300 mL of 1:1 hexane:methylene chloride to the 500-mL round-bottom flask. Add several Teflon boiling chips.

   b. Insert the glass fiber thimble into the extractor body and assemble the soxhlet extractor without the Dean Stark adapter.

   c. Power up the recirculating cooler and check that the display reads approximately 10°C.

   d. Turn on each heating mantle and set the control knob to "7".

   e. Allow the extraction to continue for 18 to 24 hours.

   f. Turn off the heating mantle power. Allow the extractors to cool.

   g. Turn off the recirculating cooler.

   h. Disassemble the extractor and quantitatively transfer the 1:1 hexane:methylene chloride extract from the 500-mL round-bottom flask through a sodium sulfate drying column into a KD concentrator. Rinse salt column with ~10 to 20 mL hexane, and lightly push hexane through the salt column with red bulb. Remove/replace salt column with 3-ball Snyder column.

   i. Extract is concentrated on a steam bath (90° to 95°C) to remove most of the hexane, Then methylene chloride is added to achieve a final volume of 10 ml. The extract is then ready for GPC cleanup following *T-HRMS-WI39008*.

   j. Carefully add 50 mL of hexane through the top of the Snyder column to perform an exchange to hexane.

   k. Concentrate the sample to <10 mL. If the sample is scheduled for an optional lipid determination, additional steps are required. See *T-HRMS-WI12013*.

   l. If a cleanup of the extract is scheduled for a later time, cap the ampule with a glass stopper and store at room temperature until column cleanup is performed.

D. Extract Cleanup Procedure

The cleanup of sample extracts is needed to remove potential interferences that are observed in the HRMS analysis. Different combinations of adsorbents can be used to achieve cleanup goals and separate analytes into fractions. Routine extract cleanups require the following adsorbent column combinations:

Analyte	Adsorbent
Dioxins/Furans	Multi-layer silica gel + Alumina
PCB Congeners	Multilayer silica gel

NOTES: Based on the severity of the sample matrix and the concentrations of PCBs, alumina can also be used in addition to the multilayer silica gel for the clean-up of PCB congener extracts.

Cleanup sorbents may be modified based on client specific requirements and a vetting of the performance of the modified sorbent.

1. Prepare the alumina column

   a. Place a stainless steel screen disc in the bottom of the column and place a 13 mm glass fiber filter paper on top of the screen. Place a glass funnel with a 14/20 joint on top of Cleanup Column #2.

   b. In a hood, place Cleanup Column #2 in a buret clamp so it can be loaded with adsorbent.

   c. Add 1 ½ teaspoons (5.5 g) of alumina to the column, pack the column.

   d. Add Na_2SO_4 to the top of the alumina in the column until the level of the Na_2SO_4 reaches the flare point of the threaded column fitting on the column top, or 1/2 teaspoon if using the other column set.

   e. Attach to the flask and cover with hexane.

2. Prepare multi-layer silica gel column

   a. Place a 7/16" diameter stainless steel screen disc in the bottom of the column and a 13 mm glass fiber filter on top of the screen. Fit the column with a Teflon/silicon seal ring, Teflon side down, and a red cap with hole.

   b. In a hood, place Cleanup Column #1 in a buret clamp so that it can be filled with adsorbent. Place a glass funnel with a 24/40 joint on top of the column to facilitate filling. The silica gel tends to create small amounts of airborne dust so the filling operation must be done in a hood.

   c. Add layers of silica gel according to the following table. The measurement of the adsorbent requires a spoon full of media to be scraped with one pass of a spatula to make sure the measurement is reproducible and level full. After column is poured, pack the column, quickly cover with hexane.

Layer position	Material	Measurement
Top	Na_2SO_4	1/2 teaspoon
	Acid Silica Gel	1 tablespoon
	Silica Gel	1/4 teaspoon
	Basic Silica Gel	1 teaspoon
	Silica Gel	1/4 teaspoon
	$AgNO_3$ Silica Gel (1)	1/2 teaspoon
Bottom	Silica Gel (1)	1/4 teaspoon

NOTE: Omit the $AgNO_3$ and Silica Gel segment of the column when performing cleanup of PCB Congener extracts.

3. Assemble column set

Assemble the column cleanup set by attaching the glassware pieces to one another in the following order (top to bottom) and clamping the set in a buret clamp at the column cleanup workstation:

   a. 250 mL solvent reservoir

   b. Cleanup Column #1 multi-layer silica gel column

   c. Cleanup Column #2 alumina column

   d. stopcock adapter

   e. vacuum adapter

   f. 500-mL filter flask with vacuum supply line

   g. pre-wet the column with approximately 20 mL of hexane.

4. Condition the columns

   a. Condition the column by eluting with 50 mL of hexane. Discard the hexane and rinse the flask with methylene chloride, acetone, and ending with hexane, and reattach the flask to the column apparatus at this point for congener cleanups. If conditioning the column for D/F cleanups, discard hexane when the cleanup is complete.

   b. If necessary, detach the silica gel column from the alumina column and add hexane to fill the headspace above the alumina column. Reattach the silica gel column to the alumina column.

All samples for D/F, with the exception of clear and colorless drinking water extracts for TCDD only, will require the multi-layer silica gel-alumina column described above. All samples for PCBs will require the multi-layer silica gel column.

5. Cleanup of Dioxins/Furans Extracts:

When using the multi-layer Silica Gel with the Alumina Column for Dioxins/Furans cleanup, proceed in the following manner. All samples, with the exception of clear and colorless drinking water extracts for TCDD only, will require the multi-layer silica gel-alumina column described above.

   a. Condition the column by eluting with 50 mL of hexane to the waste flask, remove solvent bulb after conditioning is complete.

   b. If necessary, detach the silica gel column from the alumina column and add hexane to fill the headspace above the alumina column. Reattach the silica gel column to the alumina column.

   c. Add 100µL of working cleanup standard solution to sample extract. Dioxins/Furans and PCBs each have their corresponding cleanup solutions.

   d. Using hexane, quantitatively transfer the extract from the concentrator tube to the head of the silica gel column.

   e. Start the column flow with vacuum at a rate of 2-3 drops per second to allow the sample extract to flow into the silica gel column.

f. Add a few milliliters of hexane using a Teflon solvent bottle to rinse the extract and the cleanup standard spike into the column adsorbent. Add a solvent bulb.

g. Add 50 mL of hexane to the solvent reservoir and elute the column at about 2 drops per second. Vacuum can be used as necessary to assist in the adjustment of the column flow.

h. Stop the column flow as the hexane surface approaches the top of the alumina layer. At this point, the silica gel column will have gone "dry".

i. Remove the silica gel column and disconnect the vacuum line. Allow any hexane left in the alumina column to elute to waste.

j. Elute the alumina column with 25mL of 5% methylene chloride in hexane. This fraction is discarded.

k. Detach the 500mL filter flask and attach the appropriately labeled concentrator tube. Elute the alumina column with 25mL of methylene chloride and collect this fraction containing the PCDD/PCDF compounds in the concentrator tube.

l. Detach the concentrator tube from the column set and place in MicroVap concentrator. Set the water bath temperature to 40°C and the N_2 flow to about 5 psi. Concentrate the extract to approximately 100-200µl and quantitatively transfer to a GC vial with insert.

m. Submit the concentrated extract in the vial to the high resolution mass spectrometry lab for PCDD/PCDF analysis.

6. Cleanup of PCB Congener Extracts:

When using the multi-layer Silica Gel column for PCB Congeners, proceed in the following manner.

a. Condition the column by eluting with 50 mL of hexane into a 250-mL or 500-mL Erlenmeyer flask. Discard the hexane and rinse the filter flask with the following solvents, always ending with hexane:methylene chloride, acetone and hexane. Discard, reattach the flask to the column, and remove the solvent bulb.

b. Add 1.0 mL of working cleanup standard solution to sample extract. Dioxins/Furans and PCBs each have their corresponding cleanup solutions.

c. Using hexane, quantitatively transfer the extract from the concentrator tube to the head of the silica gel column.

d. Start the column flow with vacuum at a rate of 2-3 drops per second,to allow the sample extract to flow into the silica gel column.

e. Add a few milliliters of hexane using a Teflon solvent bottle to rinse the extract and the cleanup standard spike into the column adsorbent. Add a solvent bulb.

f. Load 50 mL of hexane and elute the column at 2 to 3 drops per second.

g. Collect the entire 50 mL hexane eluent.

h. Open stopcock slowly maintaining the 2-3 drop per second drip rate as the column starts to dry. Stop the elution as the silica gel column goes dry.

i. Detach the silica gel column, vacuum connector, and stopcock.

j. Add 20µl nonane to each flask. Divide the hexane eluent evenly between three concentrator tubes. Place tubes in MicroVap concentrator. Set the water bath temperature to 40°C and the N_2 flow to about 5 psi. Concentrate the extracts far enough so that they can be combined into a single tube for each sample. Concentrate each single tube to <1 mL and quantitatively transfer to a Chromacol vial. Submit the concentrated extract in the vial to the high resolution mass spectrometry lab for analysis.

7. Optional Pre-treatment options for samples with high fat content or matrix interferences.

a. 1:1 PSA Acid silica gel for tissues

(1) Mix equal amounts of PSA and Acid silica gel, this can be made and stored for 6 months in a tightly sealed jar in a desiccator.

(2) Add 1 teaspoon of 1:1 PSA acid silica gel to a 40-mL glass vial.

(3) Quantitatively transfer the extract from the ampule to the vial.

(4) Cap and shake vigorously.

(5) Centrifuge sample at 1200 rpm for 5 minutes

(6) Sample is ready for multi-layer silica gel/alumina cleanup (Procedure C.3 and C.4).

b. Concentrated Acid Shake

(1) Add 18 ml of Sulfuric Acid to a 40-mL glass vial.

(2) Quantitatively transfer the extract from the ampule/concentrator tube to the vial.

(3) Cap and invert gently 10 times.

(4) Centrifuge sample at 1200 rpm for 5 minutes.

(5) Sample is ready for multi-layer silica gel/alumina cleanup (Procedure C.3 and C.4).

c. Prepare large acid column.

(1) Place a 7/16 inch diameter stainless steel screen disc in the bottom of the column and a 13 mm glass fiber filter on top of the screen.

(2) Add 1 teaspoon of Na_2SO_4 into bottom of column.

(3) Add 60g of sulfuric acid silica gel.

(4) Add 1 teaspoon of Na_2SO_4 on top of sulfuric acid silica gel.

(5) Condition the column by eluting 100 mL of hexane. Discard the hexane.

(6) Rinse the flask with approximately 25 mL of hexane, acetone, and methylene chloride ending with hexane and discard.

d. Load sample extract onto the column, under vacuum at a drip rate of 2-3 drops per second. Using hexane, quantitatively transfer the extract from the concentrator tube to the head of the acid silica gel column.

e. Add a few milliliters of hexane using a Teflon solvent bottle to rinse the extract and the cleanup standard spike into the column adsorbent. Add a solvent bulb.

f. Elute the column with 250 mL of hexane and collect entire eluent.

g. Transfer the hexane to a KD concentrator and concentrate at 95°C on steam bath to <10 mL.

h. Sample is ready for multi-layer silica gel/alumina cleanup (Procedure C.3 and C.4).

8. Optional Back-Extraction with Base and Acid for D/F extracts only **(performed prior to column cleanups)**

a. Add 100 µL of Working Cleanup Spiking Solution (See *T-HRMS-WI9446*) to the sample and place in a small 125-mL glass separatory funnel.

b. Add 50 mL of potassium hydroxide solution (20 g to 100 mL DI water) cap the separatory funnel. Shake for 2 minutes with venting.

c. Remove and discard aqueous phase.

d. Repeat steps b. and c. a second time, discarding the aqueous phase each time, until any color disappears up to a maximum of 4 times.

e. Add 50 mL of sodium chloride solution (5 g to 100 mL DI water), shake for 2 minutes and discard aqueous phase.

f. Drain hexane layer into a 40-mL vial that contains 10mL of H_2SO_4. Rinse the separatory funnel with hexane and place rinsate into the 40-mL vial containing the sample. Invert 10-15 times and centrifuge.

g. Repeat step f with a new H_2SO_4 vial until color disappears, up to a maximum of 4 times. Once there is no color or the sulfuric acid extraction has been performed 4 times, transfer the hexane layer using a disposable pipette back to the mini-separatory funnel and repeat step e.

h. Transfer extract by draining into a 40 mL vial containing 5.0 ± 0.5 grams Na_2SO_4. Shake quickly to prevent the Na_2SO_4 from solidifying on bottom of the vial.

i. The resulting extract is then ready for column cleanup as outlined in the column cleanup section of this SOP (Procedure C.3 and C.4).

9. If interferences are observed after current cleanup procedures are followed, management will be notified. Additional cleanup procedures will be evaluated and developed as necessary such as, but not limited to, a carbon cleanup.

Calculations

% Lipids: Refer to *T-HRMS-WI12013* for this calculation

Statistical Information/Method Performance

See *T-HRMS-WI9476* for Dioxins/Furans and *T-HRMS-WI9432* for PCB Congeners.

Quality Assurance/Quality Control

All samples are spiked with ^{13}C labeled compounds to monitor analyte recovery using isotope dilution quantitation. A sample "batch" will consist of no more than 20 field samples per set of Quality Control (QC) samples. For each batch of samples extracted, a method blank (sand for soils or isoluted spike with 1.0g of vegetable oil for tissues), and an Ongoing Performance and Recovery (OPR) sample (sand or isolute spiked with 1.0g of vegetable oil spiked with all compounds to be determined carried through the entire procedure) must be extracted. See *T-HRMS-WI9476* for Dioxins/Furans and *T-HRMS-WI9432* for acceptance criteria/corrective action. If any client, state, or agency has more stringent QC or batch requirements, these must be followed instead.

10697 % Moisture Calculation and % Solids Calculation (Gravimetric)
12013 Determination of Percentage Lipids in Animal and Marine Tissue using EPA Method 1613B
23907 Redacted SOPs
39008 HRMS Extract Cleanup Using GPC by Method 3640A
9432 PCB Congeners by Method 1668 HRGC/HRMS in Aqueous and Solid Matrices
9446 Standards Management in the High Resolution Mass Spectrometry Laboratory
9476 Determination of Tetra- Through Octa- Chlorinated Dioxins and Furans in water/solid/food/feed samples using HRGC/HRMS by EPA 1613B or SW-846 Method 8290A
9485 Glassware Cleaning for HRMS Extractions

End of document

Version history

Version	Approval	Revision information	
5	09.NOV.2020		
6	03.DEC.2021		
7	16.JUN.2022		

QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896 Establishing Control Limits
T-WC-WI11644 Maintenance of the OI Analytical Total Organic Carbon Solids Analyzer

End of document

Version history

Version	Approval	Revision information
15	22.MAY.2015	
16	11.SEP.2018	
17	22.JUN.2021	

eurofins	Always check on-line for validity. **GC/MS Preventative and Corrective Maintenance**	Level: **Work Instruction**
Document number: **T-SVOA-WI9598**		
Old Reference: **1-P-QM-PRO-9015393; DOD - MC-EX-001**		
Version: **6**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **26-SEP-2019**	Document users: **5_EUUSLA_GC/MS Semivolatiles_All**	Responsible: **5_EUUSLA_GC/MS Semivolatiles_Manager**

Revision Log
Reference
Purpose
Scope
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Procedure

Revision Log

	Revision: 06	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout document	Reflects current instrumentation	Removed references to old instrumentation and added references to new instrumentation
Preventative Maintenance Basic Principles, Maintenance Authorization, Vacuum System Preventative Maintenance Basic Principles, Corrective Maintenance Basic Principles	Flow	Sections removed and information relocated to Procedure

Revision:	05	**Effective Date:**	Apr 13, 2011
Section	**Justification**	**Changes**	
Revision Log	Formatting requirements per LOM-SOP-LAB-201	Removed revision logs up to the previous version.	
References	Referenced in document	Added manual for the new instruments (Trace DSQ II)	
Scope	New instruments added to department	Preventative and corrective maintenance pertaining to new instruments (Trace DSQ II)	
Safety Precautions and Waste Handling	Formatting requirements per LOM-SOP-LAB-201	Added required text	
Personnel Training and Qualifications	Formatting requirements per LOM-SOP-LAB-201	Added required text	

Reference

1. Hardware Manual: HP 5973 Mass Selective Detector, Hewlett Packard, Hewlett-Packard Company, 1996.

2. 5975 Series MSD Troubleshooting and Maintenance Manual, Agilent, 2010.

3. HP 6890 Series Gas Chromatograph Maintenance and Troubleshooting Manual, Hewlett-Packard Company, 1989-1994.

4. *Chemical Hygiene Plan*, current version.

Purpose

Preventative and corrective maintenance are crucial in maintaining the overall performance of the GC/MS system. This SOP explains the basic principles of managing the integrity of the GC/MS system.

Scope

This document serves as a guideline for the performance of preventative and corrective maintenance on HP6890 and HP7890 GC and HP5973, HP5975, and HP5977 MSD GC/MS systems.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

Safety glasses must be worn and all necessary safety precautions taken when performing any type of preventative or corrective maintenance. See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP.

Each new chemist will train with an experienced chemist for the first 8 weeks depending on the individual and their previous experience. The first 8 weeks is spent working one-on-one with the trainer. This time may be less if the new chemist has prior experience in the GC/MS Semivolatiles area.

During the training period, the new chemist will learn daily preventative maintenance and corrective maintenance procedures, column and source changing procedures, calibration techniques, data and library search review, and form generation. They are also required to read all relevant SOPs and EPA methods. They can also participate in on-line GC/MS tutorials.

Procedure

Routine preventative maintenance is required to maintain a GC/MS system that will perform to method specifications. The performance of preventative maintenance is at the discretion and determination of the chemist, based on experience and what may be required to meet method performance specifications.

Corrective maintenance may be performed by the chemist based on the observed non-conformance. If, however, it is determined that an outside contractor must be contacted to perform certain types of preventative or corrective maintenance on a system, the chemist should consult with their group leader. The group leader will then help determine if contact must be made with the outside contractor and will determine who will make that contact.

The various types of maintenance are as follows:

A. Routine preventative maintenance:

Routine preventative maintenance may be performed daily on the gas chromatograph injector and gas chromatograph column to ensure maximum system performance. Specific maintenance techniques may vary from instrument to instrument depending on analyst experience, instrument setup, method requirements, and types of samples run.

Routine preventative maintenance may include the following:

1. Injector maintenance

a. Lower the GC oven temperature to 30ºC and the injection port temperature to 70°C. Turn off the pressure/flow.

b. To replace the septum, remove the automatic injection tower and set aside. Lift the GC cover; loosen, remove, and set aside the septum retainer nut. Remove and discard the old septum. Place a new septum on top of the inlet base. (Be sure the inlet is free of particulate matter.) Replace the septum retainer nut, tightening to finger tightness. Avoid overtightening; the retainer nut is spring-loaded to provide sufficient pressure for sealing. Turn the pressure on and check to be sure head pressure has returned to the level it was prior to performing this task.

c. To replace the inlet liner, remove the insert retainer nut. Remove the insert liner already in place. (Optional: Swab the port with methylene chloride or other suitable solvent.) Inspect the new liner; if chipped or cracked, **DO NOT USE – DISCARD**. Place a silicone O-ring on the insert liner, about 2 to 3 mm from the top end.

Install the insert liner by pressing it straight down, as far as possible, into the inlet. Replace the insert retainer nut. Turn the pressure on and check to be sure head pressure has returned to the level it was prior to performing this task.

d. To clean or replace the injector seal, turn off the GC oven and open the oven door. With a small wrench, loosen, remove, and set aside the column nut. Remove and set aside the bottom insulation cover. (You may need to loosen one or two screws to do this.) With a large wrench, remove the reducing nut. The washer and seal are inside the reducing nut. Swab the seal with methylene chloride or an appropriate solvent. Check for graphite in the ferrule end of the seal. If graphite is clogging the opening, remove it. If the flat side of the seal is visibly dirty and cannot be cleaned properly, replace it with a new seal. Place the washer back in the bottom of the reducing nut; place the seal, flat side up, on top of the washer. Screw the reducing nut in place. Secure the bottom insulation cover. Move to column maintenance.

2. Column maintenance

a. While the column is still disconnected from the injection port, slide the desired amount of column to be removed through the column nut and clip the head of the column with a column-cleaving tool. Check for a clean break. (The amount of column removed is at the chemist's discretion based on the type of samples run. 1-3" is typical for systems designated for water samples; 6" to 1' is typical for systems desigated for soil samples. More length may be taken if extremely dirty samples were analyzed. The reason for sliding the column through the column nut and ferrule BEFORE clipping is to avoid blockage by graphite particles at the head of the column.) Slide the column nut 6 to 12 mm from the end of the column and insert the column nut and column into the injector port.

Tighten the column nut. Turn the pressure on and check to be sure head pressure has returned to the level it was prior to performing this task. Close the oven door and set the temperature zones to 300ºC.

b. Fill out the routine maintenance page of the maintenance logbook found next to the instrument. Record all maintenance performed in a clear, concise manner.

B. Vacuum System Preventative Maintenance:

Vacuum system preventative maintenance may be performed every six to nine months to ensure maximum vacuum system performance. Specific maintenance techniques may vary from instrument to instrument depending on analyst and instrument setup. For specific maintenance techniques, chemists should refer to the proper hardware manual. This maintenance may be performed by an outside contractor.

Vacuum system preventative maintenance includes the following:

1. Check and, if necessary, replace foreline pump fluid
2. Check and, if necessary, replace diffusion pump fluid
3. Check and, if necessary, refill calibration vial
4. Replace carrier gas trap

Vacuum system preventative maintenance must be documented on the non-routine maintenance page of the maintenance logbook in a clear, concise manner.

C. Corrective Maintenance

Corrective maintenance is performed on the gas chromatograph and mass spectrometer only when symptoms indicate they are necessary to ensure maximum system performance, or to correct poor system performance. The specific maintenance required will vary depending on the observed problem(s), instrument setup, types of samples run, and method requirements. Following is a list of possible corrective maintenance and related symptoms; to properly troubleshoot the instrument symptoms, chemists should refer to the proper hardware manual. This maintenance may be performed by an outside contractor.

Corrective maintenance may, depending on symptoms, include the following:

1. Remove and clean the ion source
2. Replace the column
3. Replace ion source parts
4. Replace filaments
5. Replace electron multiplier (detector)
6. Replace entire analyzer
7. Replace purge lines and insert assembly
8. Replace heater/sensor assembly
9. Replace electronics (fuses, printed circuit boards)

Related symptoms may be grouped in the following categories:

1. General symptoms
    a. GC or MSD does not turn on
    b. Foreline and/or diffusion pump is not operating
2. Chromatographic symptoms
    a. No peaks
    b. Does not pass tune
    c. Peaks are tailing or fronting
    d. Peaks have flat or split tops
    e. Baseline is high

f. Baseline is rising or falling

g. Baseline wanders

h. Retention times for all peaks drift

i. Poor sensitivity

j. Poor repeatability

3. Mass spectral symptoms

Missing isotopes or incorrect isotope ratios

a. High background

b. High abundances at m/z 18, 28, 32, 44

c. Mass assignments incorrect

d. Peaks have precursors

e. Peak widths inconsistent

f. Poor high mass sensitivity

g. Pressure symptoms

h. Foreline pressure is too high or too low

i. Vacuum manifold pressure is too high or too low

j. Temperature symptoms

k. Ion source will not heat up

l. Mass filter (quad) heater will not heat up

m. GC/MSD interface will not heat up

4. Error messages

Numerous possibilities, refer to proper system hardware manual

5. Contamination

Excessive background in mass spectra

6. Air leaks

a. Higher than normal vacuum pressure

b. Higher than normal background

c. Peaks characteristic of air (m/z 18, 28, 32, 44)

d. Poor sensitivity

All corrective maintenance procedures, whether performed internally or by outside contractor, must be fully documented in the instrument maintenance logbook in a clear, concise manner.

End of document

Version history

Version	Approval	Revision information	
5	13.APR.2011		
6	12.SEP.2019		

eurofins	Always check on-line for validity. **Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS**	Level: **Work Instruction**
Document number: **T-SVOA-WI9617**		
Old Reference: **1-P-QM-WI-9015100**		
Version: **12.1**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date **26-APR-2021**	Document users: **5_EUUSLA_GC/MS Semivolatiles_All**	Responsible: **5_EUUSLA_GC/MS Semivolatiles_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I
Table II
Table III
Table IV

Revision Log

Revision: 12	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	Method not applicable to procedure	Removed TALS method 8270C
Throughout document	Clarification	Removed all references to footnotes regarding qualified data and drafted a general statement addressing data qualification as a means to differentiate between data that needs to be qualified and instances that require corrective action

Revision: 11	**Effective Date:**	17-MAR-2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	New analyses	Added LIMS ID for malononitrile (12987) and state-specific master 14960
Reference	Reflects current practice	Removed reference to method 8000C
Cross Reference	Enhancement	Added references to extractables SOPs
Basic Principles	Enhancement	Added references to extractables SOPs; made volume of injections less specific to allow for variation

Revision: 11	**Effective Date:**	17-MAR-2020
Section	**Justification**	**Changes**
Interferences	Enhancement	Added discussion of sample matrix as a possible interference
Personnel Training and Qualifications	Enhancement	Added specific information regarding IDOC spiking and acceptance criteria. Added additional DOC option
Sample Collection, Preservation, and Handling	Reflects current practice	Added specific information regarding collection containers and enhanced extract storage conditions
Reagents and Standards	Formatting requirements	Added chemical names for methylene chloride
Procedure E.2.	Removing duplicate	Both DFTPP tables were identical so one was removed
Procedure F.1.	Enhancement	Added tables addressing MDLs and ICVs; provided additional corrective actions; discussed the dropping of calibration points
Procedure F.2.	Clarification	Clarified that COD failure exceptions are not to be used for compliance samples and data reported under a calibration with a failed COD must be qualified
Procedure G.	Clarification	Clarified that low failures require analysis of a sensitivity check; added what can be done in the case of high failures; removed two consecutive CCV requirement as this was removed in 2016 TNI update – this was replaced with new TNI requirements
Procedure	Enhancement	Added sample analysis step and re-numbered section accordingly
Procedure	Clarification	Added acceptability of use of a certified reference library for reference spectra
Calculations	Ease of use	Removed all calibrations from this section and referred the reader to *T-SVOA-FRM9602*
Statistical Information and Method Performance	Clarification	Re-worded entire section
Quality Assurance/Quality Control	Clarification	Clarified when LCS/D is used as opposed to LCS/MS/MSD; added spike concentrations of compounds, internals, and surrogates; clarified that high surrogate recoveries in method blanks are OK when there aren't detections in the method blank; clarified when data would be qualified with a comment; added use of marginal exceedance; added MDL and LOQ information

Reference

1. SW-846 Test Method 8270E: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Rev. 6, June 2018.
2. SW-846 Test Method 8270D: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, Rev. 5, February 2015.
3. Test Methods for Evaluating Solid Wastes, SW-846 Method 8000D, Rev. 5, July 2018.
4. *Federal Register*, Vol. 57, No. 227, November 24, 1992, p. 55114 (TCLP).
5. *Federal Register*, Vol. 57, No. 160, August 18, 1992, p. 37203 (CCW).
6. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title

Document	Document Title
T-OE-SVOA-WI10917	Waste Dilution, EPA 3580A for Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix
T-OE-SVOA-WI10916	Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix
T-OE-SVOA-WI10928	Microwave Extraction by Method 3546 for Semivolatiles
T-OE-SVOA-WI10935	Separatory Funnel Extraction (Method 3510C) or Waste Dilution (Method 3580A) of Base Neutrals and Acid Extractables in Leachates
T-OE-SVOA-WI11432	Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater
T-SVOA-FRM9602	Dept 4026 Calculations
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards
T-SVOA-WI9598	GC/MS Preventative and Corrective Maintenance
T-SVOA-WI9604	Monitoring GC/MS Semivolatile QC Data Acceptance Limits
Q-EQA-FRM6869	Nonconformance Form
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is suitable for the determination of the concentration of certain semivolatile organic compounds (priority pollutant list, target compound list, Appendix IX list, TCLP list, and CCW list) found in soils, tissues, waters, and leachates. Typical limits of quantitation (LOQ) achieved are 33 µg/kg for soils, 132 µg/kg for tissues, 1 µg/L for waters, and 0.002 mg/L for leachates. Specific compound lists and associated method detection limits (MDLs) and LOQs can be found in the Laboratory Information Management System (LIMS) under the analysis numbers listed in the header of this SOP.

Basic Principles

Water samples are extracted according to *T-OE-SVOA-WI11432*. Soil samples are extracted according to T-OE-SVOA-WI10925 or *T-OE-SVOA-WI10928*. Leachates are extracted according to *T-OE-SVOA-WI10935*. Non-water soluble matrices are extracted according to *T-OE-SVOA-WI10917*.

An environmental sample (soil, water, sludge, etc.) is solvent extracted and then analyzed by electron impact gas chromatography/mass spectrometry (EI GC/MS). A predetermined aliquot of an extract containing organic compounds in solvent is injected onto a fused silica capillary column coated with a relatively non-polar stationary phase, which is enclosed in a temperature controlled oven. A carrier gas, which is ultra-pure helium, passes continuously through the column. The GC oven is temperature programmed and the organic mixture separates into its individual components as it moves along the length of the column. This separation is the function of the polarity and boiling point of the individual compounds. This column empties into a mass selective detector. When a compound reaches the detector, it is bombarded by high-energy electrons (70eV). This causes the compounds to fragment, forming ions. By applying various voltages to the lens, the positive ions are thrust into a quadrupole mass analyzer, which selects for a given mass fragment at a given time. These selected fragments reach an electron multiplier that detects and generates a signal for each mass fragment. The signals are amplified and sent to a computer. Target compounds are identified on the basis of relative retention times and spectral match to standards that are injected every 12 hours on the same system.

Quantification is achieved via use of the internal standard calibration technique. The average relative response factor of a multi-point calibration is used for quantification when the appropriate criteria are met.

Interferences

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in the processing of samples. All glassware is solvent rinsed before use and a method blank is performed with each extraction batch to demonstrate that the extraction system is free of contamination.

Sample matrices can have an effect on the ability of the GC/MS system to resolve the individual masses used for quantification. Samples may require dilutions, a reduction in the extraction volume/weight used, a raised final extraction volume, or extract clean-up using various techniques in order to achieve proper target separation and determination.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound and reagent should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means are available such as fume hoods, safety glasses, lab coats, and gloves.

All solvent waste generated from this analysis must be collected for recycling (if applicable) or must be disposed of in designated containers. These are then transferred to a lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) must be disposed of in the normal solid waste collection containers or sharps containers, as applicable.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently perform daily maintenance, calibrate the instrument, change the column, clean the source, interpret chromatograms, perform calculations, review data, and enter data into the LIMS. The analyst is also trained on the preparation of dilutions and calibration standards. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are spiked at a concentration that is 1-4x the LOQ and are carried through all steps of the procedure. The defined acceptance criteria must be met. The criteria include the calculation of mean accuracy and standard deviation. The mean accuracy for all compounds must fall within the laboratory's most recent statistically derived LCS limits ±20% and must exhibit a standard deviation =20%.

Various options are available for a DOC and can include four laboratory control samples, one blind sample, or 1 valid initial calibration curve combined with four valid continuing calibration checks. Refer to *QA-SOP11178* for more guidance on these options.

Sample Collection, Preservation, and Handling

Water samples are collected in 250mL or 1L glass amber glass containers with PTFE-lined lids and may be preserved with sodium thiosulfate ($Na_2S_2O_3$). They are stored at 0ºC to 6ºC, not frozen, prior to extraction and must be extracted within 7 days of collection.

Solid samples are collected in glass wide-mouth jars with PTFE-lined lids and are not preserved. They are stored at 0ºC to 6ºC, not frozen, prior to extraction and must be extracted within 14 days of collection.

All sample extracts must be stored at ≤-10ºC (freezer) and protected from light using amber glass vials. All samples, sample extracts, and standards must be stored separately and in an area free from contamination. All extracts must be analyzed within 40 days of extraction.

Apparatus and Equipment

1. Hewlett-Packard Model 5890 (Series I and II) or Hewlett-Packard/Agilent 6890 or 7890 Gas Chromatograph or equivalent
2. Hewlett-Packard Models 5971, 5972, and Hewlett-Packard/Agilent 5973, 5975 Mass Selective Detector or equivalent
3. Hewlett-Packard ChemStation Software
4. Thru-Put Systems Target Acquisition Software/Oracle Database or equivalent
5. Column – 20 M × 0.18 mm ID × 0.18 µm, Agilent DB-5MS or equivalent
6. Column - 30M × 0.25 mm ID x 0.25 µm df, J&W Scientific DB-5MS or equivalent
7. Hamilton Gastight syringe, or equivalent – various volumes
8. Amber GC vials with crimp caps

Reagents and Standards

A. Reagents - All reagents are stored per manufacturer guidelines unless otherwise noted. Reagent vendors are subject to change without notification.

1. Helium carrier gas, UPC grade
2. Methylene chloride ($MeCl_2$ or CH_2Cl_2) – Baker Ultra Resi-Analyzed

B. Standards

1. Supelco Equity Semivolatile Internal Standard Mix, Part #46955-U or equivalent, 1000 µg/mL in methylene chloride. Ampulated solutions are maintained under refrigeration (0° to 6°C, not frozen) until consumed or manufacturer determined expiration date. Working solution is maintained at room temperature and is replenished daily from ampulated solutions. For 250 mL aqueous analyses Supelco Equity Semivolatile Internal Stanadard Mix is diluted 4x to make a 250 µg/mL in methylene chloride solution. This solution is maintained under refrigeration (0° to 6°C, not frozen) for up to 6 months.

2. Refer to *T-SVOA-WI11998* for the preparation and storage of tuning, calibration, and spiking solutions.

Calibration

See Procedure F for initial calibration processing and Procedure G for continuing calibration check processing.

Procedure

A. Standard preparation – Solutions are used to standardize the GC/MS system every 12 hours and are prepared approximately every 20-30 days or more frequently if needed based on consumption. See *T-SVOA-WI11998* for standard preparation. Calibration standard solutions may be used up to the labeled expiration date or until component degradation is observed. Degradation is determined by the inability to pass continuing calibration checks or by observations of unacceptable chromatography.

B. Internal standard mix is added to all standards and subsequent samples at a concentration of 20 µg/mL (5 µg/mL for 250 mL aqueous analyses). Using a 25-µL syringe, 20 µL of Supelco Equity Semivolatile Internal Standard Mix or equivalent, 1000 µg/mL (250 µg/mL for 250 mL aqueous analyses) in methylene chloride are added to 1 mL of standard or sample extract. If only 0.5 mL of sample is in the vial, 10 µL of internal spiking solution is added to the sample. See Table II for the list of compounds calibrated for and the internal standard that is assigned to each.

C. Daily maintenance – Refer to *T-SVOA-WI9598* for this procedure.

D. Instrument conditions

Equip a GC/MS (such as referenced under Apparatus and Equipment) in one of the two following manners:

1. For a 5890/5971 or 5972 and 6890/5973 or 5975

a. Column – 30M × 0.25 mm ID x 0.25 µm df, J&W Scientific DB-5MS or equivalent

b. Injector – Split/splitless operated in splitless mode

c. Injector Temp – 275°C

d. Detector Temp – 300°C

e. Gas – Helium at approximately 1.5 mL/min, constant flow mode

f. Oven Temp – 45°C for 3 minutes, ramp at 8°C/minute to 225°C, then ramp at 12°C/minute to 300°C and hold for 7.5 minutes.

2. For a 6890/5973 or 5975

a. Column – 20M × 0.18 mm ID x 0.18 µm df, J&W Scientific DB-5MS or equivalent

b. Injector – Split/splitless operated in split mode, 20:1 split

c. Injector Temp – 275°C

d. Detector Temp – 280°C

e. Gas – Helium at approximately 1.0 mL/min, constant flow mode

f. Oven Temp – 40°C for 1 minute, ramp at 25°C/minute to 100°C, then ramp at 30°C/minute to 280°C, followed by another ramp at 25°C/minute to 320°C, hold for 2 minutes.

NOTE: It is not necessary to use the exact parameters listed above. Equivalent columns and conditions may be used to improve the linearity, sensitivity, overall chromatography, and performance required by the method on each GC/MS system.

E. Tuning

1. The DFTPP tune check standard is used to assess GC column performance and injection port inertness as well as mass spectrometer performance. The GC/MS system's tune is checked by inspecting the mass spectrum of the DFTPP peak and column performance and injection port inertness is evaluated with pentachlorophenol, benzidine, and DDT.

2. The GC/MS should be tuned using a predetermined aliquot of a 50 ng/µL or 12.5 ng/µL solution of DFTPP containing decafluorotriphenylphosphine, pentachlorophenol, benzidine, and DDT. This solution is prepared as indicated in *T-SVOA-WI11998*. See the tables below for acceptance criteria and corrective actions.

DFTPP Frequency	Acceptance Criteria	Corrective Action
Prior to initial calibration and every 12 hours prior to continuing calibration standard	1. Criteria in Table I 2. DDT breakdown ≤20%* 3. Tailing factors: - Benzidine ≤ 2 - Pentachlorophenol ≤ 2	1. Re-tune. Analysis cannot proceed until tune meets criteria. 2. More aggressive injection port maintenance. 3. Clean the source. 4. Change the column.

***NOTE:** DDT breakdown greater than 20% may be acceptable if you are calibrating for polynuclear aromatic hydrocarbon compounds only. Consult your supervisor when this situation occurs.

3. Use only the background-subtracted spectrum of the following when evaluating the DFTPP:

A three scan average of the apex of the scan, the apex of the scan –1 and the apex of the scan +1.

NOTE: All standards, samples, and associated quality control samples with a particular tune must use the identical conditions of the mass spectrometer.

F. Initial calibration (ICAL)

1. Perform standardization by analyzing at least five levels of calibration standards ranging from 0.5 µg/mL to 120 µg/mL or from 0.125 µg/mL to 30 µg/mL for mini-sep waters analysis. (Refer to *T-SVOA-WI11998* for the preparation of calibration standards.) Use the internal standard calibration technique to generate an average relative response factor for each target compound and surrogate. The relative standard deviation (%RSD) of the response factors determines the suitability of the average relative response factor for calculation of compound concentration. At the end of the calibration standard injections, inject a Method Detection Limit (MDL) standard and an initial calibration verification (ICV) standard. See the tables below for acceptance criteria and corrective actions.

ICAL Frequency	Acceptance Criteria	Corrective Action
Initially and when the daily calibration standard fails criteria.	1. Minimum response factors must be met in all levels of the calibration – especially in the lowest level of the calibration (see table IV).** 2. %RSD for each compound must be ≤20%. If more than 10% of the compounds in the ICAL exceed 20% RSD and/or also do not meet the minimum correlation coefficient for alternate fits (ie, the correlation coefficient is	1. Any target compound with a %RSD <20% will use the average RRF. For any compound in which the %RSD >20%, use a first degree (linear) fit provided the correlation coefficient (CC; r) is ≥0.995 or the coefficient of determination (COD;r^2) is ≥0.99. If the linear fit fails to meet this criteria, then a second order (quadratic) fit may be used*** provided the coefficient of determination is ≥0.99. If use of both the

	<0.990) then the analysis cannot proceed. 3. For any compound on a linear or quadratic fit the % error is measured between the calculated and expected amounts of the compound(s) at each calibration level to determine the calibration function acceptability for linear and non-linear curves. The % error must be ≤50% for the low calibration point. For calibration points above the LOQ the % error must be ≤30%. 4. The relative retention times of the target compounds must agree within 0.06 relative retention time units. 5. Structural isomers that produce very similar mass spectra are identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.	linear fit and the quadratic fit is acceptable using this criteria for any given compound, then use the fit with the smallest negative y-intercept. When using a quadratic fit, if the y-intercept quantifies to be greater than the MDL, consult your supervisor immediately or re-calibrate. See below for corrective action if the coefficient of determination for a quadratic fit is <0.99.* 2. Re-inject any levels that appear to be outliers due to an injection error. 3. If standard levels on the outside of the curve appear to be outliers for individual compounds and are throwing off the calibration curve, they can be dropped from the calibration keeping the following in mind: a. If a low calibration point is dropped, the analyst must ensure that the compound is still being calibrated to or below its LOQ. b. If a high calibration point is dropped, any detections must recover below the new upper calibration limit. 4. Re-prep calibration standards. 5. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

*See USEPA Method 8000D for the calculations associated with non-linear fit types.
**Minimum response factors are not required to be met for method 8270E. They are provided for guidance.
***Quadratic fits are not permitted when analyzing samples from South Carolina.

MDL Frequency	Acceptance Criteria	Corrective Action
Immediately following an initial calibration and before sample analysis	1. The system must be able to detect all compounds in the MDL standard.	1. If any compounds are not detected in the MDL standard, analysis can proceed if the compound is detected at or below its MDL in a higher concentration level. 2. If the system does not detect the compound(s), then the tuning and/or calibration procedure must be repeated under conditions that will yield a detection for the compound(s) or the MDL must be raised for the compound(s). 3. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

ICV Frequency	Acceptance Criteria	Corrective Action

ICV Frequency	Acceptance Criteria	Corrective Action
Immediately following an initial calibration and before sample analysis	1. The ICV must be prepared using a second source standard. 2. %Drift for each compound must be ≤30% 3. The EICP area for each internal standard must fall within the window of -50% to +100% of the areas from the mid-level calibration standard produced during the initial calibration.	1. Re-prep and re-analyze the ICV. 2. If the recovery for any compound fails these criteria low, the compound cannot be analyzed for under the calibration until a new calibration has been established or a passing ICV has been analyzed. 3. If the recovery for any compound fails these criteria high, the compound may be analyzed for but any samples with detections should be re-analyzed under a valid ICAL or will be reported with a qualifying comment. 4. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

With supervisory approval, the following problematic compounds can be allowed to fail the 0.99 coefficient of determination criteria for a quadratic fit. If the COD is less than 0.99 for any other compound, the system should be inspected for problems and re-calibrated. Supervisory approval is required for exceptions to these guidelines.

1,4-Phenylenediamine
4-Aminobiphenyl
3,3’-Dimethylbenzidine
4,4’-Methylenebis(2-chloroaniline)
4-Nitroquinoline-1-oxide
1,4-Naphthoquinone
methapyrilene

Note that this allowance is not to be used for compliance samples, and any data reported under the calibration must be qualified.

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

3. Six levels of calibration standards must be used if a quadratic (second-order) type calibration fit is used.

4. One of the calibration standards must be at a concentration at or below the limit of quantitation (LOQ). The other concentrations correspond to the expected range of concentrations found in samples or should define the working range of the GC/MS system.

5. The concentration of the MDL standard may require modification dependent upon the current MDL values.

G. Continuing Calibration Verification (CCV)

1. Perform a continuing calibration verification (CCV) by injecting a predetermined aliquot of a calibration standard at a concentration near the mid-point of the calibration, not to exceed ½ the highest level in the calibration.

CCV Frequency	Acceptance Criteria	Corrective Action

1. Every 12 hours. 2. The CCV is analyzed each day a curve is not analyzed. 3. The CCV is analyzed after the DFTPP.	Target compounds must meet the minimum response factor criteria (see Table IV).* 1. The maximum % drift for all target compounds is 20%. No more than 20% of the target compounds can be greater than 20% drift. All target compounds that exceed 20% drift must be less than or equal to 50% drift. 2. The relative retention times of the internal standards must be within 10 seconds of the retention times from the mid-level calibration standard of the last initial calibration. The exception would be in the case of column maintenance. 3. The EICP area for each internal standard must fall within the window of -50% to +100% from the areas of the mid-level standard produced during the last initial calibration. 4. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. The resolution should be verified on the mid-point concentration of the ICAL as well as the check standard.	1. In cases where compound(s) recover >20%D low, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound(s) at the applicable quantitation limit. For situations when the failed compound is present, the concentrations must be reported as estimated values. 2. In cases where compound(s) recover >20%D high, analysis may continue, but any samples with detections should be re-analyzed under a valid CCV or the results will be qualified. 3. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

*Minimum response factors are not required to be met for method 8270E. They are provided for guidance.

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

2. In the event that a CCV fails and the cause is not obvious such as in the case of a concentrated standard or a mis-injection, corrective action must be taken. The corrective action must be documented in the form of a non-conformance memo or with an internal non-conformance form (*Q-EQA-FRM6869*). If the CCV does not pass after corrective action, a new initial calibration must be established.

H. Analysis of Samples:

1. All sample extracts are stored at ≤-10°C and protected from light from the time of sample extraction.

2. Prior to sample analysis, add 20 µL of internal standard to each 1.0 mL of sample extract. Concentration of internal standards in extract is 20 ng/µL (5 ng/µL for 250 mL aqueous analyses).

3. Analyze a predetermined aliquot of each sample extract under the same conditions used for the initial and continuing calibrations.

4. At the conclusion of data acquisition, use the same software to tentatively identify peaks within the retention time window of interest. Examine the ion abundances of components in the chromatogram. If the ion abundance of the target ion used for quantitation exceeds the calibration range, dilute the aliquot and reanalyze. When preparing dilutions, add sufficient internal standard to maintain the same concentration as that of the ICAL.

Dilution criteria:

1) Initial dilutions are recommended in the following situations:

i. More than three internal standard recoveries are <-50%

ii. Either of the last two internal standard recoveries are <-80%.

iii. The analyst's judgment of a sample extract's color or viscosity indicates possible matrix interference.

2) Secondary dilutions are required to bring all target compounds into the calibration range of the GC/MS.

I. Qualitative analysis

A compound is identified by comparison of the following parameters with those of a standard of the suspected compound (standard reference spectra). The reference mass spectrum used for this comparison should be generated by the laboratory using the conditions of the method, but the laboratory may also

use a certified reference library. In order to verify identification, the following criteria must be met:

1. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

2. The sample component relative retention time must compare within ±0.06 RRT units of the RRT of the standard component.

3. The relative intensities of the qualifier ion(s) should agree within 30% of the relative intensities of these ions in the reference spectrum.

NOTE: N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. For this reason, it is acceptable to report the combined result for both n-nitrosodiphenylamine and diphenylamine for either of these compounds as a combined concentration.

NOTE: 1,2-Diphenylhydrazine is unstable even at room temperature and readily converts to azobenzene. Given the stability problems, it would be acceptable to calibrate for 1,2-diphenylhydrazine using azobenzene. Under these poor compound separation circumstances the results for either of these compounds should be reported as a combined concentration.

J. Quantitative analysis

Once a compound has been identified, quantitation is based on the internal standard technique and the integrated abundance from the extracted ion current profile (EICP) of the primary characteristic ion. The list of primary characteristic ions and secondary ions can be found in Table III.

Calculations

Refer to *T-SVOA-FRM9602* for all calculations.

Statistical Information/Method Performance

LCS, MS, surrogate, and RPD recoveries are compared to the limits stored in the LIMS. LCS and surrogate limits are statistically derived every six months in accordance with *T-SVOA-WI9604*. All RPDs are set to a default value of 30%. MS limits are set equal to LCS limits.

Historical data for MS/Ds, LCS/Ds, surrogates, and measurement of uncertainty is reviewed at least annually.

Refer to the QA/QC section of this SOP and the criteria listed throughout this procedure for additional information on the performance of this method.

Quality Assurance/Quality Control

A. Batch QC

1. Each extraction batch of ≤20 samples must contain a method blank, a laboratory control sample (LCS) and an unspiked background sample (US), a matrix spike (MS), and a matrix spike duplicate (MSD).

2. A laboratory control sample/laboratory control sample duplicate (LCS/LCSD) is prepared with the extraction batch if adequate sample volume is not provided to prepare a matrix spike and matrix spike duplicate.

3. Additional QC samples may be required to meet project or state certification requirements.

B. QC and sample spiking

1. The LCS/D and MS/D are spiked at a concentration of 50 µg/L with the exception of the following (in µg/L):

Hexachlorocyclopentadiene	100	Benzoic acid	100
2,4-Dinitrophenol	100	1-Naphthylamine	100
2-Naphthylamine	100	3,3’-Dimethylbenzidine	100
Benzidine	250	3-Methylphenol	25
4-Methylphenol	25		

2. All samples are spiked with surrogates by the organic extraction group to evaluate the extraction process. Acid extractable surrogates are spiked at a concentration of 200 ng/µL and base/neutral extractable surrogates are spiked at a concentration of 100 ng/µL.

3. Prior to analysis each extract is spiked with an internal standard mix at a concentration of 20 ng/µL.

4. All spiking concentrations are 4x lower for 250 mL aqueous analyses.

C. QC items, acceptance criteria, and corrective actions.

NOTE: If any client, state, or agency has more stringent QC, QC limits, or batch requirements, these must be followed instead.

Quality Control Item	Acceptance Criteria	Corrective Action

Quality Control Item	Acceptance Criteria	Corrective Action
Internal Standards	1. Peak area within -50% to +100% of the area in the associated reference standard. 2. Retention time (RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then re-inject sample(s). 2. If re-injection meets the criteria, report this injection. 3. If re-injection still shows the same problem, report first injection. 4. If there is substantial matrix interference, the analyst may dilute the extract as outlined in Procedure H.4.
Method Blank	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All target compounds must be less than the reporting limit for the associated samples.	1. Inspect system for possible problems and reanalyze. 2. If the surrogates are out of spec high data can be used provided there aren't detections in the method blank. 3. If the surrogates are out of spec low and there aren't detections in the associated samples, the data can be used.* 4. If the method blank contains target compounds and the associated samples do not contain these compounds, no corrective action is required. 5. If the target compounds in the blank are also in the associated samples at a concentration <10x that in the blank, the samples are re-extracted unless the detection does not interfere with project data requirements. 6. If the target compounds in the blank are also in the associated samples at a concentration >10x than in the blank the data is usable.
Instrument Blank**	1. Must run after the CCV if no clean method blank is analyzed at the beginning of a 12-hour analytical period. 2. Must meet internal standard criteria. 3. All target compounds must be less than the reporting limit for the associated samples.	1. Inspect system for possible problems and reanalyze. 2. If the instrument blank contains target compounds and the associated samples do not contain these compounds, no corrective action is required. If the target compounds in the blank are also in the associated samples, the samples should be re-extracted unless it does not interfere with project data requirements or if sample detections are at a level 10x higher than the detections in the blank.

Quality Control Item	Acceptance Criteria	Corrective Action
Laboratory Control Sample/Laboratory Control Sample Duplicate	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. % Recoveries within QC limits. Refer to the analysis numbers in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis. 4. RPDs within QC limits.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD recoveries are still outside acceptance limits, one of the following actions must be taken: a. if recoveries are outside acceptance limits low, the sample(s) must be re-extracted. b. if recoveries are outside acceptance limits high, data may be usable if the compounds that recovered above QC limits are not detected in samples. c. if recoveries are outside acceptance limits high and there are detections for the failing compounds, the sample(s) must be re-extracted. 4. If RPDs fail but recoveries are within QC limits, no further action is required. 5. If surrogates fail to meet criteria but all target compounds are within specification, data is usable.* 6. Marginal exceedance limits, as defined in the NELAC standards, may be used if the defined requirements have been met.
Matrix Spike/Matrix Spike Duplicate(MS/MSD)	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. % Recoveries within LCS limits. Refer to the analysis number in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis. 4. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries or RPDs out of spec, consult supervisor. BKG, MS, MSD may need to be re-extracted.
Surrogates	% Recoveries within QC limits. Refer to the analysis numbers in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If no problem is found, re-extract and reanalyze. 4. If surrogates are out of spec high and no targets are detected in the sample no corrective action is required. 5. For samples analyzed only at a dilution ≥10x, no further action is required for surrogate failures.

*Requires approval of supervisor
**Method blank or instrument blank in each 12-hour analytical period required for 8270E.

NOTE: Any failures without corrective action require approval of supervisor and completion of a non-conformance memo (NCM).

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

D. Lower Limit of Quantitation (LLOQ)

1. Refer to *QA-SOP11892* for initial and ongoing LLOQ requirements.

E. Method Detection Limit (MDL)

1. Refer to *QA-SOP11892* for initial and ongoing MDL requirements.

F. Limit of Quantitation (LOQ)

1. Refer to *QA-SOP11892* for initial and ongoing LOQ requirements.
2. Until the laboratory has sufficient data to determine the acceptance limits, the LLOQ criteria is ± 20% of the statistically determined LCS limits.

Table I

DFTPP Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
51	10% to 80% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	10% to 80% of mass 198
197	<2% of mass 198
198	Base peak, or >50% of mass 442
199	5% to 9% of mass 198
275	10% to 60% of mass 198
365	>1% of mass 198
441	Present but less than 24% of mass 442
442	Base peak, or >50% of mass 198
443	15% to 24% of mass 442

Table II

Semivolatile Internal Standard with Corresponding Compounds Assigned for Quantitation

1,4-Dichlorobenzene-d_4	Naphthalene-d_8	Acenaphthene-d_{10}
Acrylamide		
Aniline	Acetophenone	Acenaphthene
Benzyl alcohol	Benzoic acid	Acenaphthylene
Bis(2-chloroethyl) ether	Bis(2-chloroethoxy)methane	1-Chloronaphthalene
Bis(2-chloroisopropyl) ether	4-Chloroaniline	2-Chloronaphthalene
2-Chlorophenol	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether
1,3-Dichlorobenzene	2,4-Dichlorophenol	Dibenzofuran
1,4-Dichlorobenzene	2,6-Dichlorophenol	Diethyl phthalate
1,2-Dichlorobenzene	α,α-Dimethylphenylamine	Dimethyl phthalate
Ethyl methanesulfonate	2,4-Dimethylphenol	2,4-Dinitrophenol
2-Fluorophenol (surr)	Hexachlorobutadiene	2,4-Dinitrotoluene
Hexachloroethane	Isophorone	2,6-Dinitrotoluene
Methyl methanesulfonate	2-Methylnaphthalene	Fluorene
2-Methylphenol	Naphthalene	2-Fluorobiphenyl (surr)
4-Methylphenol	Nitrobenzene	Hexachlorocyclopentadiene
N-Nitrosodimethylamine	Nitrobenzene-d5 (surr)	1-Naphthylamine
N-Nitroso-di-n-propyl amine	2-Nitrophenol	2-Naphthylamine
Phenol	N-Nitrosodi-n-butylamine	2-Nitroaniline
Phenol-d6 (surr)	N-Nitrosopiperidine	3-Nitroaniline
2-Picoline	1,2,4-Trichlorobenzene	4-Nitroaniline
1,4-Dioxane	1-Methylnaphthalene	4-Nitrophenol
Pyridine	O,O,O-triethylphosphorothioate	Pentachlorobenzene
		1,2,3,4-Tetrachlorobenzene
		1,2,3,5-Tetrachlorobenzene
Acetophenone	Hexachlorpropene	1,2,4,5-Tetrachlorobenzene
o-Toluidine	1,4-Phenylenediamine	2,3,4,6-Tetrachlorophenol
N-Nitrosomethylethylamine	Safrole	2,4,6-Tribromophenol (surr)
N-Nitrosodiethylamine	(2-Bromoethyl)benzene	2,4,6-Trichlorophenol
N-Nitrosopyrrolidine	Caprolactam	2,4,5-Trichlorophenol
N-Nitrosomorpholine	1, 3, 5 – Trichlorobenzene	1,1'-Biphenyl
N,N-dimethyl formamide	1, 2, 3 – Trichlorobenzene	Diphenyl ether
N,N-dimethyl acetamide	1, 2, 3, 4 – Tetrachlorobenzene	Isosafrole
Benzaldehyde	1 – Chloro-4-Nitrobenzene	1,4-Naphthoquinone
Malononitrile	2-chlorobenzaldehyde	1,4-Dinitrobenzene
		1,3-Dinitrobenzene
		Thionazin

(surr) = surrogate

5-Nitro-o-toluidine
2-chlorobenzalmalononitrile

Phenanthrene-d_{10}
4-Aminobiphenyl
Anthracene
4-Bromophenyl phenyl ether
Di-n-butyl phthalate
4,6-Dinitro-2-methylphenol
Fluoranthene
Hexachlorobenzene
N-Nitrosodiphenylamine
Octachlorostyrene
Pentachlorophenol
Pentachloronitrobenzene
Phenacetin
Phenanthrene
Pronamide
1-Nitronaphthalene
1,2-Diphenylhydrazine
Carbazole
Tetraethyldithiopyrophosphate
1,3,5-Trinitrobenzene
Diallate trans/cis
Phorate
Dimethoate
Methyl parathion
Parathion
4-Nitroquinoline-1-oxide
Methapyrilene
Isodrin
Atrazine

(surr) = surrogate
Benzophenone

Pyrene-d_{10}
Benzidine
Benzo(a)anthracene
Bis(2-ethylhexyl) phthalate
Butyl benzyl phthalate
Chrysene
3,3'-Dichlorobenzidine
p-Dimethylaminoazobenzene
Pyrene
Terphenyl-d_{14} (surr)
7,12-Dimethylbenz(a)anthracene
Chlorobenzilate
2-Acetylaminofluorene
3,3'-Dimethylbenzidine
4,4'-Methylenebis(2-Chloroaniline)
3-Quinuclidinyl benzilate

Perylene-d_{12}
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Dibenz(a,j)acridine
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Di-n-octylphthalate
3-Methylcholanthrene

Table III

Characteristic Ions for Semivolatile Compounds

Compound	Primary Ion	Secondary Ions
2-Picoline	93	66, 92
Aniline	93	66, 65
Phenol	94	65,66
Bis(2-chloroethyl) ether	93	63,95
2-Chlorophenol	128	64,130
1,3-Dichlorobenzene	146	148, 113
1,4-Dichlorobenzene-d_4 (IS)	152	150,115
1,4-Dichlorobenzene	146	148, 113
Benzyl alcohol	108	79,77
1,2-Dichlorobenzene	146	148, 113
N-Nitrosomethylethylamine	88	42,43,56
Bis(2-chloroisopropyl) ether	45	77, 121, 79
Methyl methanesulfonate	80	79,65,95
N-Nitrosodi-n-propylamine	70	42,101,130
Hexachloroethane	117	201,199
Nitrobenzene	77	123,65
Isophorone	82	95,138
N-Nitrosodiethylamine	102	42,57,44,56
2-Nitrophenol	139	109,65
2,4-Dimethylphenol	107	122, 121
Bis(2-chloroethoxy)methane	93	95,123
Benzoic acid	105	122,77
2,4-Dichlorophenol	162	164,98

Characteristic Ions for Semivolatile Compounds

Compound	Primary Ion	Secondary Ions
Ethyl methanesulfonate	109	79,97,45,65
1,2,4-Trichlorobenzene	180	182,145
Naphthalene-d_8 (IS)	136	68
Naphthalene	128	129,127
Hexachlorobutadiene	225	223,227
4-Chloro-3-methylphenol	107	144,142
2-Methylnaphthalene	142	141, 115
2-Methylphenol	108	107,77,79,90
Hexachloropropene	213	211, 215, 117, 141
Hexachlorocyclopentadiene	237	235,272
N-Nitrosopyrrolidine	100	41,42,68,69
Acetophenone	105	71,51,120
4-Methylphenol	108	107,77,79,90
2,4,6-Trichlorophenol	196	198, 200
o-Toluidine	106	107,77,51,79
3-Methylphenol (as 4-Methylphenol)	108	107,77,79,90
2-Chloronaphthalene	162	127,164
N-Nitrosopiperidine	114	42,55,56,41
1,4-Phenylenediamine	108	80,53,54,52
1-Chloronaphthalene	162	127,164
2-Nitroaniline	138	92, 65
Dimethyl phthalate	163	194,164
Acenaphthylene	152	151,153
2,6-Dinitrotoluene	165	63,89, 121
Phthalic anhydride	104	76,148
3-Nitroaniline	138	108,92
Acenaphthene-d_{10} (IS)	164	162,160
Acenaphthene	153	154, 152
2,4-Dinitrophenol	184	63, 154, 107
2,6-Dinitrophenol	162	164,126,98,63
4-Chloroaniline	127	129,65,92
Isosafrole	162	131,104,77,51
Dibenzofuran	168	139
2,4-Dinitrotoluene	165	63,89, 182
4-Nitrophenol	109	139,65
2-Naphthylamine	143	115,116
1,4-Naphthoquinone	158	104,102,76,130
Diethyl phthalate	149	177,150
Fluorene	166	165,167
N-Nitrosodi-n-butylamine	84	57,41,116,158
4-Chlorophenyl phenyl ether	204	206,141
4,6-Dinitro-2-methylphenol	198	51, 105, 182, 77
N-Nitrosodiphenylamine	169	168,167
Safrole	162	104,77,103,135
Diphenylamine	169	168,167
1,2,4,5-Tetrachlorobenzene	216	214,179,143,218
1-Naphthylamine	143	115,89,63
4-Bromophenyl phenyl ether	248	250,141
2,4,5-Trichlorophenol	196	198,97,132,200
Hexachlorobenzene	283	142,249
Pentachlorophenol	266	264,268

Characteristic Ions for Semivolatile Compounds

Compound	Primary Ion	Secondary Ions
5-Nitro-o-toluidine	152	77,79,106,94
Thionazin	107	96,97,143,79
4-Nitroaniline	138	65,108,92,80
Phenanthrene-d_{10} (IS)	188	94,80
Phenanthrene	178	179,176
Anthracene	178	176,179
1,4-Dinitrobenzene	168	75,50,76,92
1,3-Dinitrobenzene	168	76,50,75,92
Diallate (cis or trans)	86	234,43,70
Pentachlorobenzene	250	252,248,215,254
5-Nitro-o-anisidine	168	79,52,138,153,77
Pentachloronitrobenzene	237	142,214,249,295
4-Nitroquinoline-1-oxide	190	160, 116, 114
Di-n-butyl phthalate	149	150,104
2,3,4,6-Tetrachlorophenol	232	131,230,166,234
Fluoranthene	202	101, 203, 100
1,3,5-Trinitrobenzene	213	74,75,120,91
Benzidine	184	92,185
Pyrene	202	101,203
Phorate	75	121,97,93,260
Phenacetin	108	179,109,137,80
Dimethoate	87	93,125,143,229
4-Aminobiphenyl	169	168,170,115
Pronamide	173	175,145,109,147
Dinoseb	211	163,147,117,240
Disulfoton	88	97,89,142,186
Butyl benzyl phthalate	149	91,206
Methyl parathion	109	125,263,79,93
Dimethylaminoazobenzene	225	120,77,148,42
Benz(a)anthracene	228	229,226
Chrysene-d_{12} (IS)	240	120,236
3,3'-Dichlorobenzidine	252	254,126
Chrysene	228	226,229
Parathion	109	97,291, 186
Bis(2-ethylhexyl) phthalate	149	167,279
3,3'-Dimethylbenzidine	212	106,196,180
Methapyrilene	97	58, 72, 191, 261
Isodrin	193	66, 195, 263, 265,
Di-n-octyl phthalate	149	167,43, 150
2-Aminoanthraquinone	223	167, 195, 139
Aramite	185	191,319,334,197,321
Benzo(b)fluoranthene	252	253,125
Benzo(k)fluoranthene	252	253,125
Chlorobenzilate	139	251, 253, 111, 141
Benzo(a)pyrene	252	253,125
Perylene-d_{12} (IS)	264	260,265
7,12-Dimethylbenz(a)anthracene	256	241,239,120
2-Acetylaminofluorene	181	180,223,152
4,4'-Methylenebis(2-chloroaniline)	231	266, 140, 195
3-Methylcholanthrene	268	252,253,126,134

Characteristic Ions for Semivolatile Compounds

Compound	Primary Ion	Secondary Ions
Indeno(1,2,3-cd)pyrene	276	138,227
Dibenz(a,h)anthracene	278	139,279
Benzo(g,h,i)perylene	276	138,277
1,2-Diphenylhydrazine	77	105, 182, 51
Endosulfan I	195	33
2-Fluorobiphenyl (surr)	172	171
2-Fluorophenol (surr)	112	64, 92
Nitrobenzene-d_5 (surr)	82	128,54
N-Nitrosodimethylamine	74	42,44
Phenol-d_6 (surr)	99	42,71
Terphenyl-d_{14} (surr)	244	122,212
2,4,6-Tribromophenol (surr)	330	332,141
N,N-dimethyl formamide	73	44,42
N,N-dimethyl acetamide	87	72,44,42
(2-Bromoethyl)benzene	184	77,91,105,186
Atrazine	200	173,215
Benzaldehyde	77	105, 106
Caprolacatam	113	55,56
1,1-Biphenyl	154	153,152,76
Carbazole	167	166,139
1,3,5-Trichlorobenzene	180	182,145,109
1,2,3-Trichlorobenzene	180	182,145,109
1,2,3,4-Tetrachlorobenzene	216	214,218,179
1-Chloro-4-Nitrobenzene	157	111,75,99
IS = internal standard		
surr = surrogate		
Acrylamide	71	55, 44
Octachlorostyrene	308	343, 380, 273
1,2,3,5-tetrachlorobenzene	216	214, 218, 179, 143
1,2,3,4-tetrachlorobenzene	216	214, 218, 179, 143
2-chlorobenzaldehyde	139	111, 140, 76
Benzophenone	105	182, 77, 51
3-Quinuclidinyl benzilate	183	126, 337, 110
2-chlorobenzalmalononitrile	153	188, 126
Malononitrile	<66	38,39

Table IV

Recommended Minimum Response Factor Criteria for Initial and Continuing Calibration Verification Using the Suggested Ions from Table III

Semivolatile Compounds	Minimum Response Factor (RF)
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl)ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.700
2,2'-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600

Recommended Minimum Response Factor Criteria for Initial and Continuing Calibration Verification Using the Suggested Ions from Table III

Semivolatile Compounds	Minimum Response Factor (RF)
N-Nitroso-di-n-propylamine	0.500
Hexachloroethane	0.300
Nitrobenzene	0.200
Isophorone	0.400
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.200
Bis(2-chloroethoxy)methane	0.300
2,4-Dichlorophenol	0.200
Naphthalene	0.700
4-Chloroaniline	0.010
Caprolactam	0.010
4-Chloro-3-methylphenol	0.200
2-Methylnaphthalene	0.400
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1'-Biphenyl	0.010
2-Chloronaphthalene	0.800
2-Nitroaniline	0.010
Dimethylphthalate	0.010
2,6-Drintrotoluene	0.200
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dintirophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4Dinitrotoluene	0.200
Diethylphthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-Chlorophenyl-phenylether	0.400
Fluorene	0.900
4-Nitroaniline	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenylether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700

Recommended Minimum Response Factor Criteria for Initial and Continuing Calibration Verification Using the Suggested Ions from Table III

Semivolatile Compounds	Minimum Response Factor (RF)
Anthracene	0.700
Carbazole	0.010
Di-n-butylphthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butylbenzylphthalate	0.010
3,3'-Bichlorobenzidine	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Bis(2-ethylhexyl)phthalate	0.010
Di-n-octlyphthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010

Q-EQA-FRM6869 Nonconformance Form
QA-SOP11178 Demonstrations of Capability
QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
T-OE-SVOA-WI10916 Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix
T-OE-SVOA-WI10917 Waste Dilution, EPA 3580A for Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix
T-OE-SVOA-WI10928 Microwave Extraction by Method 3546 for Semivolatiles
T-OE-SVOA-WI10935 Separatory Funnel Extraction (Method 3510C) of Base Neutrals and Acid Extractables in Leachates
T-OE-SVOA-WI11432 Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater
T-SVOA-FRM9602 Dept 4026 Calculations
T-SVOA-WI11998 Semivolatile Spiking and Calibration Standards
T-SVOA-WI9598 GC/MS Preventative and Corrective Maintenance
T-SVOA-WI9604 Monitoring GC/MS Semivolatile QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information
11	17.MAR.2020	
12	10.JUN.2020	
12.1	26.APR.2021	Version 12.1 published for editorial changes only

eurofins	Always check on-line for validity. **Interpretation of Chromatographic Data**	Level: **Work Instruction**
Document number: **T-PEST-WI9954**		
Old Reference: **1-P-QM-PRO-9015494; DOD - SOP-011**		
Version: **16**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **28-FEB-2022**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Chemist Tr, 6_EUUSLA_Pesticide Residue Analysis_All Management**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

Revision Log
Cross Reference
Purpose
Scope
Definitions
Personnel Training and Qualifications
Procedure
Table I

Revision Log

Revision: 16	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure	Reflects current practice	Removed method 504.1

Revision: 15	**Effective Date:**	16-MAR-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Removed all references to old LIMS and replaced all terminology specific to old LIMS with terminology specific to the new LIMS
Definitions	New LIMS	Added NCM definition
Procedure	Reflects current practice	Removed methods: 8141A, 8141B, 608, 622, and OP Pest 622
Attachments	New LIMS	Removed all attachments as they were specific to the old LIMS

Cross Reference

Document	Document Title
T-PEST-WI9980	Monitoring QC Data Acceptance Limits
T-PEST-WI10020	Uploading Data to the LIMS
QA-SOP11913	Laboratory Notebooks, Logbooks, and Documentation

Purpose

The purpose of this SOP is to outline how chromatographic data is interpreted in the pesticide residue group so that consistency between all analysts is ensured.

Scope

This SOP applies to all pesticide, herbicide, PCB, and other analyses performed by GC and HPLC in Department 4024 with the exception of explosives. The explosives (Method 8330) are detailed in the individual methods. This SOP assumes that 1) the samples were run according to the appropriate method, 2) the data was checked for conformance to method criteria, and 3) the samples were analyzed on a calibrated run.

Definitions

1. GC – Gas chromatography or gas chromatograph
2. HPLC – High performance liquid chromatography or chromatograph
3. LOQ – Limit of quantitation
4. MDL – Method detection limit
5. LIMS – Laboratory Information Management System
6. RPD – Relative percent difference (percent difference divided by the true value)
7. RSD – Relative standard deviation (standard deviation divided by the mean)
8. RT – Retention time
9. CCV- Continuing Calibration Verification
10. OOS- Out of specification
11. NCF - Nonconformance Form
12. NCM - Nonconformance Memo

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP.

Each analyst interpreting chromatography data must have documentation that they have read, understood and agree to follow this version of the SOP *T-PEST-WI9980* and the instrumental analysis and extraction methods associated with the data. They must go through several sets of data with an experienced analyst until they can independently determine surrogate and spike concentrations, perform all related calculations, understand and apply the appropriate LOQs and MDLs. They must learn to interpret data for single-component analyses over the course of several weeks, followed by interpretation of multi-component data such as PCBs. Proficiency is measured through verification of data, along with an Initial Demonstration of Capability study. Calculations must be done manually by the trainee and submitted for overchecking at least once for each type of equation used by the software programs. A Demonstration of Capability is also done annually for an ongoing evaluation of proficiency.

Procedure

A. The samples must be run under the following conditions before accurate data interpretation can be performed:

1. The GC or HPLC must be set up according to the method specifications.

2. The retention times on the GC or HPLC must be stable.

3. The data system must be calibrated for each target compound and the correct RT and RT search window must be established and entered into the calibration file for accurate and consistent compound identification.

B. Quality control samples

All blanks, LCS/LCSD, and MS/MSD must conform to the QC acceptance criteria.

C. Interpretation of chromatograms

1. The following items are recorded by Chrom peak review:

   a. Laboratory sample number, with any cleanup steps, reinjection, or re-extraction noted where applicable

   b. Sample code

   c. Date and time of injection

   d. Raw data file number

   e. Extraction information – Weights, volumes

   These items are automatically recorded if proper entry of this information into the sequence file was performed following *T-PEST-WI10020* prior to data acquisition.

2. Check the surrogate standard recovery, which is recorded in the LIMS. Any problems with the surrogate standard must be noted, such as diluted out or matrix related. If the surrogate is outside the acceptance limits, the corrective action must be followed.

3. The automated LIMS forms used during data interpretation are dependent on accurate entries in the sequence file, accurate calibration files, stable retention times, and correctly labeled quantitation reports. Therefore, they must be double-checked for accuracy against the raw data (chromatograms and quantitation reports).

   The automated forms do not replace the review of raw data by the analyst but are used to provide additional information to the analyst, to perform calculations, neatly summarize results and increase the speed and accuracy of data interpretation.

4. Procedure C.5. through C.10. outline the basic raw data review process.

5. Review the chromatograms for all columns and detectors used. The following items must be checked:

   a. The integration of each peak to ensure it is correct.

      (1) Use PeakReview in TALs to correct baseline problems.

      (2) The experience of the analyst is an important factor in determining when a baseline is drawn incorrectly.

6. With the help of the LIMS, review the chromatograms and determine if any presumptive peaks are present by checking the list of analytes reported in the quantitation report for each chromatogram.

a. A presumptive peak is one that lies within the RT window of a compound or is close enough to the RT to interfere with the detection of that compound.

b. The experience of the analyst weighs heavily in determining if a compound separates from an interfering peak. This decision depends on the size of the interference as well as the RT of the interference in relation to the expected RT of the compound of interest. Check peak widths to assist in determining overlapping peaks.

7. A compound is reported in a sample if a presumptive peak in the chromatogram lies inside the retention time window for that compound. For dual-column or dual-detector analyses, a peak must be present within the retention time window on both columns/detectors.

8. For single column analyses, if no presumptive peak is present, the normal LOQ can be reported.

   a. If the concentration is below the LOQ but above the MDL, flag the value with a J for estimated.

   b. If the concentration is below the MDL, flag the value as <MDL. This value is not reported to the client as a detected hit.

9. For dual-column (or dual detector) analyses, the following guidelines apply:

SW-846 Methods 8081A, 8082, 8151A (CCV ±15%)

a. No presumptive peaks are present which confirm on the second column, the normal LOQ can be reported.

(1) Data reporting defaults to D1 unless there is a CCV OOS on D1, then would default to D2 assuming CCV is in spec and there are no coelutions on the in-spec column.

(2) If compound not detected on one column, and the CCVs are in spec on that column, then would report as ND from that column.

(3) If CCV oos high and no detections, would need to comment but no reinjection necessary.

b. If a presumptive peak is present on both columns, evaluate the agreement between the concentrations. This is done by calculating the %RPD between the values as follows:

% RPD = difference over the average of the two results x 100

(1) Data is reported from the high side (surrogates all data is reported) if %D is <40% D between the 2 columns when all CCV data is within the limits (15% no grand mean follow update V(8000D)).

(2) If > 40%, the low side is reported when all CCV data is within the limits (15% no grand mean follow update V(8000D)). P flag is on at compound level

(3) If %D is >100% a worst-case determination is made to raise limit above the low side.

(4) If CCV fails high on one column, then the sample would need to be reinjected for detections. If reinjection cannot be done, then sample data requires an internal NCM and a comment on the report.

(5) If CCV fails low on one column, then the sample would need to be reinjected for detections. If reinjection cannot be done, then sample data requires an internal NCM and a comment on the report.

(6) If a surrogate is OOS for recovery a comment is always required on the report.

(7) Project specific requirements would supersede the above listing.

SW-846 Methods 8081B, 8082A, (CCVs ±20%)

c. No presumptive peaks are present which confirm on the second column, the normal LOQ can be reported.

(1) Data reporting defaults to D1 unless there is a CCV OOS on D1, then would default to D2 assuming CCV is in spec and there are no coelutions on the in-spec column.

(2) If compound not detected on one column, and the CCVs are inspec on that column, then would report as ND from that column.

(3) If %D is >100% a worst-case determination is made to raise limit above the low side.

(4) If ccv oos high and no detections, would need to comment but no reinjection necessary.

d. If a presumptive peak is present on both columns, evaluate the agreement between the concentrations (%RPD).

(1) Data is reported from the high side (surrogates all data is reported) if %D is <40% RPD between the 2 columns when all CCV data is within the limits (20% no grand mean follow update V(8000D)).

(2) If >40%, the low side is reported when all CCV data is within the limits (20% no grand mean follow update V(8000D)). P flag is on at compound level.

(3) If CCV fails high on one column, then the sample would need to be reinjected for detections. If reinjection cannot be done, then sample data requires an internal NCM and a comment on the report.

(4) If CCV fails low on one column, then the sample would need to be reinjected for detections. If reinjection cannot be done, then sample data requires an internal NCM and a comment on the report.

(5) If a surrogate is OOS for recovery a comment is always required on the report.

(6) Project specific requirements would supersede the above listing.

Method 608.3 (both oc pest and pcbs)

e. No presumptive peaks are present which confirm on the second column, the normal LOQ can be reported.

(1) Data reporting defaults to D1 unless there is a CCV OOS on D1, then would default to D2 assuming CCV is in spec and there are no coelutions on the inspec column.

(2) If compound not detected on one column, and the CCVs are inspec on that column, then would report as ND from that column.

(3) If ccv oos high and no detections, would need to comment but no reinjection necessary.

f. If a presumptive peak is present on both columns, evaluate the agreement between the concentrations (%RPD).

(1) data is reported from low side if %D is <50%. All surrogate data is reported.

(2) (we would rarely use this option) If %D is >50%, if the amounts do not agree, and the RT data indicate the presence of the analyte (per Section 14), it is likely that a positive interference is present on the column that yielded the higher result. That interference may be represented by a separate peak on the other column that does not coincide with the

retention time of any of the target analytes. If the interfering peak is evident on the other column, report the result from that column and advise the data user that the interference resulted in a %D value greater than 50%.

(3) (this is the preferred option) If an interference is not identifiable on the second column, then the results must be reported as "not detected" at the lower concentration (AKA worst-case). In this event, the pesticide is not confirmed and the reporting limit is elevated.

(4) If CCV is outside the criteria, reinjection must occur unless ND and OOS high, then can report with comment. All SS CCV must pass to report the data.

(5) If CCV fails high on one column, then the sample would need to be reinjected for detections. If reinjection cannot be done, then sample data requires an NCM and a comment on the report.

(6) If CCV fails low on one column, then the sample would need to be reinjected for detections. If reinjection cannot be done, then sample data requires an NCM and a comment on the report.

(7) Any OOS SS would require commenting on the report.

Method 531.1

g. If CCV out on primary(D1) must reinject.

h. If reporting from confirmation must do NCM and comment.

i. If EW or PW designation no QC may fail.

j. If WW designation (531.1) may do NCM and comment for failures if reinjection is not possible.

Method 8011

k. Data reports from the primary column(D1)

l. If CCV out on primary must reinject (unless OOS high no hits)

m. If CCV is outside the criteria, reinjection must occur unless ND and OOS high, then can report with comment. All SS CCV must pass to report the data.

n. Confirmation column must be in spec. If the primary column CCV's pass and no detection on the primary you could report as nd without reinjection for confirmation.

o. If reporting from confirmation must do NCM and comment.

Method 8330A,8330B,8318

p. Report from primary

q. If CCV out on primary must reinject

r. If reporting from confirmation, must write NCM and comment

s. Co-Elution Exceptions:

(1) Explosive 8330A

Nitrobenzene/Tetryl coelutes on D1

(2) Explosive 8330B

4-Am2,6-DNT/Nitrobenzene coelutes on D2
HMX/2,6Diamino-4-Nitrotoluene coelutes on D2

10. The following situations must be evaluated by the analyst for all analyses:

    a. A presumptive peak is present with a retention time just outside the RT window on the one column and just inside the window on the second column and the amounts are both above the LOQ.

        (1) If the retention times during the run are stable, the compound should not be reported.

        (2) The normal LOQ can be reported if the analyst feels there would be separation of the target compound from the interference. If separation is uncertain, a worst-case determination is made.

        (3) However, the compound might be reported after the following parameters have been considered: the RT of the standards bracketing the sample injection, the history of the sample and site, the peak shape, the baseline where the peak eluted, and the possible coelution of matrix interferences. The experience of the analyst weighs heavily in deciding if the compound must be reported.

    b. A presumptive peak is present on both columns but the retention time is outside the windows on both columns. Only in rare cases is a compound to be reported. The parameters listed above in Procedure C.10.a. must be evaluated. The normal LOQ can be reported if the analyst feels there would be separation of the target compound from the interference. If separation is uncertain, a worst-case determination is made.

11. The LIMS lists all the target analytes found on both columns, then summarize the results into a summary report as follows. However, how the data is evaluated may change based on client or project specific requirements.

    a. If a target analyte is not detected or not detected on both columns, ND is placed on the summary section, but the MDL and LOQ must have a "<" symbol in front of their respective numbers.

    b. If a target analyte is detected on both columns for SW-846, the LIMS configuration is set so that it places the highest value in the summary section, unless the RPD is >40%, then the lower value is listed.

    c. If a target analyte is detected on both columns for 500 series, the LIMS configuration is set so that it places the value from the primary column in the summary section.

    d. If a target analytes is detected on both columns for method 608/622, the LIMS configuration is set so that it places the lowest value in the summary section, unless the RPD between columns is greater than 100%. In this case the detection limit is raised to report a less than value (to a value above the lowest concentration detected) since there is significant uncertainty to the presence of the compound.

12. The LIMS also summarizes the result for each multicomponent compound in the calibration. Each peak used for quantitation is shown as well as averages, %RSD between peaks, and the RPD between the two columns on the final data.

D. Worst-case calculation

1. A worst-case calculation is performed using the peak height (area) of the interference in a sample (see Procedure C.7.), using the lower value for dual column data (provided the associated check standards meet specifications).

2. The value obtained is rounded off to the proper number of figures as if the number were to be reported based on the LOQ. An elevated LOQ and/or MDL are established at one figure higher than this value.

3. If the worst-case value is above the LOQ, then both the LOQ and MDL must be adjusted.

For example, if the worst-case value is 0.39 µg/L for the analyte and the LOQ is 0.1, the value is rounded to 0.4 µg/L and the LOQ and MDL are set at <0.5 µg/L.

4. By raising the LOQ and/or MDL, we tell the client that the most accurate determination we can make with the data for the sample is that the analyte is not present at 0.5 µg/L or above. Due to the interference present, we cannot be sure of concentrations below this amount.

5. These values are edited into the upload file prior to uploading to the LIMS. Care should be taken to edit only the MDL and/or LOQ fields as appropriate to the situation as outlined above.

6. An NCM must be added to the report stating that reporting limits were raised due to interference from the sample matrix.

Table I

Qualifiers:

J = The compound was detected at an amount below the quantitation limit and is therefore an estimated value.

E = Peak response exceeds the calibration range – a dilution must be performed.

Abbreviations:

R = Designates that the data is from a repeated extraction.
DF = Dilution Factor – This is the amount that the extract was diluted by (i.e., a DF10 is a 10-fold dilution).
DO = Diluted Out
WC = Worst-Case – Denotes the actual value from the worst-case calculation.

10020 Uploading Data to the LIMS
11913 Laboratory Notebooks, Logbooks, and Documentation
9980 Monitoring QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information	
14	08.JUL.2019		
15	02.MAR.2021		
16	23.FEB.2022		

eurofins	Always check on-line for validity. **Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection**	Level: **Work Instruction**
Document number: **T-PEST-WI9981**		
Old Reference: **1-P-QM-WI-9029396**		
Version: **7**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **13-JUL-2022**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_Explosive Chem**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Aparatus and Equipment
Reagents and Standards
Extraction Procedure
HPLC Instrument Conditions
Calibration
Retention Time Windows
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I
LCS ISM
Table 2

Revision Log

Revision: 7	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Cross Reference	Formatting	Removed SOP WI9980
Header	Formatting	Updated company name
Reagents and Standards 11.	Reflects current practice	Updated standard name in LIMS system

Revision: 7	**Effective Date:**	This version
Section	**Justification**	**Changes**
Calibration 1.	Reflects current practice	Updated naming in sequence
Throughout Document	Formatting	Updated SOP naming to the correct SOP
Personnel Training and Qualifications	Reflects current practice	Added LCS and RSD criteria
Calculations	Reflects current practice	changed peak ht/height to peak area

Revision: 6	**Effective Date:**	05 May, 2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reagents and Standards	Clarification	Reagents: Added additional reagent Standards (9.e): revised volume requirement
LIMS ID	Current process	Updated to LIMS method codes
LCS ISM	Current process	Updated to current LIMS terminology

Reference

1. *Test Methods for Evaluating Solid Wastes*, EPA SW-846, Method 8330B, Rev. 2, October 2006

2. Determinative Chromotographic Separations, SW-846, Method 8000D, July 2014

3 *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-PEST-WI10942	Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Water
T-OE-PEST-WI10943	Sonication Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Solids
T-PEST-WI10011	QC Data Acceptability and Corrective Action
T-PEST-WI10008	Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department
T-PEST-WI9954	Interpretation of Chromatographic Data
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

The method is applicable for the determination of trace levels of nitroaromatics and nitroamines from explosives in soil and water samples. Table I lists these compounds and their limits of quantitation (LOQ).

Basic Principles

Soil samples are extracted with acetonitrile in an ultrasonic bath. Aqueous samples with low concentrations of explosive residues are extracted with a solid phase extraction procedure using Porpak RDX SPE cartridges and acetonitrile.

Separation of the nitroaromatics and nitroamines is performed using reversed-phase chromatography with a water/methanol mobile phase on a Phenyl-Hexyl column. The explosive residues are detected by their ultraviolet absorbance at 254 nm and 214nm. A second dissimilar column is used to confirm any positive identification of the analytes made on the primary column.

Reference Modifications

Method 8330B recommends an expiration for intermediate dilutions of 1 year and fresh preparation of calibration standards on the day of calibration. Our ongoing verification of working standards using an initial verification standard has shown that the standards are stable over a 60 day timeframe.

Interferences

Method interferences are caused by impurities in solvents, reagents, glassware or other hardware used in sample processing. The UV detector is a general detector and many organics responds. All glassware is rinsed with solvent before use and a method blank is performed with each batch of samples to demonstrate that the system is free of contaminants.

Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All samples expected to contain tetryl should not be exposed to temperatures above room temperature.

Safety Precautions and Waste Handling

1. See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

2. All laboratory waste is accumulated, managed, and disposed of in accordance with all federal and state laws and regulations.

3. Avoid inhaling solvents and chemicals and getting them on the skin. Wear gloves when handling neat materials.

4. Samples suspected of being high in explosives must be handled carefully. (Method 8510 can be used to screen for high levels of explosives.)

5. Prior to performing moisture analysis, all soil samples must be found to contain less than 1% by weight total explosives (see Calculation section).

   a. If samples are found to contain greater than this level, wet weight results must be reported.

   b. If moisture determination is deemed safe, contact client services to add moisture analysis to the sample.

6. All HPLC vials and solvent waste is disposed of in designated vial collection bins and solvent waste containers in the laboratory. Each of these is then emptied into appropriate designated containers in the lab-wide storage facility for subsequent disposal.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the chromatography data system to set up

sequences, perform the calculations, interpret data, perform instrument maintenance, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the LCS acceptance criteria and RSD </=20%. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four laboratory control samples, one blind sample, or one ICAL with ICVs and/or CCVs.

Sample Collection, Preservation, and Handling

Samples (waters and solids) must be collected in amber glass jars with Teflon™-lined lids and stored in the dark at 0° to 6° C, not frozen.

Each water extraction requires a 500 mL sample which must be extracted within 7 days of collection. Each soil extraction requires 10 g of soil which must be extracted within 14 days of collection. HPLC analysis must be within 40 days of extraction.

Aparatus and Equipment

1. HPLC with dual high-pressure pump and gradient capabilities – HP1260 or equivalent
2. HPLC autosampler – HP1260 or equivalent
3. HPLC oven – HP1260 or equivalent
4. 2-HPLC UV detectors – Agilent Mutiwavelength Detector collecting 254nm and 214nm
5. Chrom Perfect data system or equivalent
6. Phenomenex: Synergi Hydro-RP: 250mm x 4.6 mm x 4um (confirmation column) or equivalent
7. Phenomenex: Luna Phenyl-Hexyl: 250mm x 4.6mm x 5um (primary column) or equivalent
8. Analytical balance

Reagents and Standards

A. Reagents

1. Acetonitrile (CH_3CN) – HPLC grade
2. Methanol (CH_3OH) – HPLC grade
3. Calcium chloride ($CaCl_2$) – Reagent grade; prepare an aqueous solution of 5 g/L. Store in glass for up to 1 year at room temperature.
4. Reagent water, HPLC water, or Milli-Q water
5. 50:50 ACN: $CaCl_2$ Solution - Mix 200 mL of 5g/L $CaCl_2$ Solution with 200 mL of ACN. Store in glass for up to 6 months at room temperature

B. Standards

1. Stock standard mixes of the nitroaromatic and nitroamine compounds listed in this method can be purchased from Restek and Accustandard.

NOTE: Because of the reactive nature of these compounds and the danger from explosion, it is recommended that the neat compounds not be purchased.

2. All standards are prepared using Class-A volumetric pipettes, flasks, and syringes.

3. The ampulated stocks are stored according to the manufacturer's instructions and are valid until manufacturer's expiration date.

4. Working standards are prepared in 50:50 acetonitrile/$CaCl_2$ solution (5 g/L).

5. All standards must be stored at 0° to 6°C, not frozen.

6. Intermediate dilutions are prepared every 60 days and calibration standards are made every 60 days. Surrogates and matrix spikes are prepared every 6 months for all methods.

7. Standards are sonicated or shaken vigorously prior to bottling fresh daily. This helps warm the standards up to room temperature and gives the standards mixing as well.

8. Stock Standards:

Stock	**Description**	**Vendor**	**Cat #**	**Concentration µg/ml**
1	8330B Explosives Mix	Restek	33204	1000
2	Nitroglycerin Standard	Restek	31498	1000
3	PETN Explosives Standard	Restek	31600	1000
4	3,5-DNA (ICV)	Restek	31661	1000
5	2-NMX	Chemservice	S-10114T5	2000
6	8330 Explosive (ICV)	Restek	33905	1000
7	PETN (ICV)	Accustandard	M-8330-ADD-2	100
8	Nitroglycerin (ICV)	Accustandard	M-8330-ADD-1	100
9	2,4-Diamino-6-NT	Accustandard	M-8330-ADD-12	100
10	2,6-Diamino-4-NT	Accustandard	M-8330-ADD-13	100

9. Intermediate solutions:

a. Intermediate 8330B – Add 1mL stock 1 in 10 mL volumetric flask. Dilute to volume with acetonitrile.

b. Intermediate PETN/Nitro –Add 0.1mL of stock 2 and stock 3 to a 10 mL volumetric flask. Dilute to volume with acetonitrile.

c. Intermediate 2-NMX - Add 1mL of stock 5 to 10mL volumetric flask. Dilute to volume with acetonitrile.

d. Intermediate 8330B (ICV) – Add 0.5mL of stocks 4 and 6 to a 5 mL volumetric flask. Dilute to volume with acetonitrile.

e. Intermediate 5 (Diamino intermediate) – Add 1 mL of stock 9 and stock 10 to a 5 mL volumetric flask. Dilute to volume with acetonitrile.

10. Working Standard Preparation, Surrogates and Spikes:

Standard ID	Intermediate 8330 (mL)	PETN/Nitro (mL)	2-NMX int.	Solvent	FV (mL)	µg/L *
8330 Level 6	0.2	0.33	0.3	1:1 ACN/$CaCl_2$	10	2000
8330 Level 5	0.15	0.24	0.22	1:1 ACN/$CaCl_2$	10	1500

Standard ID	Intermediate 8330 (mL)	PETN/Nitro (mL)	2-NMX int.	Solvent	FV (mL)	µg/L *
8330 Level 4	0.1	0.16	0.15	1:1 ACN/$CaCl_2$	10	1000
8330 Level 3	0.125	0.15	0.19	1:1 ACN/$CaCl_2$	25	500
8330 Level 2	0.01	0.04	0.015	1:1 ACN/$CaCl_2$	10	100
8330 Level 1	0.125 of Level 6	0.015	0.009	1:1 ACN/$CaCl_2$	10	25
MDL	1.0 of Level 2	0.004	0.006	1:1 ACN/$CaCl_2$	10	10

* Concentrations for PETN, Nitroglycerin, and 2-NMX are higher concentrations.

	ICV int (mL)	2-NMX int	PETN icv stock	NG stock	FV (mL)	ug/L
ICV	0.05	0.075	0.2	0.2	10	

	2,4 stock (mL)	2,6 stock (mL)	FV (mL)	Solvent	ug/L
Diamino Level 6	0.2	0.2	10	1:1 ACN/$CaCl_2$	2000
Diamino Level 5	0.15	0.15	10	1:1 ACN/$CaCl_2$	1500
Diamino Level 4	0.1	0.1	10	1:1 ACN/$CaCl_2$	1000
	Intermediate				
Diamino Level 3	0.625		25	1:1 ACN/$CaCl_2$	500
Diamino Level 2	0.05		10	1:1 ACN/$CaCl_2$	100
Diamino Level 1	0.015		10	1:1 ACN/$CaCl_2$	30
Diamino MDL STD	0.005		10	1:1 ACN/$CaCl_2$	10

Diamino Water Matrix Spike	Stock 9	0.1	25	1:1 ACN/$CaCl_2$
	Stock 10	0.1		
Diamino Soil Matrix Spike	Stock 9	0.18	25	1:1 ACN/$CaCl_2$
	Stock 10	0.18		
8330 Soil Matrix Spike	Stock 3	0.75	25	1:1 ACN/$CaCl_2$
	Stock 2	0.75		
	Stock 1	0.25		
8330 Water Matrix Spike	Stock 3	1.6	25	1:1 ACN/$CaCl_2$
	Stock 2	1.6		
	Stock 1	0.5		

11. Standards Database Entry:

Enter each working standard into the system as follows:

IBLANK: GCS_XIBLK

Level 1: GCS_83301
Level 2: GCS_83302
Level 3: GCS_83303
Level 4: GCS_83304
Level 5: GCS_83305
Level 6: GCS_83306
Level ICV: GCS_8330ICV

Level MDL: GCS_8330MDL

Level 1: GCS_DIAM1 (Diamino compounds)
Level 2: GCS_DIAM2
Level 3: GCS_DIAM3
Level 4: GCS_DIAM4
Level 5: GCS_DIAM5
Level 6: GCS_DIAM6
Level MDL: GCS_DIAMMDL

Extraction Procedure

See T-OE-PEST-WI10942 for the extraction of water samples and T-OE-PEST-WI10943 for the extraction of solid samples.

HPLC Instrument Conditions

A. Dual column analysis

Below are the recommended chromatographic conditions for the reversed-phase separation. Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process. In general, a simultaneous dual column approach must be used. Single column conditions are listed as well.

Connect a T splitter to the autosampler exit line, then to short lines connected to each of two columns. The primary column must be directed into a multiwavelegth detector acquiring at 254 nm and 214 nm. The confirmation column must be connected to a multiwavelength detector acquiring at 254 and 214nm. There must be a total of four channels of data on chromperfect. There must be two start signals, using stacked connections.

Primary channels:	Phenomenex: Luna Phenyl-Hexyl: 250mm x 4.6mm x 5um. Mutliwavelenghth detector at 254 nm and 214 nm
Confirmation channels:	Phenomenex: Synergi Hydro-RP: 250mm x 4.6mm x 4um. Mutliwavelength detector at 254 nm and 214 nm
Gradient:	55% MeOH hold to 2 min, 71% MeOH at 22 min, 90% MeOH at 28 min, 55% MeOH at 30 min..
Total Flow:	2.8mL/min
Oven:	Primary 23° C, Confirmation 27° C
Injection Size:	70 µL

Calibration

1. Prepare a sequence using the following suggested order of injections:

    1. Conditioner
    2. Conditioner
    3. PIBLX (IBLK)
    4. IC 83301
    5. IC 83302
    6. ICRT 83303
    7. IC 83304
    8. IC 83305
    9. IC 83306
    10. ICVL 8330 (MDL Standard)

11. ICV 8330 (ICV Standard)
12. IC Diam1
13. IC Diam2
14. IC Diam3
15. IC Diam4
16. IC Diam5
17. IC Diam6
18. ICVL Diam (MDL Standard)
19. BLANKA
20. LCSA
21. LCSDA
22. SAMPLE1
23. SAMPLE1 MS
24. SAMPLE1 MSD
25. – 28. SAMPLE2 – 6
29. CCV 8330
30. CCV Diam
31. – 40. TEN SAMPLES
41. CCV 8330
42. CCV Diam
43. – 52. TEN SAMPLES
53. 83303
54. Diam3

Diam ICAL standards and check standards are run as needed when 2,4-diamino-6-nitrotoluene and/or 2,6-diamino-4-nitrotoluene are requested target analytes.

2. Initial Calibration (ICAL)

a. An external 6-point calibration is performed by injecting working standards at 6 levels.

An example chromatogram of a midlevel standard is shown in Figure 1A, for the primary column.

b. If the relative standard deviation (RSD) from these 6-response factors is less than or equal to 20%, then the overall average response factor is used to calculate unknown analyte concentrations from the peak heights.

c. If the RSD is > 20%, a linear fit is used.

d. Do not force or extrapolate to zero.

e. The coefficient of determination (r^2) must meet ≥0.99 for the curve to be valid.

f. Samples cannot be analyzed until a compliant ICAL is achieved.

g. See *T-PEST-WI10008* if instrument maintenance is needed to troubleshoot and/or correct any problems.

When curve fits are used in the initial calibration, percent error (%E) must be calculated for each calibration level. Standard levels at or below the LOQ must meet ±50%, standards above the LOQ must meet ±30%. (%error = (true concentration - calculated concentration)/true concentration)*100).

3. Initial Calibration Verification (ICV)

a. Inject the ICV after the ICAL and evaluate prior to sample analysis. An initial verification standard must be bottled fresh on the day of calibration to ensure no degradation of the target analytes has occurred when running method 8330B.

b. The concentration for each analyte must be within ± 30% from the nominal value.

4. Continuing Calibration Verification (CCV)

a. A continuing calibration is run after each set of ten samples.

b. CCV uses the Level 3 calibration standard

c. The concentration quantitated for the calibration check standards must be within 20% difference (%D) of the nominal concentration.

d. Exception: If the standard following a sample is outside the 20% but exhibits increasing response, the samples before it do not have to be reinected if the target analytes are not detected. A comment must be added to the analytical report.

e. If two consecutive/sequential CCVs fail, corrective action must be taken. Two consecutive/sequential CCVs must meet the criteria or an initial calibration must be performed before sample analysis can continue.

f. If confirmation of target analytes is needed, then the second column should meet the 20% continuing calibration criteria, as well as all initial calibration criteria. If either of these are not met, a comment must be added to the analytical report.

5. The scaling of chromatograms and peak integration parameters is set so that the peaks for each compound of interest are detected and integrated at the concentration of the Method Detection Limit (MDL). This ensures that the quantitation limits and MDLs can be met.

Retention Time Windows

1. Established as 3x the standard deviation determined over a 72-hour period, or at no less than ±0.1 min, applied to the mid-point initial calibration standard.

2. If the RTs for a continuing calibration standard fall outside the windows, update the midpoint RT using that standard.

a. Save this under an appropriate name to indicate an update has occurred.

b. All subsequent continuing standards run within a 24-hour period must fall within this window.

c. RTs cannot be updated more than once per day.

d. If RTs are not consistent, the cause must be investigated and corrective action taken.

Procedure

1. Analyze the samples using the chromatographic conditions listed in the HPLC Instrument Conditions section and the sequence listed in the Calibration section of this document.

2. Peaks are identified by matching retention times within retention time windows established for the target analytes.

3. All positive identifications for target compounds made on the Primary Luna Phenyl -Hexyl column must be confirmed by injection on the Synergi.

4. For analytes that are detected on both columns, See T-PEST-WI9954.

a. Report the result from the primary column.

b. There are cases, however, where use of confirmatory data is necessary.

For example, if a target compound detected on the primary column is not detected on the confirmation column, the result is reported as “not detected” using the confirmation data. If there are interferences on

the primary column masking the result for a target analyte, the result may need to be reported from the confirmation data. All initial and continuing calibration requirements apply to the second column data.

5. See Figures 1A, 1B, 2A, and 2B for identification of compounds.

6. If the response for any target compound exceeds the upper calibration standard, a dilution must be performed which brings the response into the upper end of the calibration curve.

Calculations

1. Waters

$$\frac{\text{Peak Area x FV x DF}}{\text{RF x IV}} = \text{Concentration (µg/L)}$$

Where:

Peak area = Peak area found in sample

RF = Average response factor [peak area/(µg/L)] from the initial calibration

FV = Final volume of sample extract in mL (normally 10 for waters)

DF = Dilution factor if applicable

IV = Initial volume of sample extracted in liters (500 mL)

2. Soils:

$$\frac{\text{Peak Area x FV x DF}}{\text{RF x IW}} = \text{Concentration (µg/kg)}$$

Where:

Peak area = Peak area found in sample

RF = Average response factor [peak area/(µg/L)] from the initial calibration

FV = Final volume of sample extract in mL (normally 10 mL for soils)

DF = Dilution factor if applicable (normally 2 for soils)

IW = Initial weight of soil extracted in grams

NOTE: Prior to performing moisture analysis, all soil samples must be found to contain less than 1% by weight total explosives. Percent by weight is calculated by dividing the ppm value by 10,000.

Statistical Information/Method Performance

LCS, MS, and RPD are compared to the limits stored in the LIMS. The limits for LCS and MS are statistically derived. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the manager. The department database is updated via a download from the LIMS.

An annual lower limit of quantification (LLOQ) verification is required annually on at least one instrument. All instruments must have an LLOQ verification performed every three years.

Quality Assurance/Quality Control

A batch is defined as the samples to be extracted on any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared.

For each batch of samples extracted, a blank, an LCS, an MS, and MSD must be extracted. If there is limited sample which prevents the preparation of the MS/MSD, then an LCSD must be prepared instead.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed.

2NMX is added as a surrogate to each sample and QC to monitor the efficiency of the extraction, the operation of the autosampler, and to monitor retention times throughout the HPLC run.

See *T-PEST-WI10011* for more information on QC acceptance criteria and corrective action.

Table I

LOQs of Nitroaromatics/Nitroamines

			Limit of Quantitation (LOQ)	
Compound	CAS	Abbrev.	Soil (µg/kg)	Water (µg/L)
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	2691-41-0	HMX	300	0.6
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4	RDX	120	0.6
1,3,5-Trinitrobenzene	99-35-4	1,3,5-TNB	120	0.6
1,3-Dinitrobenzene	99-65-0	1,3-DNB	120	0.6
Methyl-2,4,6-trinitrophenylnitramine	479-45-8	TETRYL	300	0.6
Nitrobenzene	98-95-3	NB	300	0.6
2,4,6-Trinitrotoluene	118-96-7	2,4,6-TNT	120	0.6
4-Amino-2,6-dinitrotoluene	1946-51-0	4-Am-DNT	120	0.6
2-Amino-4,6-dinitrotoluene	355-72-78-2	2-Am-DNT	120	0.6
2,4-Dinitrotoluene	121-14-2	2,4-DNT	300	0.6
2,6-Dinitrotoluene	606-20-2	2,6-DNT	120	0.6
2-Nitrotoluene	88-72-2	2-NT	120	0.6
3-Nitrotoluene	99-08-1	3-NT	120	0.6
4-Nitrotoluene	99-99-0	4-NT	120	0.6
Pentaerythritol tetranitrate	1607-17-6	PETN	2400	10
Nitroglycerin	55-63-0	NG	2400	10
3,5-Dinitroaniline	618-87-1	3,5-DNA	120	0.6
2,4-Diamino-6-nitrotoluene	6629-29-4		300	0.6
2,6-Diamino-4-nitrotoluene	59229-75-3		300	0.6

LOQs in this table are subject to change. The LIMS contains the most current LOQs.

LCS ISM

1. Custom Organic Standard purchased from Phenova - 5mL spiking solution to be applied to 500g solid matrix, containing 17 analytes requested at a final spiked concentration of 2000 ug/kg (with Nitroglycerin and PETN at a final spiked concentration of 10,000 ug/kg), solvent will be Acetonitrile, and each standard will be provided as a premeasured 5.00mL spike flame sealed in a 10mL amber ampoule, designed for "snap and spike" use where quantitative transfer of 100% of the 5mL is applied to 500g solid matrix.

2. The 500 grams is then puck milled by SA and 10 gram aliquots are weighed out to use as the LCS ism required for this method. The LCS ism has surrogate added to the 10ml aliquot after puckmilling and then is extracted as per the prep SOP.

Compound	Certified value (ug/kg)	Final Spiked Concentration
4-Amino-2,6-dinitrotoluene	947	2000
2-Amino-4,6-dinitrotoluene	650	2000
1,3-Dinitrobenzene	1010	2000
2,4-Dinitrotoluene	638	2000
2,6-Dinitrotoluene	1320	2000
HMX	620	2000
Nitrobenzene	1400	2000
2-Nitrotoluene	1460	2000
3-Nitrotoluene	1020	2000
4-Nitrotoluene	1830	2000
RDX	587	2000
1,3,5-Trinitrobenzene	701	2000
2,4,6-Trinitrotoluene	808	2000
Nitroglycerine	1000	10000
Pentaerythritol tetranitrate (PETN)	1000	10000
3,5-Dinitroaniline		2000
Tetryl		2000

Triplicate

To assess if the grinding, mixing, and subsampling adequately addressed the compositional and distribution heterogeneity in the sample, triplicate subsamples should be removed and analyzed for every 5 to 20 samples processed. A unique sample number is entered for each triplicate. The data for each triplicate is entered into a spreadsheet to determine the %RSD. The spreadsheet is included with the batch data for scanning. See Table 2.
An NCM must be added to the sample with the following wording: "This sample was used for the ISM triplicate. The individual %RSD is included in the data package for review."

The RSD for results above the LOQ must not exceed 20%. If above 20%, examine the project specific requirements. Contact the client to determine what additional measures are to be taken. If reported per the client, apply J-flag if acceptance criteria are not met and explain in case narrative.

Table 2

Triplicate summary form

Sample #	8886374	8886375	8886376			
compound	result (ug/kg) trial1	result (ug/kg) trial2	result (ug/kg) trial3	AVERAGE	std dev	%rsd
4-AM-2,6-DNT	0	0	0	0	0	#DIV/0!
2-AM-4,6-DNT	0	0	0	0	0	#DIV/0!
1,3-DNB	0	0	0	0	0	#DIV/0!
2,4-DNT	0	0	0	0	0	#DIV/0!
2,6-DNT	0	0	0	0	0	#DIV/0!
HMX	0	0	0	0	0	#DIV/0!
Nitrobenzene	0	0	0	0	0	#DIV/0!
2-NT	0	0	0	0	0	#DIV/0!
3-NT	0	0	0	0	0	#DIV/0!
4-NT	0	0	0	0	0	#DIV/0!
RDX	0	0	0	0	0	#DIV/0!
1,3,5-TNB	0	0	0	0	0	#DIV/0!
2,4,6-TNT	0	0	0	0	0	#DIV/0!
Nitroglycerin	0	0	0	0	0	#DIV/0!
PETN	0	0	0	0	0	#DIV/0!
Tetryl	0	0	0	0	0	#DIV/0!
3,5-DNA	0	0	0	0	0	#DIV/0!

Attachment:
Figure 1A (.doc)
Figure 1B (.doc)
Figure 2A (.doc)
Figure 2B (.doc)

10008 Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department
10011 QC Data Acceptability and Corrective Action
10942 Extraction of Nitroaromatics and Nitroamines by Method 3535A in Water
10943 Ultrasonic Extraction of Nitroaromatics and Nitroamines by Method 8330B in Solids
11892 Determining Method Detection Limits and Limits of Quantitation
9954 Interpretation of Chromatographic Data

End of document

Version history

Version	Approval	Revision information	
5	14.MAY.2019		
6	05.MAY.2021		
7	29.JUN.2022		

eurofins	Always check on-line for validity. **Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS**	Level: **Work Instruction**
Document number: **T-SVOA-WI9995**		
Old Reference: **1-P-QM-WI-9015192**		
Version: **19**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **03-JUN-2022**	Document users: **5_EUUSLA_GC/MS Semivolatiles_All**	Responsible: **5_EUUSLA_GC/MS Semivolatiles_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I
Table II
Table III
Table IV
Table V
Table VI

Revision Log

Revision: 19	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Header	Reflects current Naming	Updated to current company name
Basic Principles	Updated SOP #s	Added T-OE-SVOA -WI11432 and T-OE-SVOA-WI19916
Personnel Training and Qualifications	Reflects current practice	Updated IDOC criteria for 8270 and 625.1
Procedure	Clarification	Added wording for clarification on certain processes.
Statistical Information/Method Performance	Text duplicated	Removed duplicated text; revised statement about which methods use statistical surrogate limits
Quality Assurance/Quality Control	Clarification	Clarified that marginal exceedance is only used for 8270C/D/E

Revision: 19	**Effective Date:**	This version
Section	**Justification**	**Changes**
Table I	Removed	Method 8270C was added to the existing Table II. All table numbering was then renumbered accordingly.

Revision: 18	**Effective Date:**	APR. 27.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout document	Clarification	Removed all references to footnotes regarding qualified data and drafted a general statement addressing data qualification as a means to differentiate between data that needs to be qualified and instances that require corrective action
LIMS ID	Reflects current LIMS	Removed Parallax analysis numbers
Cross Reference	Updated title	*T-OE-SVOA-WI10947* - removed 625 from title and added 612
Personnel Training and Qualifications	Reflects current practice	Revised the standard deviation criteria for 625.1 DOC to use the limits in Table VI, removed option to use 1CCV and 4 CCVs as an ongoing DOC as these do not include the preparation step
Procedure	Updated process	Laboratory will begin using ICV/CCV acceptance criteria put forth by the method rather than in-house limits
Statistical Information/Method Performance	Text duplicated	Removed duplicated text; revised statement about which methods use statistical surrogate limits
Quality Assurance/Quality Control	Clarification	Clarified that marginal exceedance is only used for 8270C/D/E
Table VII	New table	Added surrogate table containing method-specific surrogate limits for method 625.1

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 8270C (SIM), December 1996
2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8270D (SIM), July 2014
3. Hazardous Waste Test Method, SW-846 Test Method 8270E (SIM), June 2018
4. Test Methods for Evaluating Solid Wastes, SW-846 Method 8000D, July 2014
5. USEPA, 40 CFR Part 136, Method 625.1, December 2016 (SIM); MUR Effective September 2017
6. *Hewlett-Packard Operations Manuals*
7. *Chemical Hygiene Plan*, current version

Cross Reference

Document	Document Title

Document	Document Title
T-OE-SVOA-WI10916	Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix
T-OE-SVOA-WI10928	Microwave Extraction by Method 3546 for Semivolatiles
T-OE-SVOA-WI11432	Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater
T-OE-SVOA-WI10947	Separatory Funnel Extraction for BNAs in Wastewater by Method 612 or 625.1
T-SVOA-FRM9602	Dept 4026 Calculations
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards
T-SVOA-WI9598	GC/MS Preventative and Corrective Maintenance
T-SVOA-WI9604	Monitoring GC/MS Semivolatile QC Data Acceptance Limits
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is suitable for the determination of low-level semivolatile compounds in soils and waters by selected ion monitoring (SIM) Gas Chromatography/Mass Spectrometry (GC/MS). The analysis applies to a concentration range that spans from an MDL of 0.01 µg/L in water (0.33 µg/kg for soil) to an upper calibration concentration of 10 µg/L in water (330 µg/kg for soil). Specific compound lists and their associated MDLs/LOQs are found in the Laboratory Information Management System (LIMS) under the analysis numbers listed on the front page of this SOP.

Basic Principles

Water samples are extracted according to *T-OE-SVOA-WI11432* for 8270 analysis or *T-OE-SVOA-WI10947* for 625.1 analysis. Soil samples are extracted according to either *T-OE-SVOA-WI10928* or *T-OE-SVOA-WI10916*.

An environmental sample (soil, water, sludge, etc.) is solvent extracted and then analyzed by electron impact gas chromatography/mass spectrometry (EI GC/MS). A predetermined aliquot of an extract containing organic compounds in solvent is injected onto a fused silica capillary column coated with a relatively non-polar stationary phase, which is enclosed in a temperature controlled oven. A carrier gas, which is ultra-pure helium, passes continuously through the column. The GC oven is temperature programmed and the organic mixture separates into its individual components as it moves along the length of the column. This separation is the function of the polarity and boiling point of the individual compounds. This column empties into a mass selective detector. When a compound reaches the detector, it is bombarded by high-energy electrons (70 eV). This causes the compounds to fragment, forming ions. By applying various voltages to the lens, the positive ions are thrust into a quadrupole mass analyzer, which selects for a given mass fragment at a given time. These selected fragments reach an electron multiplier that detects and generates a signal for each mass fragment. The signals are amplified and sent to a computer. By analyzing for specific masses over a narrow mass range, SIM analysis allows for longer dwell times at specific masses. This allows for significantly greater sensitivity of analysis with a small reduction in specificity of analysis.

Target compounds are identified on the basis of spectral match and relative retention times as they compare to standards that are injected every 12 hours on the same system. Quantification is achieved via use of the internal standard calibration technique. The average relative response factor of a multi-point calibration is used for quantification when the appropriate criteria are met.

Interferences

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in the processing of samples. All glassware is solvent rinsed before use and a method blank is extracted with each extraction batch to demonstrate that the extraction system is free of contamination.

Sample matrices can have an effect on the ability of the GC/MS system to resolve the individual masses used for quantification. Samples may require dilutions, a reduction in the extraction volume/weight used, a raised final extraction

volume, or extract clean-up using various techniques in order to achieve proper target separation and determination.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See Chemical Hygiene Plan for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; therefore, each chemical compound should be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as the use of fume hoods, lab coats, safety glasses, and gloves.

All solvent waste generated from this analysis must be collected for recycling (if applicable) or must be disposed of in designated containers. These will then be transferred to a lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, and pH paper) must be disposed of in the normal solid waste collection containers or sharps containers, as applicable.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently perform daily maintenance, calibrate the instrument, change the column, clean the source, interpret chromatograms, perform calculations, review data, and enter data into the LIMS. The analyst is also trained on the preparation of dilutions and calibration standards. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

For 8270C/D/E the IDOC consists of four laboratory control samples that are spiked at 1-4x the LOQ and are carried through all steps of the procedure. For 625.1, the IDOC is spiked near the midpoint of the calibration. The defined acceptance criteria must be met. The criteria include the calculation of mean accuracy and standard deviation. The mean accuracy for all compounds must fall within the laboratory's most recent statistically derived LCS limits ±20% and must exhibit a standard deviation ≤20% for methods 8270C/D/E. The mean accuracy for all compounds must fall within the limits listed in table V under 'X' and must exhibit a standard deviation less than or equal to the limits listed in Table V under 's' for method 625.1. Analytes not listed in table V in 625.1 use statistically derived limits. See statistical info/method performance for more information.

Various options are available for a DOC and can include four laboratory control samples or one blind sample. Refer to *QA-SOP11178* for more guidance on these options.

Sample Collection, Preservation, and Handling

Water samples are collected in 250mL or 1L glass amber containers with PTFE-lined lids and may be preserved with sodium thiosulfate ($Na_2S_2O_3$). They are stored at 0°C to 6°C, not frozen, prior to extraction and must be extracted within 7 days of collection.

Solid samples are collected in glass wide-mouth jars with PTFE-lined lids and are not preserved. They are stored at 0°C to 6°C, not frozen, prior to extraction and must be extracted within 14 days of collection.

All sample extracts must be stored at ≤-10°C (freezer) and protected from light using amber glass vials. All samples, sample extracts, and standards must be stored separately and in an area free from contamination. All extracts must be analyzed within 40 days of sample extraction.

Apparatus and Equipment

1. Hewlett-Packard Model 6890 Gas Chromatograph or equivalent
2. Hewlett-Packard Model 5973 and 5975 Mass Selective Detector or equivalent
3. Hewlett-Packard ChemStation Software or equivalent
4. Chrome Peak Review data system or equivalent

5. Column:

30 m x 0.25 mm x 0.5 µm film thickness, Restek Rxi-5Sil MS or equivalent
30 m x 0.25 mm x 0.25 µm film thickness, Agilent DB-5MS or equivalent

6. Hamilton Gastight syringe, or equivalent – various volumes

7. Amber GC vials with crimp caps

Reagents and Standards

Refer to *T-SVOA-WI11998* for all standard preparation information.

Calibration

Calibration is accomplished using an internal standard calibration technique. Calibration standards at five or more concentration levels are analyzed. See Procedure F for the initial calibration process and criteria and see Procedure G for the continuing calibration process and criteria. If any client, state, or agency has more stringent calibration criteria, these must be followed instead.

NOTE: South Carolina does not allow the use of quadratic fits.

Procedure

A. Standard preparation

Solutions are used to standardize the GC/MS system every 12 hours. Refer to *T-SVOA-WI11998* for standard preparation. Calibration solutions may be used up to the labeled expiration date or until component degradation is observed. Degradation is determined by the inability to pass continuing calibration checks or by observations of unacceptable chromatography.

B. Internal standards

Internal standard mix is added to all standards and subsequent samples at a concentration of 1 µg/mL for soil and 1L analyses, and 0.25 µg/mL for 250 mL analyses. Using a 25 µL syringe, add 10 µL of internal standard to 1 mL of sample extract or standard. See Table III for the list of compounds calibrated for and the internal standard that is assigned to each.

C. Daily maintenance

Refer to *T-SVOA-WI9598* for this procedure

D. Instrument conditions

1. The GC/MS system must be capable of meeting the following specifications:

Mass range:	35 to 500 amu
Scan time:	1 scan/sec
GC column:	30 m x 0.25 mm x 0.5 µm film Restek Rxi – 5 or equivalent
Injector temperature and mode:	250° to 300°C; splitless
Transfer line temperature:	250° to 300°C
Detector temperature:	300°C
EI condition:	70 eV
Mass scan:	Capable of SIM scanning (see manufacturer's instructions)
Carrier gas:	Helium at approximately 30 cm/sec.
GC Oven temperature program:	Initial temperature – 35°C Initial hold time – 1.82 minutes GC Ramp #1 – 20°C/minute to 310°C GC Ramp #2 – 4°C/minute to 325°C Final hold time – 4.30 minutes

NOTE: It is not necessary to use the exact parameters listed above. Equivalent columns and conditions may be used to improve the linearity, sensitivity, overall chromatography, and performance required by the method on each GC/MS system.

2. Prior to analysis by SIM, a check standard must be analyzed in the full scan mode to determine where the specific start and stop times are for each of the groups. Each time column maintenance is performed, the scan times are reviewed to ensure that all ions are included. The GC/MS is configured in the SIM mode with a total cycle time (including voltage reset time) of 1 second or less. Set the Low Res to "N" and the Start Time for each group. In the m/z field, enter the ions for each group from the following tables:

GROUP 1 (Dwell – 60 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
1,4-Dioxane	Target	88	58
N-Nitrosodimethylamine	Target	74	42

GROUP 2 (Dwell – 40 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Quinoline	Target	129	102
1,4-Dichlorobenzene-d4	ISTD	152	115
Naphthalene-d8	ISTD	136	68
Naphthalene	Target	128	129,102
Bis(2-chloroethyl)ether	Target	93	63

GROUP 3 (Dwell – 40-50 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Dimethylphthalate	Target	163	194
2-Methylnaphthalene	Target	142	141
1-Methylnaphthalene	Target	142	141
1-Methylnaphthalene-d10	Surrogate	152	76
Acenaphthylene	Target	152	76
Acenaphthene-d10	ISTD	164	162
Acenaphthene	Target	154	152

GROUP 4 (Dwell – 25-30 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Dibenzofuran	Target	168	139
Diethylphthalate	Target	149	177
Fluorene	Target	166	165
Hexachlorobenzene	Target	284	142
N-Nitrosodiphenylamine	Target	169	168
Phenanthrene-d10	ISTD	188	94
Phenanthrene	Target	178	176
Anthracene	Target	178	176

GROUP 5 (Dwell – 50 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Di-n-butylphthalate	Target	149	150

GROUP 5 (Dwell – 50 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Fluoranthene	Target	202	101
Pyrene	Target	202	101
Flouranthene-d10	Surrogate	212	106

GROUP 6 (Dwell – 40 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Butylbenzylphthalate	Target	149	91
Benzo(a)anthracene	Target	228	229
Chrysene-d12	ISTD	240	236
Chrysene	Target	228	229
Bis(2-ethylhexyl)phthalate	Target	149	167
Di-n-octylphthalate	Target	149	150
Benzo(b)fluoranthene	Target	252	253
Benzo(k)fluoranthene	Target	252	253
Benzo(e)pyrene	Target	252	253
Benzo(a)pyrene	Target	252	253
Perylene-d12	ISTD	264	260
Benzo(a)pyrene-d12	Surrogate	264	132
Perylene	Target	252	253

GROUP 7 (Dwell – 100 msec)			
Compound	**Type**	**Quant Ion (m/z)**	**Monitor Ion (m/z)**
Indeno(1,2,3-cd)pyrene	Target	276	138
Dibenz(a,h)anthracene	Target	278	139
Benzo(g,h,i)perylene	Target	276	138

NOTE: Each program must be identical for the Temperature and Pressure programs so that the peak retention times are the same.

E. Tuning

1. The DFTPP tune check standard is used to assess GC column performance and injection port inertness as well as mass spectrometer performance. The GC/MS system's tune is checked by inspecting the mass spectrum of the DFTPP peak and column performance and injection port inertness is evaluated with pentachlorophenol, benzidine, and DDT.

2. The GC/MS should be tuned using a 50 ng/µL solution (12.5 ng/µL for 250 mL analyses) of DFTPP containing decafluorotriphenylphosphine, pentachlorophenol, benzidine, and DDT. This solution is prepared as indicated in *T-SVOA-WI11998*. See the table below for acceptance criteria and corrective actions.

Frequency	**Acceptance Criteria**	**Corrective Action**
Prior to initial calibration and every 12 hours prior to continuing calibration standard **NOTE**: Analysis of DFTPP, the LCS, and the blank are outside of the 12-hour analysis shift for method 625.1. The total time for DFTPP, the LCS, the blank,	1. Ion Acceptance Criteria in Table I 2. DDT breakdown ≤20%* 3. Tailing factors: a. 8270C: - Benzidine ≤3 - Pentachlorophenol ≤5**	1. Re-tune. Analysis cannot proceed until tune meets criteria. 2. More aggressive injection port maintenance. 3. Clean the source. 4. Change the column.

and the 12-hour shift must not exceed 15 hours.	b. 8270D/E: - Benzidine ≤2 - Pentachlorophenol ≤2** c. 625.1: - Benzidine <2 - Pentachlorophenol <2**	

*DDT breakdown greater than 20% may be acceptable if calibrating for polynuclear aromatic hydrocarbon (PAH) compounds only. Consult supervisor when this situation occurs.

**Unless project requirements dictate otherwise, the PCP tailing factor may fail acceptance criteria as only compounds with basic or neutral properties are targets of interest by SIM.

3. Use only the background-subtracted spectrum of the following when evaluating the DFTPP:

A three scan average of the apex of the scan, the apex of the scan -1, and the apex of the scan +1.

NOTE: All standards, samples, and associated quality control samples analyzed within a particular tune must use the identical conditions of the mass spectrometer.

F. Initial calibration (ICAL)

1. The initial calibration consists of analyzing standards at 6 concentration levels (0.05, 0.2, 0.5, 1, 5, and 10 ng/µL for solid and 1L water analyses) (0.01, 0.05, 0.1, 0.5, 1, and 2.5 ng/µL for 250-mL analyses). The initial calibration for 8270D soil and 1L water extractions includes an additional calibration point at 0.01 ng/µL. Response factors are produced for each level. An average response factor is then generated for each compound and surrogate. The relative standard deviation (%RSD) of the response factors determines the suitability of the average relative response factor for calculation of compound concentration. Use of the average relative response factor requires at least four calibration levels. If an alternate fit is required for any compound, at least five calibration levels are required for linear fits, and six calibration levels are required for quadratic fits. At the end of the calibration standard injections, inject the Method Detection Limit (MDL) standard and an initial calibration verification (ICV) standard. See the tables below for acceptance criteria and corrective actions.

ICAL Frequency	**Acceptance Criteria**	**Corrective Action**
1. Initially establish with at least 6 levels of standards. 2. When % drift in the daily continuing calibration check standard fails criteria.	1. %RSD requirements (if these criteria are met, then calculate concentrations based upon the average response factor fit): a. 8270C: %RSD ≤15% b. 8270D/E: %RSD ≤20% c. 625.1: %RSD ≤35% 2. The relative retention time of each target compound in each calibration standard should agree within 0.06 relative retention time units. 3. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer-peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. 4. 8270D/E: See table II for minimum response factors for	1. If the %RSD for any compound is greater than the defined acceptance criteria, use a first degree(linear) fit provided the correlation coefficient (CC; r) is ≥0.995 or the coefficient of determination (COD;r2) is ≥0.99. If the linear fit fails to meet this criteria, then a second order (quadratic) fit may be used provided the coefficient of determination is ≥0.99.* If use of both the linear fit and the quadratic fit is acceptable using these criteria for any given compound, then use the fit with the smallest negative y-intercept. When using a quadratic fit, if the y-intercept quantifies to be greater than the MDL, consult your supervisor immediately or re-calibrate. 2. Re-inject any levels that appear to be outliers due to an injection error. 3. If standard levels on the outside of the curve appear to be outliers for individual compounds and are throwing off the calibration curve, they

	each compound. It is not necessary to meet these specifications. They are provided merely as guidance. 5. The %Error is measured between the calculated and expected amounts of a compound at each calibration level to determine the calibration function acceptability for linear and quadratic curve fits. The % error must be ≤50% for the low calibration point. For calibration points above the LOQ the % error must be ≤30%. **NOTE:** For 625.1 calibrations, only the low calibration point and the mid-point need to be evaluated.	can be dropped from the calibration keeping the following in mind: a. If a low calibration point is dropped, the analyst must ensure that the compound is still being calibrated down to or below its RL. b. If a high calibration point is dropped, any detections must recover below the new upper calibration limit. 4. Re-prep calibration standards. 5. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

*South Carolina does not allow the use of quadratic fits.

MDL Frequency	Acceptance Criteria	Corrective Action
Immediately following an initial calibration and before sample analysis	1. The system must be able to detect all compounds in the MDL solution.	1. If any compounds are not detected in the MDL standard, analysis can proceed if the compound is detected at or below its MDL in a higher concentration level. 2. If the system does not detect the compound(s), then the tuning and/or calibration procedure must be repeated under conditions that will yield a detection for the compound(s) or the MDL must be raised for the compound(s). 3. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

NOTE: 625.1 does not require the analysis of an MDL standard as part of the initial calibration.

ICV Frequency	Acceptance Criteria	Corrective Action
Immediately following an initial calibration and before sample analysis	1. The ICV must be prepared using a second source standard 2. %D requirements: a. 8270C/D/E: ±30%D b. 625.1: Criteria listed under Q in Table V of this SOP 3. The EICP area for each internal standard must fall within the window of -50% to +100% of the areas from the mid-level calibration standard produced during the initial calibration. Surrogate compounds must be included in the processing list for	1. Re-prep and re-analyze the ICV. 2. If the recovery for any compound fails these criteria low, the compound cannot be analyzed for under the calibration until a new ICV has been analyzed. 3. If the recovery for any compound fails these criteria high, the compound may be analyzed for but any samples with detections should be re-analyzed under a valid ICAL or will be reported with a qualifying comment. 4. Perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* and re-calibrate.

	analysis 625.1 and must meet the same criteria as target compounds.	

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

2. One of the calibration standards must be at a concentration at or below the limit of quantitation (LOQ). The other concentrations correspond to the expected range of concentrations found in samples or should define the working range of the GC/MS system.

3. The concentration of the MDL standard may require modification dependent upon the current MDL values.

G. Continuing calibrations

Perform the continuing calibration verification (CCV) by injecting a predetermined aliquot of a calibration standard at a concentration near the mid-point of the calibration, not to exceed ½ the highest level in the calibration. See the table below for acceptance criteria and possible corrective actions.

CCV Frequency	Acceptance Criteria	Corrective Action
1. Every 12 hours. 2. The CCV is analyzed each day a curve is not analyzed. 3. The CCV is analyzed after DFTPP.	1. %Drift: a. 8270C/D/E: ≤20% b. 625.1: Criteria listed under Q in Table V of this SOP 2. The relative retention times of the internal standards must be within 10 seconds of the retention times from the mid-level calibration standard of the last initial calibration. The exception would be in the case of column maintenance. 3. The EICP area for each internal standard must fall within the window of -50% to +100% of the areas from the mid-level calibration standard produced during the last initial calibration. 4. 8270D/E: See Table II for minimum response factors for each compound. It is not necessary to meet these specifications. They are provided merely as guidance. 5. Structural isomers that produce very similar mass spectra are identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved when the height of the valley between two isomer peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.	1. If the CCV fails and the cause is obvious such as in the case of a concentrated standard or a mis-injection, re-inject the CCV, making sure to select another standard vial if a bad standard is suspected. 2. If the %Drift for any compound is >20% high and it is not detected in samples, data can be reported. 3. If the %Drift for any compound is >20% low, perform more aggressive system maintenance as outlined in *T-SVOA-WI9598* or adjust the tune file. Document the corrective action in the form of a non-conformance memo. Re-inject DFTPP and the calibration standard. If the CCV does not pass after corrective action, a new initial calibration must be established. **NOTE:** For method 8270D, in cases where compounds recover >20%D low, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compounds at the applicable quantitation limit. For situations when the failed compound is present, the concentrations must be reported as estimated values.

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

H. Analysis of Samples

1. All sample extracts are stored at ≤-10°C and protected from light from the time of sample extraction.

2. Prior to sample analysis, add 10 µL of internal standard to each 1.0 mL of sample extract.

3. Analyze a predetermined aliquot of each sample extract under the same conditions used for the initial and continuing calibrations.

4. At the conclusion of data acquisition, use the same software to tentatively identify peaks within the retention time window of interest. Examine the ion abundances of components of the chromatogram. If the ion abundance of the target ion used for quantitation exceeds the calibration range, dilute the aliquot and reanalyze. When preparing dilutions, add sufficient internal standard to maintain the same concentration as that of the ICAL.

a. Dilution criteria

I. Initial dilutions are recommended in the following situations:

i. More than three internal standard recoveries are <50%.

ii. Either of the last two internal standard recoveries are <20%.

iii. The analyst's judgment of a sample extract's color or viscosity indicates possible matrix interference.

iv. Raised final prep volume can also be indicative of potential matrix interference

I. Secondary dilutions are required to bring all target compounds into the calibration range of the GC/MS.

A. Qualitative Analysis:

A compound is identified by comparison of the following parameters with those of a standard of the suspected compound (standard reference spectra). The reference mass spectrum used for this comparison should be generated by the laboratory using the conditions of the method. In order to verify identification, the following criteria must be met:

1. The sample component relative retention time should compare within ±0.06 RRT units of the RRT of the standard component.

2. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 20% relative intensity if less than three such ions occur in the reference spectrum.

3. The relative intensities of the characteristic ions:

a. 8270C/D/E - The relative intensities of the characteristic ions must agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.)

b. 625.1 - The relative intensities of the characteristic ions must agree within 50% to 200% (0.5 to 2 times) for the quantitation and secondary m/z's in the reference mass spectrum stored in the data system. For example, if a peak has an intensity of 20% relative to the base peak, the analyte is identified if the intensity of the peak in the sample is in the range of 10% to 40% of the base peak. Analyst discretion is used to determine compound identification.

4. The above criteria apply to detections greater than or equal to the LOQ. For detections between the MDL and the LOQ, the above criteria and analyst discretion are used to determine compound identification. If identification is ambiguous, an experienced spectrometrist must determine the presence or absence of the compound.

B. Quantitative Analysis:

When a compound has been identified, quantitation is based on the internal standard technique and the integrated abundance from the extracted ion current profile (EICP) of the primary characteristic ion.

Calculations

Refer to *T-SVOA-FRM9602* for all departmental calculations.

Statistical Information/Method Performance

LCS, MS, surrogate, and RPD recoveries are compared to the limits stored in the LIMS. The surrogate recoveries will be compared to statistically generated limits for acceptance criteria for 8270C/D/E and for the surrogate in Table IV for 625.1. The LCS and MS recoveries will be compared to statistically generated limits for 8270C/D/E and for all 625.1 compounds contained in Table IV. For any compounds not contained in table IV, the LCS and MS recoveries will be compared to limits contained in Table V and the surrogate recoveries will be compared to limits contained in Table VI for 625.1.

For 8270C/D/E LCS and surrogate limits are statistically derived every six months in accordance with *T-SVOA-WI9604*. For 625.1 limits are derived anually. All RPDs are set to a default value of 30%, and MS limits are set equal to LCS limits.

All current and historical limit data is stored in the LIMS under the methods listed in the header of this SOP. The historical data for MDLs, MS/D, LCS/D, and measurement of uncertainty is reviewed at least annually and kept on file. Refer to the QA/QC section of this SOP and the criteria listed throughout this procedure for additional information on the performance of this method.

Quality Assurance/Quality Control

A. Batch QC

1. Each extraction batch of ≤20 samples must contain a method blank, a laboratory control sample (LCS) and an unspiked background sample (US), a matrix spike (MS), and a matrix spike duplicate(MSD).
2. A laboratory control sample/laboratory control sample duplicate (LCS/LCSD) is prepared with the extraction batch if adequate sample volume is not provided to prepare a matrix spike and matrix spike duplicate.
3. Additional QC samples may be required to meet project or state certification requirements.

B. QC and sample spiking

1. The LCS/D and MS/D are spiked at a concentration of 1 ppm.
2. All samples are spiked with surrogates at a concentration of 1 ppm by the extraction group to evaluate the extraction process.
3. Prior to analysis each sample extract is spiked with an internal standard mix.
4. All spiking concentrations are 4x lower for 250-mL aqueous analyses.

C. QC items, acceptance criteria, and corrective actions.

NOTE: If any client, state, or agency has more stringent QC, QC limits, or batch requirements, these must be followed instead.

Quality Control Item	Acceptance Criteria	Corrective Action
Internal Standards	1. Peak area within -50% to +100% of the area in the associated reference standard. 2. Retention time (RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then re-inject sample(s). 2. If re-injection meets the criteria, report this injection. 3. If re-injection still shows the same problem, report first injection. 4. If there is substantial matrix interference, the analyst may dilute the extract as outlined in Procedure H.4.

Quality Control Item	Acceptance Criteria	Corrective Action
Method Blank	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All target compounds must be less than the reporting limit for the associated samples. 4. For 625.1 the method blank must be analyzed immediately after the LCS and before the MS/D.	1. Inspect system for possible problems and reanalyze. 2. If the surrogates are out of spec high data can be used provided there aren't detections in the method blank. 3. If the surrogates are out of spec low and there aren't detections in the associated samples, the data can be used.* 4. If the method blank contains target compounds and the associated samples do not contain these compounds, no corrective action is required. 5. If the target compounds in the blank are also in the associated samples at a concentration <10x that in the blank, the samples are re-extracted unless the detection does not interfere with project data requirements. 6. If the target compounds in the blank are also in the associated samples at a concentration >10x that in the blank the data is usable. 7. Phthalates may be detected in the method blank and data reported as long as the phthalate detection is <LOQ.
Instrument Blank**	1. Must run after the CCV if no clean method blank is analyzed at the beginning of the 12-hour analytical period. 2. Must meet internal standard criteria. 3. All target compounds must be less than the reporting limit for the associated samples.	1. Inspect system for possible problems and reanalyze. 2. If the instrument blank contains target compounds and the associated samples do not contain these compounds, no corrective action is required. 3. If the target compounds in the blank are also in the associated samples, the samples should be re-extracted unless it does not interfere with project data requirements or if sample detections are at a level 10x higher than the detections in the blank.

Quality Control Item	Acceptance Criteria	Corrective Action
Laboratory Control Sample/Laboratory Control Sample Duplicate	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. % Recoveries within QC limits. Refer to the analysis numbers in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis. 4. RPDs within QC limits.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD recoveries are still outside acceptance limits, one of the following actions must be taken: a. if recoveries are outside acceptance limits low, the sample(s) must be re-extracted. b. if recoveries are outside acceptance limits high, data may be usable if the compounds that recovered above QC limits are not detected in samples. c. if recoveries are outside acceptance limits high and there are detections of the failing compounds, the sample(s) must be re-extracted. 4. If RPDs fail but recoveries are within QC limits, no further action is required. 5. If surrogates fail to meet criteria but all target compounds are within specification, data is usable.* 6. Marginal exceedance limits, as defined in the NELAC standards, may be used if the defined requirements have been met for 8270C/D/E. 7. South Carolina requires an aqueous LCS recovery criterion of 70-130% for PAH SIM analysis.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. % Recoveries within LCS limits. Refer to the analysis number in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis. 4. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries or RPDs out of spec, consult supervisor. BKG, MS, MSD may need to be re-extracted.

Quality Control Item	Acceptance Criteria	Corrective Action
Surrogates	1. %Recoveries within QC limits. Refer to the methods in the header of this document in LIMS for acceptance limits. These are reviewed and updated on a semiannual basis.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If no problem is found, re-extract and reanalyze. 4. If surrogates are out of spec high and no targets are detected in the sample no corrective action is required. 5. For samples analyzed only at a dilution ≥10x, no further action is required for surrogate failures.

*Requires approval of supervisor.
**Method blank or instrument blank in each 12-hour analytical period required for 8270E. (an instrument blank is recommended for all methods to demonstrate the instrument is free of contamination)

NOTE: Any failures without corrective action require approval of supervisor and completion of a non-conformance memo (NCM).

NOTE: All data associated with failed quality control will be qualified on the final report. QC outlier qualifiers are added to the associated sample results on the report by the LIMS.

D. Lower Limit of Quantitation (LLOQ)

1. The lower limit of quantitation (LLOQ) is verified annually through the extraction and analysis of an LCS at 0.5 to 2 times the established LLOQ.
2. The LLOQ is performed on similar analytical instruments such that all are included, at a minimum, within a 3 year time period.
3. Until the laboratory has sufficient data to determine the acceptance limits, the LLOQ criteria is ± 20% of the LCS limits.
4. Refer to *QA-SOP11892* for additional initial and ongoing LLOQ requirements.

E. Method Detection Limit (MDL)

1. Initial MDL studies must contain at least seven replicates and must be prepped across three different calendar days.
2. The MDLs must be analyzed on every instrument used for that analysis across three different calendar days.
3. Two ongoing MDLVs are analyzed and confirmed quarterly on each instrument, and MDLs are updated, if necessary, after enough points have been collected.
4. All compounds in the ongoing MDL verifications must be spiked at the same concentration level as the initial study.
5. Refer to *QA-SOP11892* for additional initial and ongoing MDL requirements.

F. Limit of Quantitation (LOQ)

1. Initial LOQ studies are spiked with compounds at the laboratory assigned LOQ and are analyzed on every instrument used for that analysis.
2. One ongoing LOQV is analyzed and confirmed quarterly on each instrument, and the LOQs are updated, if necessary.
3. Until the laboratory has sufficient data to determine the acceptance limits, the LOQ criteria is ±20% of the LCS limits.
4. Refer to *QA-SOP11892* for additional initial and ongoing LOQ requirements.

Table I

DFTPP Key Ion Abundance Criteria (8270C/D/E/625.1)

Mass	Ion Abundance Criteria
51	10% to 80% of mass 198
68	less than 2% of mass 69
70	less than 2% of mass 69
127	10% to 80% of mass 198
197	less than 2% of mass 198
198	base peak, or >50% mass 442
199	5% to 9% of mass 198
275	10% to 60% of mass 198
365	greater than 1% of mass 198
441	present but less than 24% of mass 442
442	Base peak, or >50% of mass 198
443	15% to 24% of mass 442

Table II

Recommended Minimum Response Factor Criteria for Initial and Continuing Calibration Verification (8270D)

Semivolatile Compounds	Minimum Response Factor (RF)
Naphthalene	0.700
2-Methylnaphthalene	0.400
Dimethylphthalate	0.010
Acenaphthylene	0.900
Acenaphthene	0.900
Dibenzofuran	0.800
Diethylphthalate	0.010
Fluorene	0.900
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Phenanthrene	0.700
Anthracene	0.700
Di-n-butylphthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butylbenzylphthalate	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Benzo(a)anthracene	0.800
Bis(2-ethylhexyl)phthalate	0.010
Di-n-octlyphthalate	0.010

Recommended Minimum Response Factor Criteria for Initial and Continuing Calibration Verification (8270D)

Semivolatile Compounds	Minimum Response Factor (RF)
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500

Table III

Semivolatile Internal Standard with Corresponding Analytes Assigned for Quantitation

1,4-Dichlorobenzene-d_4	Naphthalene-d_8	Acenaphthene-d_{10}
1,4-Dioxane	Quinoline	Acenaphthene
N-Nitrosodimethylamine	2-Methylnaphthalene	Acenaphthylene
	Naphthalene	Diethyl phthalate
	Bis(2-chloroethyl)ether	Dimethyl phthalate
	1-Methylnaphthalene	Fluorene
	1-Methylnaphthalene-d10 (surr)	Dibenzofuran
Phenanthrene-d_{10}	Chrysene-d_{12}	Perylene-d_{12}
Anthracene	Pyrene	Benzo(b)fluoranthene
Phenanthrene	Benzo(a)anthracene	Benzo(k)fluoranthene
Di-n-butyl phthalate	Bis(2-ethylhexyl) phthalate	Benzo(g,h,i)perylene
Fluoranthene	Butyl benzyl phthalate	Benzo(a)pyrene
Hexachlorobenzene	Chrysene	Benzo(a)pyrene-d12 (surr)
N-Nitrosodiphenylamine		Dibenz(a,h)anthracene
Fluoranthene-d10 (surr)		Indeno(1,2,3-cd)pyrene
		Di-n-octylphthalate
		Benzo(e)pyrene
		Perylene

(surr) = surrogate

Table IV

625.1 Analytes and Surrogate that use statistical limits

1,4-Dioxane
1-Methylnaphthalene
2-Methylnaphthalene
Dibenzofuran
N-Nitrosodimethylamine
1-Methylnaphthalene-d10 (surr)

(surr) = surrogate

Table V

Table 6 – QC Acceptance Criteria – Method 625 [1]					
Analyte	**Range for Q (%) [2]**	**Limit for s (%) [3]**	**Range for X (%) [3]**	**Range for P_1, P_2(%) [3]**	**Limit for RPD (%)**
Acenaphthene	70-130	29	60-132	47-145	48
Acenaphthylene	60-130	45	54-126	33-145	74
Anthracene	58-130	40	43-120	27-133	66
Benzo(a)anthracene	42-133	32	42-133	33-143	53
Benzo(b)fluoranthene	42-140	43	42-140	24-159	71
Benzo(k)fluoranthene	25-146	38	25-146	11-162	63
Benzo(a)pyrene	32-148	43	32-148	17-163	72
Benzo(ghi)perylene	13-195	61	10-195	10-219	97
Benzyl butyl phthalate	43-140	36	10-140	10-152	60
bis(2-Chloroethyl)ether	52-130	65	43-126	12-158	108
bis(2-Ethylhexyl) phthalate	43-137	50	29-137	10-158	82
Chrysene	44-140	53	44-140	17-168	87
Dibenz(a,h)anthracene	13-200	75	10-200	10-227	126
Di-n-butyl phthalate	52-130	28	10-120	10-120	47
Diethyl phthalate	47-130	60	10-120	10-120	100
Dimethyl phthalate	50-130	110	10-120	10-120	183
Di-n-octyl phthalate	21-132	42	19-132	10-146	69
Fluoranthene	47-130	40	43-121	26-137	66
Fluorene	70-130	23	70-120	59-121	38
Hexachlorobenzene	38-142	33	10-142	10-152	55
Indeno(1,2,3-cd)pyrene	13-151	60	10-151	10-171	99
Naphthalene	70-130	39	36-120	21-133	65
Phenanthrene	67-130	24	65-120	54-120	39
Pyrene	70-130	30	70-120	52-120	49

[1] Acceptance criteria are based upon method performance data in Table 7 and from EPA Method 1625. Where necessary, limits for recovery have been broadened to assure applicability to concentrations below those used to develop Table 7.

[2] Test concentration = 100 µg/mL

[3] Test concentration = 100 µg/L

Q = Calibration verification

s = Standard deviation for four recovery measurements in the DOC test.

X = Average recovery for four recovery measurements in the DOC test.

P_1, P_2 = MS/MSD recovery.

RPD = MS/MSD relative percent difference.

Table adapted from EPA method 625.1

Table VI

Surrogate Standard Acceptance Limits - Method 625		
Surrogate	**Range for Surrogate Recovery (%) [1]**	
	Calibration verification	**Recovery from samples**
Benzo(a)pyrene-d12	32-194	32-194
Fluoranthene-d10	47-215	30-187

[1] Recovery from samples is the wider of the criteria in the CLP SOW for organics or in Method 1625

10916 Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix
10928 Microwave Extraction by Method 3546 for Semivolatiles
10947 Separatory Funnel Extraction for BNAs in Wastewater by Method 612 or 625.1
11178 Demonstrations of Capability
11432 Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater
11892 Determining Method Detection Limits and Limits of Quantitation
11998 Semivolatile Spiking and Calibration Standards
9594 GC/MS Semivolatile Audit Process
9598 GC/MS Preventative and Corrective Maintenance
9602 Dept 4026 Calculations
9604 Monitoring GC/MS Semivolatile QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information	
18	07.JUL.2020		
18.1	27.APR.2021	Version 18.1 published for editorial changes only.	
19	20.MAY.2022		

eurofins	Always check on-line for validity. **Pesticides in Water by Method 8081A and 8081B using GC-ECD**	Level: **Work Instruction**
Document number: **T-PEST-WI9998**		
Old Reference: **1-P-QM-WI-9015066**		
Version: **17**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **31-MAY-2022**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_OC Pesticide C**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Extraction
Gas Chromatographic Conditions
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Appendix I

Revision Log

Revision: 17	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reagents and Standards B. 7. & 10.	Reflects current practice	Updated Toxaphene stocks
Header	Clarification	Updated Company name
Calibration J.	Reflects current practice	Added Procedure for Removal or Replacement of Calibration Standards

Revision: 16	**Effective Date:**	09-Nov-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Title	Reflects current practice	Added 8081B
Throughout document	Transition to new LIMS	Added TALS LIMS IDs and removed Parallax references
Cross Reference	Formatting requirement	Updated to D4 nomenclature
Reference Modifications	Clarification	With the addition of 8081B, clarified that the method exception applied to 8081A only
Reagents and Standards B.8.	Reflects current practice	Updated chlordane stock information
Reagents and Standards B.12.	Reflects current practice	Updated IBLK SS stock information
Reagents and Standards B.14.a.	Reflects current practice	Updated Pest Surrogate Mix information
Gas Chromatographic Conditions	Reflects current practice	Changed oven temperature program
Calibration C.	Reflects current practice	Added sixth calibration level to all curves, moved ICVs up in the sequence after each respective curve, updated closing CCVs to level4, added that IBLK must follow EVALX in the ICAL and re-ordered sequence
Calibration I.	Reflects current practice	Noted that usually 6 levels are used for all curves
Calibration 7.b.	Reflects current practice	Removed preparation and addition of sixth calibration point as the calibration process already uses 6 point
Calibration J.1.	Reflects current practice	Added that ICVs are injected directly after each of their respective curves
Calibration K.1.a.,c.	Reflects current practice	Changed mid-level from 3 to 4
Calibration K.6.a.	Reflects current practice	RT windows updated from level 4 not level 5
Appendix I	New LIMS	Removed references to Parallax-specific requirements and removed requirement to use microwave extraction as this is a water SOP
Throughout Document	SOP obsolete	Removed all references to T-PEST-WI9980
Calibration I. 7.e., 11-15	Reflects current practice	Removed datalog portion of the ICAL with the aroclors, toxaphene, and chloradane. Added removal of a calibration level
Statistical Information/Method Performance	Updated requirements	Updated 8000D requirements to TNI2016

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 8081A, December 1996.

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8081B, February 2007.

3. State of Connecticut Department of Environmental Protection, Recommended Reasonable Confidence Protocols for Pesticides by 8081, SW-846, version 2.0 July 2006.

4. Determinative Chromatographic Separations, SW-846, Method 8000D, July 2014

5. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-PEST-WI10920	Separatory Funnel Extraction by Method 3510C, 608, 608.3 or 622 for Pesticides and PCBs in a Wastewater
T-PEST-WI10007	Preventative and Corrective GC Maintenance
T-PEST-WI10011	QC Data Acceptability and Corrective Action
T-PEST-WI11971	Polychlorinated Biphenyls (PCBs) by Method 608 or 8082 in Waters
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses
T-PEST-WI9954	Interpretation of Chromatographic Data
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is used for identifying and quantitating the following pesticides in aqueous samples using Gas Chromatography with an Electron Capture Detector (GC-ECD):

Compound	LOQ (µg/L)
alpha-BHC	0.01
beta-BHC	0.01
delta-BHC	0.01
gamma-BHC (lindane)	0.01 (.05)
Heptachlor	0.01 (.05)
Aldrin	0.01
Heptachlor epoxide	0.01 (.05)
Endosulfan I	0.01
Endosulfan II	0.03
Endosulfan sulfate	0.02
Dieldrin	0.02
Endrin	0.02 (0.1)
4,4'-DDE (*p,p*)	0.02
2,4'-DDE (*o,p*)	0.02
4,4'-DDD (*p,p*)	0.02
2,4'-DDD (*o,p*)	0.02
4,4'-DDT (*p,p*)	0.02
2,4'-DDT (*o,p*)	0.02
Endrin aldehyde	0.1

Compound	LOQ (µg/L)
Endrin ketone	0.02
Methoxychlor	0.1 (0.5)
Chlordane	0.5 (2.5)
alpha-chlordane	0.01
gamma-chlordane	0.02
Toxaphene	1 (15)
Kepone	0.2
Mirex	0.05
Telodrin	0.01
Hexachlorobenzene (HCB)	0.01
Alachlor	0.04
Total Endosulfans	0.01

Limits of Quantitation (LOQs) are based on annual statistical evaluation of laboratory data and are subject to change. The current Method Detection Limits (MDLs) and LOQs are maintained in the LIMS.

Method 8081B is for Connecticut RCP work. See Appendix 1 for CT specific requirements.

Standards for the PCBs are run during this analysis since some of the PCB peaks may coelute or overlap with the pesticide peaks of interest. The information is used for proper identification and interpretation of the peaks observed for each sample. Quantitation of the same peak as a pesticide and PCB can be avoided.

Basic Principles

A portion of sample is extracted serially with methylene chloride. The volume of sample can be adjusted depending on the physical appearance of the sample and the amount submitted for analysis. The extract is dried, concentrated, and exchanged to hexane. Florisil, GPC, or copper cleanups may be employed to reduce matrix interferences such as oxygenated organics, unsaturated organics, or elemental sulfur that introduce large, unresolvable peaks into the chromatogram. The pesticides are then identified and quantitated using a GC-ECD.

Refer to *T-OE-PEST-WI10281* for details on each cleanup procedure. Refer to *T-OE-PEST-WI10920* for the extraction.

Reference Modifications

For method 8081A: GC operating conditions differ from those listed in SW-846 8081A; however, all Quality Control (QC) criteria are met.

Interferences

Avoid contact with any plastic material during the extraction and analysis procedures to minimize interferences from phthalate esters.

Scrupulously clean all glassware to minimize interferences caused by laboratory contaminants.

Cross-contamination can occur when any sample is analyzed immediately after a sample containing high concentrations of chlorinated pesticides; or large amounts of water-soluble materials, suspended solids, or high boiling point compounds. Review the prescreen data to choose the correct dilution factor prior to analysis to minimize cross-contamination.

An electron capture detector is very sensitive to compounds that contain halogens and also responds to many other compounds and materials including oxygenated organics, unsaturated organics, and elemental sulfur. Use Florisil cleanup to reduce organics that can interfere (polar compounds), use GPC to remove sulfur and

higher molecular weight organics and use copper cleanup to remove elemental sulfur. All of these interfering materials can introduce large, unresolvable peaks into the chromatogram.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Gloves, lab coats, and safety glasses must be worn when preparing standards. Lab coats and safety glasses must be worn around the GC where solvents and sample extracts are handled.

All GC vials and vials containing extracts are placed in a hazardous waste container for lab pack disposal. There is a satellite container in the laboratory, which is then emptied into the main laboratory waste collection drums. All solvent waste is disposed of in solvent waste containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the chromatography data system to set up sequences, perform the calculations, interpret chromatograms, perform instrument maintenance, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four laboratory control samples, one blind sample, or one ICAL with ICVs and/or CCVs.

Sample Collection, Preservation, and Handling

Samples are collected in amber glass containers with Teflon®-lined caps, preserved with 0.008% sodium thiosulfate, and stored at 0° to 6°C, not frozen. Samples must be extracted within 7 days of collection, and analyzed within 40 days of extraction. Sample extracts are stored at ≤-10°C.

Apparatus and Equipment

1. HP 6890 gas chromatograph equipped with dual electron capture detectors, or equivalent

2. Columns:

   a. Phenomenex MR1 30 m × 0.32 mm × 0.5 µm

   b. Phenomenex MR2 30 m × 0.32 mm × 0.25 µm

   Alternatively, Restek columns can also be used, and are in use for scan 1954 to achieve separation of alachlor

   c. RTX – CLPesticides – 30 m × 0.32 mm × 0.5 µm

d. RTX – CLPesticides II – 30 m × 0.32 mm × 0.25 µm

3. Integrating system such as Chrom Perfect® by Justice Laboratory Software, or equivalent.

4. Various sizes of Class-A volumetric pipettes, flasks, and syringes

Reagents and Standards

A. Reagents

1. Hexane for autosampler rinse vials. Pesticide grade or better stored at room temperature.

2. UPC (ultra pure carrier) helium for carrier gas

3. UPC nitrogen for detector make-up gas

4. UPC hydrogen for carrier gas, bottled or from a generator

B. Standards

1. Store unopened ampules according to the manufacturers' instructions.

2. Prepare standards using Class-A volumetric pipettes, flasks, and syringes.

3. Store all prepared standards in the freezer at ≤-10°C for up to 6 months. If comparison with check standards indicates a problem prior to expiration date, the standards must be replaced.

4. PCB standards are identical to those outlined in *T-PEST-WI11971*.

PCB standards are analyzed along with the pesticides and are used to identify aroclor peaks that may interfere with the target pesticides.

5. Mix A – Restek Catalog #32292. Equivalent to the CLP (SOW-OLMO3.2) Mix A and B, contains all single component pesticides and surrogates in the TCL and PPL organochlorine lists.

6. Mix E – Restek Custom Mix #55992. Contains additional organochlorine pesticides such as kepone, hexachlorobenzene, the *o,p* isomers of DDT, DDD, DDE, telodrin, and mirex.

7. Toxaphene stock – Restek Catalog #32005 at ~1,000,000 ppb. Prepare an intermediate by placing 1 mL into a 25-mL volumetric and bring to volume with hexane.

8. Chlordane stock (CAS #57-74-9)– Restek cat# 32021, 1,000,000 ppb in hexane.

a. Prepare an intermediate stock by bringing 1.0 mL of chlordane stock to a final volume of 10.0 mL using hexane.

9. EVAL stock – Ultra Scientific cat# CLP-250. Equivalent to CLP performance evaluation mix (PEM).

10. Initial Calibration Verification (ICV) stocks – These must be from lot numbers (or vendors) different than those used for working calibration standards. UltraScientifc CLP-216 and CLP-226B or equivalent. Accustandard Cat. #P-093S-H-10X or equivalent.

11. Alachlor stock – Accustandard Catalog #P-1025-10X, 1000 µg/mL in hexane.

12. Instrument Blank (IBLK) – surrogate stock (SS) – Restek cat# 32000 containing Decachlorobiphenyl (DCB) and Tetrachlorometaxylene (TCX) at 200,000 ppb each in acetone.

13. Prepare working standards using the electronic standard database as a guide.

a. In the database, choose the category (i.e. working spike, surrogate, intermediate, etc) and the required standard.

b. The database contains the following information: solution description (ex. MIXA1), parent solution name, aliquot used, final volume, solvent used, concentration of each compound in the solution, and expiration date. The working standards have an expiration date of 6 months.

c. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level.

14. Prepare the spiking solutions using the prep scheme in the table below:

a. Pest Surrogate Mix – Accustandard cat# CLP-032-R containing DCB/TCX at 2,000,000 ppb in acetone.

b. Pest Std Mix A – Supelco #487996 containing Gamma-BHC (lindane), heptachlor, alpha-BHC,Alpha endosulfan, 4,4-DDT, dieldrin, 4,4-DDD, endrin , and methoxychlor.

c. Pest Std Mix B – Supelco #48196 containing Beta-BHC, heptachlor epoxide, endosulfan sulfate, beta-endosulfan, endrin ketone, 4,4-DDE, endrin aldehyde, Aldrin, Alpha-chlordane, delta-BHC, gamma-chlordane.

d. TCLP Pest Mix – Restek #571010 containing gamma-BHC, heptachlor, heptachlor epoxide, endrin, methoxychlor

e. Alachlor stock - Accustandard Catalog #P-1025-10X, 1000 µg/mL in hexane

Standard Name	Parent Solution	Aliquot (mL)	Final Vol. (mL)	Solvent	Description	Expiration Date
SW-846 SS	Pest Surrogate Mix	1.5	1000	methanol	SW-846 Water Surrogate-identical to that prepared for PCB analyses	6 months
SW-846 MS	Pest Mix A	2	100	methanol	SW-846 Water Spike	6 months
	Pest Mix B	2				
TCLP Pest MS	TCLP Pest Mix	0.5	250	methanol	SW-846 Water Spike for single component organochlorines in the TCL/PPL list	6 months
Alachlor Matrix spike	Alachlor stock	0.05	50	acetone	Matrix spike, use 1 mL	6 months
IBLK	SS Stock	0.1	1000	Hexane	SW-846 Water Surrogate - identical to that prepared for the Pesticides/PCBs analysis	6 months

Extraction

See *T-OE-PEST-WI10920*

Gas Chromatographic Conditions

Detector: ECD

Detector Temp:	330°C
Oven Temp:	150°C, no hold, 45°C/min to 200°C,
	then 15°C/min to 230°C, then 30°C/min to 330°C, hold 1.5 min
Carrier:	Hydrogen at constant flow of 3.4 ml/min
	Helium may also be substituted.
Makeup Gas:	N2 at 55 mL/min
Injection Size:	1 µL, direct injection
Injector Temp:	225°C

The conditions listed above serve as a guideline and are typically the optimum operating conditions. The analyst may make changes to the chromatographic conditions to improve the speed of analysis, linearity, sensitivity and/or improve the separation if initial and continuing calibration criteria and quality assurance criteria listed within this analysis document are met.

Calibration

A. The pesticide analysis is run as a dual column approach. One injection is split onto two analytical columns. All initial and continuing calibration criteria listed below applies to both analytical columns.

B. Fill the autosampler rinse vials with clean solvent or replace vials that appear dirty.

C. Prepare a sequence in the Chrom Perfect® datafile using the following order of injections. NOTE: If the IBLK is to be reported or included in a data deliverable, it must follow the EVALX analysis in the ICAL sequence.

1. Conditioner
2. EVALX
3. IBLK
4. MIXA1
5. MIXA2
6. MIXA3
7. MIXA4
8. MIXA5
9. MIXA6
10. ICMAX (ICV)
11. MIXE1
12. MIXE2
13. MIXE3
14. MIXE4
15. MIXE5
16. MIXE6
17. ICMEX (ICV) if needed
18. TOXA1
19. TOXA2
20. TOXA3
21. TOXA4
22. TOXA5
23. TOXA6
24. ICTX (ICV)
25. CHLD1
26 CHLD2
27. CHLD3
28. CHLD4
29. CHLD5

30. CHLD6
31. ICCH (ICV)
32. AR164
33. AR2154
34. AR484
35. MDLA
36. MDLE
37. MDTX
38. MDCH
39. Blank
40. LCS
41. 1234567
42. 1234567MS
43. 1234567MSD
44. – 54. Continue running samples for a 12-hour period from last standard
55. EVALX
56. MIXA4
57. MIXE4
58. TOXA4
59. CHLD4

D. Inject conditioner to prime the system.

1. Conditioner is best utilized when the GC has not been running and there is a gap in time prior to starting a set of injections.

2. The conditioner is typically a standard or sample that has already been injected.

3. Hexane blanks can be run to allow the GC to go through some temperature programs and/or to check the cleanliness of the system after the instrument has set idle.

E. Inject instrument blank (IBLK) after the conditioners and before the initial calibration to confirm that the instrument is free of background noise or contamination.

IBLK may also be run with the continuing check standards - this is optional but frequently requested for projects.

F. Endrin / DDT Breakdown:

1. Run a breakdown evaluation standard (EVAL) at the start of an ICAL.

(The EVAL is also used throughout the run. See the continuing calibration Step K of this section.)

2. Inject and analyze the EVALX solution using the same GC parameters used for client samples.

3. Evaluate the degradation products of 4,4-DDT and Endrin

4. The breakdown for each compound cannot exceed 15%.

a. The sum of the heights of DDE, and DDD divided by the total height of DDT/DDD/DDE cannot exceed 15%.

b. The sum of the heights of endrin aldehyde and endrin ketone divided by the total height of endrin/endrin aldehyde/endrin ketone cannot exceed 15%.

5. If the breakdown check fails, perform injector maintenance. Analysis cannot proceed until the breakdown check passes.

G. The order of injections for the multi-components is not critical as long as they are all run before sample analysis. They are only used to identify possible PCB patterns which may interfere with the pesticide

detections.

H. Alachlor standards are needed for Method 8081B.

I. Initial Calibration (ICAL)

1. Calibrate the GC with at least 5 levels of the single component pesticides contained in MIX A. Also analyze 5 Levels of MIX E if the associated samples require those compounds. Analyze at least 5 levels for chlordane and toxaphene. Usually 6 levels are used for all curves.

a. Inject aroclor standards for pattern recognition only.

b. Use the aroclor standard to determine if any of the aroclor peaks overlap with the target pesticides.

2. The lowest standard must be at the LOQ. The remaining standards bracket the analyte concentrations expected in the sample extracts, or define the working range of the detector.

3. Analyze each calibration standard from low concentration to high. The data system tabulates the response against the concentration for each analyte.

4. Analyze the calibration standards on both columns.

5. Calculate the calibration factor (CF) for each analyte at each concentration, the mean CF, and the relative standard deviation (RSD) of the CFs.

6. Use an external standard calibration, if the %RSD for each analyte is ≤20%, the response of the instrument is considered linear and the average calibration factor (AVGCF) can be used to quantitate results.

7. Alternatively, if the %RSD is >20%, a calibration curve is used.

a. Attempt a linear fit. Use this fit if the correlation coefficient is ≥0.99.

b. If the correlation coefficient is <0.99 and the compound has historically exhibited a nonlinear response, quadratic fit may be used provided all six calibration points are being used. It can not be used to extend the calibration range or bypass instrument maintenance.

(1) Typically the pesticides in this method do not require a quadratic fit.

NOTE: For samples from South Carolina, a quadratic fit may not be used.

c. Set the zero to ignore within Chrom Perfect®. To extrapolate or force to zero is not allowed for either curve type. See T-PEST-WI-10016 for more details.

d. Inspect the data points if the minimum 0.99 curve coefficient is not met to determine if one or more calibration levels appear to be off. A specific calibration level may have concentrated due to solvent evaporation or analyte degradation over time. Reinject or remake the standard if this is the cause. Otherwise, the instrument may need maintenance. T-PEST-WI-10007 for troubleshooting linearity problems.

e. The laboratory may remove an entire single standard calibration level from the interior of the calibration curve when the instrument response demonstrates that the standard was not properly introduced to the instrument, or an incorrect standard was analyzed. A laboratory that chooses to remove a calibration standard from the interior of the calibration shall remove that particular standard calibration level for all analytes. Removal of calibration points from the interior of the curve is not to be used to compensate for lack of maintenance or repair to the instrument.

8. Curve types and criteria can be altered to meet client or project specific requirements as well as any regulatory agency requirements that may differ from those listed here.

9. If the curve fails on both columns for any analyte, corrective action is necessary. Corrective actions include, but are not limited to: injector/column maintenance, preparation of new calibration standards,

installation of new columns, and/or refurbishment of the ECDs.

10. If the calibration fails for only one standard and no samples have been analyzed the standard can be re-injected and the calibration criteria re-calculated.

11. Ensure the peaks in the standards are labeled properly, including the surrogates in all injections that contain them.

12. Set the scaling of chromatograms and peak integration parameters so that the peaks for each compound of interest are detected and integrated at the concentration of the Method Detection Limit (MDL). This ensures that the LOQ and MDLs can be met.

13. When 8000D is referenced and curve fits are used in the initial calibration, percent error (%E) must be calculated for each calibration level. Standard levels at or below the LOQ must meet +/- 50%, standards above the LOQ must meet +/-30%. (%error = (true concentration - calculated concentration)/true concentration)*100). All individual peaks used to calculate the multicomponent pattern must meet the %E criteria.

J. Procedure for Removal or Replacement of Calibration Standards

1. The laboratory may remove individual analyte calibration levels from the lowest and/or highest levels of the curve. Multiple levels may be removed, but removal of interior levels is not permitted.
2. The laboratory may remove an entire single standard calibration level from the interior of the calibration curve when the instrument response demonstrates that the standard was not properly introduced to the instrument, or an incorrect standard was analyzed. A laboratory that chooses to remove a calibration standard from the interior of the calibration shall remove that particular standard calibration level for all analytes. Removal of calibration points from the interior of the curve is not to be used to compensate for lack of maintenance or repair to the instrument.
3. The laboratory shall adjust the LOQ/reporting limit and quantitation range of the calibration based on the concentration of the remaining high and low calibration standards.
4. The laboratory shall ensure that the remaining initial calibration standards are sufficient to meet the minimum requirements for number of initial calibration points as mandated by this Standard, the method, or regulatory requirements.
5. The laboratory may replace a calibration standard provided that:
    a. The laboratory analyzes the replacement standard within twenty-four (24) hours of the original calibration standard analysis for that particular calibration level;
    b. The laboratory replaces all analytes of the replacement calibration standard if a standard within the interior of the calibration is replaced;
    c. The laboratory limits the replacement of calibration standards to one calibration standard concentration.
6. The laboratory shall document a technically valid reason for either removal or replacement of any interior calibration point.

K. Initial Calibration Verification (ICV)

1. Verify the calibration curve using the ICV mixtures injected directly after each of their respective curves.

2. The % difference of the concentrations for each individual target analyte must be within 15% difference of the nominal concentration.

L. Continuing Calibration Verification (CCV)

1. Analyze a set of check standards after each set of injections in a 12-hour period, or 20 injections, whichever comes first (samples, QC, blanks, etc).

a. Use (MID LEVEL) Level 4 of MIXA and MIXE (if needed) to evaluate the response for the single component analytes.

b. Run the breakdown evaluation mix (EVAL). See Endrin/DDT Breakdown Section F. for details on acceptance and actions relative to the EVAL standard.

c. Run Toxaphene and Chlordane, level 4.

2. The concentration quantitated for each target analyte in the continuing calibration check standards must be within 15% difference (%D) of the nominal concentration.

3. Samples must be bracketed by compliant standards.

4. When confirmation of target analytes is needed, the initial calibration criteria must be met and the second column should meet the 15% continuing calibration criteria. See *T-PEST-WI9954* for details on reporting data.

5. If the CCV fails high and those target compounds are not detected in the associated samples, the samples can be reported.

6. Retention time (RT) windows

a. Established as 3× the standard deviation determined over 72 hours, or at no less than 0.02 minutes, applied to the initial calibration standard, usually Level 4.

b. If the RTs for a continuing calibration standard fall outside the RT window, update the midpoint RT using that standard.

(1) Save this under the appropriate name to indicate an update has occurred.

(2) Retention times cannot be updated more than once per day. All subsequent standards run within a 24-hour period must be within this window.

(3) If RTs are not consistent, the cause must be investigated and corrective action taken.

Procedure

1. Samples are analyzed according to the sequence listed in the Calibration Section.

2. Retention times of peaks in the samples are compared to the standard RT windows.

a. Peaks present on both columns (and that are also in the correct ratios to represent toxaphene or chlordane) are quantitated.

b. The high value is reported unless there are chromatographic anomalies. See *T-PEST-WI9954* for more information.

3. Continue running groups of samples/injections followed by check standards every 12 hours or every 20 injections, whichever comes first.

4. Positive results ≥ the LOQ must be confirmed by second column.

5. Carefully examine the results of all samples that follow a high concentration sample for possible carryover.

6. If significant interference is present, ensure proper cleanups have been scheduled such as florisil cleanup. If elemental sulfur is present, copper cleanup the extract or have it put through GPC cleanup. If these techniques do not reduce the matrix problems, dilute the extract, analyze, and adjust the LOQs accordingly.

7. Dilute samples as necessary to put the peak height of the target pesticide within the range of the initial calibration. Dilutions are prepared using hexane.

8. Report the results for the least dilute sample where the concentration measured is within the acceptable calibration range.

Calculations

See *T-PEST-WI9847* for details on all calculations/equations used to evaluate the initial and continuing calibration. Calculation of results is performed according to the following procedures:

A. Single-component compounds

1. Using AVGCF from initial calibration

$$\frac{Sample\ Height}{AVGCF} \times \frac{FV}{IV} \times DF = \mu g/L \quad as\ received$$

2. Using linear curve from initial calibration:

$$\left[(Sample\ Height - Y - intercept)/Slope\right] \times \frac{FV}{IV} \times DF = \mu g/L\ as\ received$$

Where:

FV (final volume) = mLs

IV (initial volume) = mLs

DF (dilution factor) = as needed

B. Multi-component compounds

The peak heights generated by the integration system are used to calculate the Calibration Factors (CF) for peaks of interest for each aroclor. Usually the six major peaks that are unique to toxaphene and chlordane (including alpha chlordane, gamma chlordane, and heptachlor) are chosen for quantitation. Sample concentrations are calculated per peak using Average Response Factor (AVGRF).

$$\frac{Sample\ Height}{AVG\ CF\ (CF)} \times \frac{FV}{IV} \times DF = \mu g/L\ as\ received$$

Where:

FV (final volume) = mLs

IV (initial volume) = mLs

DF (dilution factor) = as needed

The final result that is reported is determined as the average of the result for each peak chosen for quantitation:

$$(Result\ 1 + Result\ 2 + \ldots + Result\ n) \ / \ n = Average\ Result$$

C. A breakdown mix (EVALX) containing p,p¢-DDT and Endrin is run to check for breakdown. The breakdown must not exceed 15% for either compound. Breakdown is calculated as:

$$\frac{\%\ Breakdown}{for\ p,p'\text{-}DDT} = \frac{pk\ ht\ (area)\ of\ p,p'\text{-}DDE + p,p'\text{-}DDD}{pk\ ht\ (area)\ of\ p,p'\text{-}DDE + p,p'\text{-}DDD + p,p'\text{-}DDT} \times 100$$

$$\frac{\%\ Breakdown}{for\ Endrin} = \frac{pk\ ht\ (area)\ of\ Endrin\ Aldehyde + Endrin\ Ketone}{pk\ ht\ (area)\ of\ Endrin\ Aldehyde + Endrin\ Ketone + Endrin} \times 100$$

If breakdown fails, injector maintenance must be performed. Analysis cannot proceed until breakdown check passes.

Statistical Information/Method Performance

LCS, MS, and RPD are compared to the limits stored in the LIMS. The limits for LCS and MS are statistically derived. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the manager. The department database is updated via a download from the LIMS.

When TNI2016 is referenced, an annual lower limit of quantification (LLOQ) verification is required quarterly on at least one instrument (1 spike per instrument). All instruments must have one at least every three years.

Quality Assurance/Quality Control

Each extraction batch (up to 20 samples) must contain a method blank, an LCS, and either an unspiked background sample (US), an MS, an MSD or an LCS/LCSD.

QC limits for surrogates, LCS/LCSD, and MS/MSD are established through statistical analysis of historical data. The limits are evaluated every 6 months and updated as needed. The limits are maintained in the LIMS for the relevant analysis numbers.

All single component pesticides of interest for each analysis are routinely spiked with the exception of Mirex, *o,p*-DDE/DDD/DDT, telodrin, kepone, and HCB. These analytes are not spiked since this would result in coelution with the other spiked compounds. These can be spiked at a client's request for special projects.

DCB and TCX are added as surrogates to each sample and QC to monitor the efficiency of the extraction, the operation of the autosampler, and to monitor retention times throughout the GC run.

See *T-PEST-WI10011* for details on QC acceptance criteria and corrective action.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed. For example, MS/MSD is performed at a frequency of 10% for South Carolina.

See Appendix 1 for CT RCP criteria.

Appendix I

Guidelines for CT RCP for Pesticides

No use of grand mean

Multiple trials are reported. If a dilution is needed, report all compounds from both injections (no more than 2).

Comments are needed to explain any raised limits (does not need precursor comment).

Alachlor is part of the routine scan. HCB is only asked for as a project-specific analyte. PCBs are always separate.

In House statistically determined percent recovery limits must be between 40–140% except for difficult analytes, which must be between 30-140% for the LCS.

Surrogate recovery limits can be statistical limits which must fall within 30-150%

10007 Preventative and Corrective GC Maintenance
10011 QC Data Acceptability and Corrective Action
10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10920 Separatory Funnel Extraction by Method 3510C, 608, or 608.3 for Pesticides and PCBs in a Wastewater
11892 Determining Method Detection Limits and Limits of Quantitation
11971 Polychlorinated Biphenyls (PCBs) by Method 608 or 8082 in Waters
9847 Common Equations Used During Chromatographic Analyses
9954 Interpretation of Chromatographic Data

End of document

Version history

Version	Approval	Revision information	
15	29.DEC.2020		
16	09.NOV.2021		
17	27.MAY.2022		

eurofins	Always check on-line for validity. **Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A Using GC-ECD**	Level: **Work Instruction**
Document number: **T-PEST-WI10004**		
Old Reference: **1-P-QM-WI-9015110**		
Version: **11**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **01-JUN-2022**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_PCB Chemist**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Extraction
Gas Chromatographic Conditions
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Appendix I

Revision Log

Revision: 11	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Personnel Training and Qualifications	Clarification	Added LCS as IDOC criteria per 8000D
Calibration 8	Clarification	Updated iblk injection to before or after based on client requirement
Statistical Information/Method Performance	Current process	LOQ verification is included in the MDLs SOP.

Revision: 10	**Effective Date:**	16.MAR.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Removed references to old LIMS analysis numbers
Throughout Document	Reflects current practice	Removed references to obsolete work instructions T-PEST-WI10016 and T-PEST-WI10022
Reagents and Standards B.18	New LIMS	Updated reagent database information

Revision: 10	**Effective Date:**	16.MAR.2021
Section	**Justification**	**Changes**
Calibration 5.f.(3)	Enhancement	SOP mentioned that quadratic fit may not be used for SC samples, but use of quadratic fit was not discussed. Added discussion about quadratic fit requirements.
Appendix I	New LIMS	Updated reagent database information

Reference

1. *Test Methods for Evaluating Solid Waste*, SW-846, Method 8082A, February 2007.
2. Determinative Chromotographic Separations, SW-846, Method 8000D, July 2014
3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-PEST-WI10922	Ultrasonic Extraction for PCBs in a Solid Matrix by Method 3550C
T-OE-PEST-WI10927	Microwave Extraction Method 3546 for PCBs in a Solid Matrix
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-PEST-WI10011	QC Data Acceptability and Corrective Action
T-PEST-WI9954	Interpretation of Chromatographic Data
T-PEST-WI10007	Preventative and Corrective GC Maintenance
T-PEST-WI9980	Monitoring QC Data Acceptance Limits
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses

Scope

This method is used for identifying and quantitating the following PCBs in solid samples and wipes using SW846 8082A:

Compound	Soil LOQ (µg/kg)	Wipes LOQ (µg)	Tissue LOQ (µg/kg)
Aroclor 1016	17	0.5	34
Aroclor 1221	17	0.5	34
Aroclor 1232	17	0.5	34
Aroclor 1242	17	0.5	34
Aroclor 1248	17	0.5	34
Aroclor 1254	17	0.5	34
Aroclor 1260	17	0.5	34
Aroclor 1262	17	0.5	34
Aroclor 1268	17	0.5	34

Aroclors 5422, 5432, and 5460 can be analyzed upon request of the client. See Appendix I for GC operating conditions and calibration information.

Compound	Soil LOQ (µg/kg)
Aroclor 5422	33
Aroclor 5432	33
Aroclor 5460	33

Limits of Quantitiation (LOQs) are based on statistical evaluation of laboratory data and are subject to change. The current Method Detection Limits (MDLs) and LOQs are maintained in the LIMS.

Basic Principles

A solid sample or entire wipe is extracted using sonic probe with 1:1 methylene chloride:acetone, or microwave extraction with hexane. The extract is dried, concentrated, and exchanged to hexane. A florisil and sulfuric acid cleanup is utilized to reduce any matrix interferences. The PCBs are then identified and quantitated using gas chromatography (GC) with electron capture detector (ECD). Copper cleanup may also be employed to reduce elemental sulfur or other matrix interferences which introduce large, unresolvable peaks into the chromatogram. Refer to *T-OE-PEST-WI10281* for details on each cleanup procedure.

Solid matrices other than soil can also be analyzed as long as the sample can be handled through the extraction technique. Typically solids are reduced to small pieces for extracting (concrete, wood, other plant material etc). Tissue samples are ground and homogenized prior to extracting. Tissue samples may be whole fish, filets, or other miscellaneous species (usually aquatic but not necessarily). Wipe samples are analyzed by taking the entire wipe sample and any solvent in the sample container.

Reference Modifications

Gas Chromatography conditions are different than those listed in Method 8082A, however, all QC criteria are met.

Interferences

Avoid contact with any plastic material during the extraction and analysis procedures to minimize interferences from phthalate esters.

Scrupulously clean all glassware to minimize interferences caused by laboratory contaminants.

An electron capture detector (ECD) is very sensitive to compounds that contain halogens and will also respond to many other compounds and materials including oxygenated organics, unsaturated organics, and elemental sulfur.

Extracts may require further cleanup by sulfuric acid, florisil, or copper if interferents such as oxygenated organics, unsaturated organics, and elemental sulfur are present. Refer to *T-OE-PEST-WI10281*
for details on each cleanup procedure.

Common single component pesicides such as DDT, DDD, and DDE may cause interference with the aroclor pattern. To ensure that the analyst is aware of this, a standard containing DDE/DDD/DDT will be run with each initial calibration.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for generalinformation regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

Gloves, lab coats, and safety glasses must be worn when preparing standards. Safety glasses must be worn around the GC where solvents and sample extracts are handled.

GC vials are disposed of in the designated lab container and subsequently lab packed for final disposal. All solvent waste is placed in designated containers in the laboratory then taken to the lab-wide facility by personnel trained in hazardous waste disposal.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst’s training records.

Initially, each analyst performing instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the chromatography data system to set up sequences, perform the calculations, interpret chromatograms, perform instrument maintenance, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation (per EPA 8000D the criteria are the statistical LCS window, and RPD </= 20%). Various options are available for a DOC and can include four laboratory control samples or one blind sample.

Sample Collection, Preservation, and Handling

Samples are collected in wide-mouth glass containers with Teflon™-lined caps and kept cool at 0° to 6°C, not frozen.

PCBs have no maximum recommended holding time for the extraction. Some agencies or projects may require a specific hold time for the extraction. If the hold time is specified in the project, this hold time must be followed. Sample analysis must be performed within 40 days of extraction. Extracts are stored in the freezer at ≤-10°C

Apparatus and Equipment

1. HP 7890 gas chromatograph equipped with an electron capture detector or equivalent
2. Columns:
    a. Phenomonex MultiRes I – 30 m × 0.32 mm × 0.5 µm or equivalent
    b. Phenomonex MultiRes II – 30 m × 0.32 mm × .25 µm or equivalent
    c. Alternatively, Restek columns can be used.
3. Integrating system such as Chrom Perfect® by Justice Laboratory Software, or equivalent. Chrom Perfect® is a data system capable of storing and reintegrating chromatographic data and determining peak areas using a forced baseline, area summation, baseline projection, and performing baseline compensation as required.
4. Various sizes of Class A volumetric flasks, pipettes, and syringes

Reagents and Standards

A. Reagents

1. Hexane for autosampler rinse vials, stored at room temperature.
2. UPC (Ultra pure carrier) helium for carrier gas
3. UPC nitrogen for detector make-up gas
4. UPC hydrogen for carrier, either bottled or from a generator

B. Standards

1. All standards are prepared using Class A volumetric pipettes, syringes, and flasks.
2. An analytical balance is used to measure all weights.
3. Unopened ampules are stored according to the manufacturer’s instructions and are stable until the expiration date provided by the manufacturer.
4. All prepared standard solutions are stored at ≤-10°C in labeled containers or vessels.
5. Aroclor 1016 & 1260 stock – Restek #32039 at 1,000,000 ppb in isooctane or equivalent. Prepare a ten-fold dilution for an intermediate.
6. Aroclor 1016 ICV Stock – Accustandard Cat# C-2165-H-10X at 1,000,000 ppb in Hexane.
7. Aroclor 1260 ICV Stock - Accustandard Cat# C-2605-H-10X at 1,000,000 ppb in Hexane.
8. Aroclor 1221 stock – Restek #32007 at 100,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source.
9. Aroclor 1232 stock – Restek #32008 at 100,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source.
10. Aroclor 1242 stock – Restek #32009 at 100,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source.
11. Aroclor 1248 stock – Restek #362010 at 1,000,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

12. Aroclor 1254 stock – Restek #32011 at 1,000,000 ppb in isooctane or equivalent. Two lots are kept on hand to provide a second source. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

13. Surrogate stock (SS) – Supelco #861284 containing DCB/TCX at 200,000 ppb in acetone or equivalent. Prepare an intermediate by diluting 1.0 mL to 25 mL of hexane for AR1016/1260, AR1254, AR1248.

14. 1016/1260 Matrix spike (MS) stock – Restek #32039 at 1,000,000 ppb in hexane or equivalent.

15. Aroclor 1262 stock – Restek #32409 at 1,000,000 ppb in hexane or equivalent. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

16. Aroclor 1268 stock – Restek #32410 at 1,000,000 ppb in hexane or equivalent. Prepare an intermediate by diluting 1 mL to 10 mL of hexane.

17. Instrument Blank (IBLK) – Surrogate Stock (SS) – Restek #32000 containing Decachlorobiphenyl (DCB) and Tetrachlorometaxylene (TCX) at 2000,000 ppb in acetone or equivalent.

18. Prepare working standards using the reagents module of the LIMS as a guide.

    a. In the reagents module, first enter the reagents in this section as 'source' reagents.

    b. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing, or create a new standard if the working standard has not yet been prepared in TALS.

    c. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The working standards have an expiration date of 6 months.

    d. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level.

    e. The scheme for preparing the matrix and surrogate spiking solutions used in the extraction process are listed below.

Standard Name	Parent Solution	Aliquot (mL)	Final Volume (mL)	Solvent	Description
PCB Spike	Aroclor 1016/1260 MS Stock	1.25	250	Acetone	PCB Spike
SS	Pest Surr Stock	1.5	1000	Methanol	SW-846 Water surrogate – identical to that prepared for Pest/PCB analyses

19. An initial calibration verification standard must also be prepared at a concentration at the mid-point of the calibration for 1016, 1260,1248 and 1254 using a stock solution purchased from a different source other than that used for the calibration standards.

20. Additional standards and preparations are listed in Appendix I for Aroclor 5442, 5432, and 5460 (PCT analysis).

Extraction

See organic extraction work instruction T-OE-Pest-WI10922 for sonication extraction and T-OE-Pest-WI10927 for microwave extraction.

Gas Chromatographic Conditions

The conditions listed are usually the optimum operating conditions but can vary to improve the sensitivity, linearity, and overall chromatography or shorten run times on each GC system. A Merlin microseal may be used in place of a traditional septum.

Detector	ECD
Detector Temperature	330°C
Oven Temperature	110°C 40°C/min to 250°C 20°C/min to 280°C 30°C/min. to 330°C Hold until DCB elutes ~ 2 min.
Carrier	Hydrogen at 12 psi, 5ml/min constant flow (Can be substituted with Helium)
Makeup gas	N2 at 30 mL/min. for Varian GCs N2 at 55 mL/min. for HP GCs
Injection size	1 µL, direct injection

Injection Temperature	225°C

Calibration

1. Fill the autosampler rinse vials with clean solvent or replace vials which appear dirty.
2. Prepare a sequence using the following suggested order of injections:

    1. Conditioner
    2. IBLK
    3. EVAL
    4. AR161
    5. AR162
    6. AR163
    7. AR164
    8. AR165
    9. AR166
    10. AR481
    11. AR482
    12. AR483
    13. AR484
    14. AR485
    15. AR486
    16. AR541
    17. AR542
    18. AR543
    19. AR544
    20. AR545
    21. AR546
    22. AR214
    23. AR324
    24. AR424
    25. AR624
    26. AR684
    27. AR16xx
    28. MD16 (MDL)
    29. IC16x (ICV)
    30. IC48x (ICV)
    31. IC54x (ICV)
    32. Blank
    33. LCS
    34. 1234567
    35. 1234567ms
    36. 1234567msd

    37-47. Continue running samples

    48. AR164(CCV)
    49. IBLK

    a. For routine PCBs:

        (1) The AR21, AR32, and AR42 are level 4 in the cal and are entered at AR214, AR324, and AR424 in the cal.

        (2) AR62 and AR68 are both level 4 and are listed as AR624 and AR684 in the sequences.

        (3) A single point of Aroclor 1016 is analyzed with the calibration to aid in better pattern recognition in the samples. Aroclor 1016 and 1242 have similar patterns with the exception of the smaller trailing peaks at the end of the Aroclor 1242 pattern. This is identified in the sequence as AR16xx.

        (4) A DDT/Endrin breakdown standard is run with each ICAL in order to provide the retention times for p,p-DDE, p,p-DDD, and p,p-DDT which may interfere with the pattern for aroclor 1248, 1254, and 1260.

    b. See Appendix I for a sequence example when the analysis of PCTs (Aroclors 5442, 5432, and 5460) is requested.

3. Inject conditioner to prime the system.

    a. The conditioner injection is usually a standard or sample which has already been injected.

b. It is used to prime the system and is best utilized when the GC has not been running and there is a gap in time prior to starting a set of injections.

c. Hexane blanks may also be run to allow the GC to go through some temperature programs and/or to check the cleanliness of the system.

4. An instrument blank (IBLK) is always run prior to a new calibration to confirm that the instrument is free of background noise or contamination. IBLK may also be run with the continuing check standards - this is optional but frequently requested for projects.

5. Initial Calibration (ICAL)

a. Calibrate for the aroclors using the six levels of 1016, 1260, 1248, and 1254 (calibration range of 50 µg/L through 1000 µg/L) and using the single point for 1221, 1232, 1242, and 1262 and 1268 when needed (200 µg/L standard used).

b. As an option, 1248 and 1254 may use a single point calibration.

c. An external standard calibration based on the average calibration factor (AVG CF)for each individual peak chosen in the pattern is used for quantitation where the %RSD is ≤20%.

d. The surrogate standards are calibrated using the AR16 levels and the calibration is also performed using AVG CF unless the %RSD is >20%.

e. When the % RSD criteria is not met (i.e. >20%), a linear calibration curve is used.

(1) The curve must meet a correlation coefficient of 0.99 to be a valid fit.

(2) Extrapolate or force to zero is not allowed. Set the zero to ignore.

(3) North Carolina and 8000D requires calculation of % error for any linear fits. The criteria for % error of standard levels at or below the LOQ is +/- 50%. The criteria for % error of all other standard levels is +/-30%.

%error = ((true – calc)/true) x 100

f. If the %RSD criteria or 0.99 curve coefficient cannot be met:

(1) Inspect the data points to see if one or more calibration levels may have concentrated due to solvent evaporation or degraded over time.

(2) Reinject or remake the standard if this is the cause.

(3) Use a quadratic fit provided six points are used in the calibration and the curve meets a correlation coefficient of 0.99. The % error must be calculated and meet the criteria defined in e.4. **NOTE:** A quadratic fit may not be used for South Carolina samples.

(4) Perform instrument maintenance as needed.

(5) See *T-PEST-WI10007* for troubleshooting linearity problems.

g. Set up the aroclor calibration data in a custom program under Datalog. The retention times of the peaks to use for identifying and quantifying the aroclors are entered into the calibration file along with the corresponding peak heights and concentrations (in µg/L).

h. Ensure the surrogate peaks in the standards are labeled properly.

i. Set the scaling of chromatograms so that the size of the peaks of interest for each aroclor are approximately 2 to 3 mm in height at the concentration of the method detection limit (MDL).

(1) Ensure all peaks in the MDL standard are integrated.

(2) By running the 1016/1260 MDL standard, the majority of peaks for all aroclors should be represented.

6. Initial Calibration Verification (ICV)

a. Verify the calibration curves using the ICV mixtures injected directly after the full ICAL.

b. The % difference of the concentrations of each individual peak used to calculate the Aroclor must be within 20% difference of the nominal concentration.

7. Continuing Calibration Verification (CCV)

a. Calibration verification is performed after each set of twenty injections (samples, QC, blanks, etc.) or 12 hours, whichever comes first.

b. Use AR16 to evaluate the calibration of the aroclors (or other aroclors as requested for particular clients or projects).

c. The concentration quantitated for each individual peak used to calculate the Aroclor in the continuing calibration verification standards must be within 20% difference (%D) of the nominal concentration for each peak/surrogate.

d. Samples must be bracketed by compliant standards.

(1) Exception: If standard following a sample is outside the ±20% but exhibits increasing response, the samples before it do not have to be reinjected if the target analytes are not detected. A comment must be added to the analytical report.

(2) If two consecutive/sequential CCVs fail, corrective action must be taken, which can include performing injection port maintenance, baking the instrument or other types of maintenance. Two consecutive/sequential CCVs must meet the criteria or an initial calibration must be performed before sample analysis can continue.

e. If confirmation of target analytes is needed, then the second column should meet the 20% continuing calibration criteria, as well as all initial calibration criteria. If either of these are not met, a comment must be added to the analytical report.

8. The instrument blank (IBLK), if requested for, is injected before or after each set of continuing calibration verification, depending on project specifications/project notes.

a. It must be evaluated as a water matrix against the water MDL/LOQs.

b. The IBLK must not have any target compounds above the reporting limits.

(1) If a target analyte is detected in the IBLK, any associated samples with a detection for that same target must be evaluated.

(2) Unless the concentration in the sample is more than 10x the IBLK value, the sample must be injected after another compliant IBLK.

(3) Instrument maintenance, i.e., baking the system or injection port maintenance is usually necessary to clean up the instrument.

9. Retention time (RT) windows

a. Established as 3× the standard deviation determined over 72 hours, or at no less than ±0.02 min, applied to the midpoint initial calibration standard.

b. If the RTs for a continuing calibration verification standard fall outside the RT window, update the midpoint RT using that standard.

(1) Save this under the appropriate name to indicate an update has occurred.

(2) RTs cannot be updated more than once per day. All subsequent standards run within a 24-hour period must be within this window.

(3) If RTs are not consistent, the cause must be investigated and corrective action taken.

Procedure

1. Prepare a sequence of injections as suggested in the Calibration Section, along with the appropriate check standards.

2. Retention times of peaks in the samples are compared to the standard RT windows.

a. Peaks present on both columns that are also in the correct ratios to represent an aroclor are quantitated, and the high value is reported unless chromatographic anomalies are observed. See *T-PEST-WI9954*.

b. Use a minimum of three to six peaks for quantitation, with the exception of certain mixes where it may be more accurate to use less peaks to avoid excessive overlap of patterns.

3. Continue running groups of samples/injections followed by check standards every 12 hours or 20 injections, whichever comes first.

a. For projects where a known aroclor is present and at the request of clients, other aroclors can be run for the continuing check standard. For instance, a set of continuing standards may be AR484, AR164, IBLK.

b. Aroclor 1262 and 1268 can be analyzed when requested. A full six point curve can also be run, depending on the project requirements.

4. If significant interference is present, schedule florisil and/or sulfuric acid cleanup. If elemental sulfur is present, TBA or copper the extract or have it put through GPC cleanup. If these techniques do not reduce the matrix problems, dilute the extract with hexane and adjust LOQs accordingly.

5. Report the results for the least dilute sample where the concentration measured is within the acceptable calibration range.

Calculations

1. The peak heights generated by the integration system are used to calculate the calibration factors (CF) for peaks of interest for each aroclor.

   Usually, the six major peaks that are unique to each aroclor are chosen for quantitation, with the exception of 1221 where only three peaks are available.

2. Sample concentrations are calculated per peak using average calibration factor (AVG CF) from the initial calibration.

$$\frac{Sample\ Height}{AVG\ CF\ (CF)} \times \frac{FV}{IW} \times DF = \mu g/kg\ as\ received\ per\ peak$$

Where:

FV = Final volume (mL)

IW = Initial weight (g)

DF = Dilution factor, as needed

The final result that is reported is determined as the average of the result for each peak chosen for quantitation:

$$(Result\ 1 + Result\ 2 + \ldots + Result\ n) / n = Average\ Result$$

3. The surrogate results are determined using either AVGRF or linear curve:

   a. Using AVGCF from the initial calibration:

$$\frac{Sample\ Height}{AVCRF\ (CF)} \times \frac{FV}{IW} \times DF = \mu g/kg\ \ as\ received$$

   b. Using linear curve from the initial calibration:

$$[(Sample\ Height - Y - intercept)/Slope] \times \frac{FV}{IW} \times DF = \mu g/kg\ as\ received$$

Where:

FV = Final volume

IW = Initial weight

DF = Dilution factor, as needed

4. See *T-PEST-WI9847* for all other equations related to the analysis.

Statistical Information/Method Performance

LCS,MS, and RPD are compared to the limits stored in the LIMS. The limits for LCS and MS are statistically derived. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Acceptance limits are generated according to *T-PEST-WI9980*. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the manager. The department database is updated via a download from the LIMS.

Quality Assurance/Quality Control

QC Acceptance limits are established as statistical limits. See *T-PEST-WI9980* for further information on monitoring and establishing limits.

A sodium sulfate blank and a sodium sulfate spike (LCS) are analyzed with every group of samples up to a maximum of 20. An MS/MSD is performed per batch. For wipes and when an MS/MSD cannot be performed, an LCSD will be extracted.

Aroclor 1016 and 1260 are routinely spiked; however, other aroclors can be spiked as requested by clients.

DCB and TCX are added as surrogates to each sample and QC to monitor the efficiency of the extraction, the operation of the autosampler, and to monitor retention times throughout the GC run.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed.

See *T-PEST-WI10011* for details on QC acceptance criteria and corrective action.

Appendix I

PCT Analysis (Aroclor 5422, 5432, and 5460)

A. Standards:

1. PCT Stocks- Aroclor 5432, 5442, and 5460 are purchased as individually ampulated solutions from Accustandard at 35,000 ug/L.
2. Surrogate Stock- Ultra ISM-320 containing TCX/DCB at 200,000ppb in acetone. Prepare an intermediate by diluting 0.25mL to 25mL of hexane.
3. MS stock of Aroclor 5442 - Absolute cat# 71791, 1000ug/L in Methanol.
4. Prepare working standards using the reagents module of the LIMS as a guide.
   a. In the reagents module, first enter the reagents in this section as 'source' reagents.
   b. Then select 'intermediate' reagent and load the most recent version of the working standard you wish to create for editing, or create a new standard if the working standard has not yet been prepared in TALS.
   c. The module contains the following information: reagent description (ex. AR161), source reagent code, amount used, final amount, solvent used and solvent lot, concentration of each compound in solution, and expiration date. The working standards have an expiration date of 6 months.
   d. The calibration scheme begins at or near the reporting limit through a 20 fold of the initial calibration level.
   e. The scheme for preparing the matrix and surrogate spiking solutions used in the extraction process are listed below.

Standard Name	Parent Solution	Aliquot (mL)	Final Volume (mL)	Solvent	Description
MS	Aroclor 5422 Stock	0.75	100	Acetone	Aroclor 5442 PCT Spike
SS	Pest Surr mix	1.5	1000	methanol	SW 846 surrogate

B. GC Chromatographic Analysis:

The conditions listed serve as a guideline only and are typically the optimum operating conditions. The analyst may make any changes to the chromatographic conditions to improve the speed of analysis, linearity, sensitivity, and/or improve separation if initial and continuing calibration criteria and quality assurance criteria listed within this analysis document are met.

Detector	ECD
Detector temp	330°C
Oven Temp	110°C to 250° at 40°C/min, to 280°C at 20°C/min, to 330°C at 30°C/min, hold 9 min.
Carrier	Hydrogen at 3.6 mL/min
Makeup gas	N2 at 60mL/min or equivalent
Injection size	1-uL, direct injection
Injection temp	225°C

C. Example of a Sequence:

1. Conditioner
2. IBLK
3. EVAL
4. AR161
5. AR162
6. AR163
7. AR164
8. AR165
9. AR166
10. AR481
11. AR482
12. AR483
13. AR484
14. AR485
15 AR486
16. AR541
17. AR542
18. AR543
19. AR544
20. AR545
21. AR546
22. PCT1
23. PCT2
24. PCT3
25. PCT4
26. PCT5
27. A4421
28. A4422
29. A4423
30. A4424
31. A4425
32. AR213
33. AR323
34. AR423
35. AR623
36. AR683
37. AR16xx
38. MDPCTX
39. MD16
40. IC16
41. IC48
42. IC54
43. Blank
44. LCS
45. 1234567
46. 1234567MS
47. 1234567MSD

48-62. Continue running samples

63. AR163
64. PCT3
65. A4423
66. IBLK

10007 Preventative and Corrective GC Maintenance
10011 QC Data Acceptability and Corrective Action
10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10922 Ultrasonic Extraction for PCBs in a Solid Matrix by Method 3550B and 3550C
10927 Microwave Extraction Method 3546 for PCBs in a Solid Matrix
9847 Common Equations Used During Chromatographic Analyses
9954 Interpretation of Chromatographic Data
9980 Monitoring QC Data Acceptance Limits

End of document

Version history

Version	Approval	Revision information	
9	29.MAR.2018		
10	16.MAR.2021		
11	18.MAY.2022		

eurofins	Always check on-line for validity. **Preventative and Corrective GC Maintenance**	Level: **Work Instruction**
Document number: **T-PEST-WI10007**		
Old Reference: **1-P-QM-PRO-9015495; DOD - SOP-PP-013**		
Version: **7**		Organisation level: **5-Sub-BU**
Approved by: **UKL3** Effective Date: **04-FEB-2019**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Chemist Tr, 6_EUUSLA_Pesticide Residue Analysis_All Management**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

Revision Log
Purpose
Scope
Personnel Training and Qualifications
Procedure

Revision Log

Revision 07	**Effective Date:** This version	
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure for Maintenance A.2.g	Reflects current procedure	Added information on Merlin microseal
Procedure for Maintenance B	Clarification	Changed wording from must to should Added if ferrule is damaged
Procedure for Maintenance C	Clarification	Added using cotton swab. Added use of hexane Changed wording from exactly to 2-4 mm

Revision 06	**Effective Date:** Mar 29, 2017	
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure II. A.	Reflects current process	Added Merlin Microseal
Procedure II. A.2.e.	Reflects current instrumentation	Removed reference to Varian instruments
Procedure II. B.3. f and g	Reflects current liner and process	Changed from uniliner to liner. Removed wording on pushing column into the uniliner
Procedure II.C	Clarification	Removed C.1-C.2 relating to packed column and renumbered section
Procedure II. C.	Unnecessary information	Removed information contained in C.4-C6 relating to packed column and renumbered section
Procedure II. C	Unnecessary information	Removed reference to Uniliners for splitless ports.

Purpose

The purpose of this SOP is to provide guidelines by which chromatographic problems causing nonconformance to the methods performed in the Pesticides Residue Analysis Department may be recognized and corrected. In addition, guidelines for the performance of preventative maintenance are presented to standardize the frequency and procedures of such maintenance throughout the department.

Scope

The guidelines outlined in this SOP are for use when performing preventative or corrective maintenance on any gas chromatographs capillary columns in the Pesticides Residue Analysis Department.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP.

The analyst being trained will work with an experienced analyst performing the instrument maintenance until such time as they can independently perform the routine tasks with minimal downtime and acceptable chromatography afterwards. For troubleshooting or repairing non-routine problems, the analyst may need to consult the instrument manuals associated with the GC or detector, and/or work with a more experienced analyst periodically as they encounter unusual situations. Proficiency is measured by auditing the person performing the routine maintenance and checking the resulting chromatography.

Procedure

I Procedure for Troubleshooting Chromatographic Problems:

A. Nonreproducible responses

When the response of continuing calibration standards run shortly after the initial calibration do not match the initial calibration within the criteria defined by the method being run, or when certain compounds repeatedly fall outside acceptable limits, column maintenance may be required. The autosampler should first be checked when all the compound responses are consistently high or low to verify that it is injecting a constant volume of sample. If the autosampler is functioning correctly, then column maintenance must be performed. An indication of the need for column maintenance is when the responses of only a few compounds, usually the ones which suffer breakdown or are breakdown components, fall off or increase sharply during the course of a run.

B. Poor linearity

Poor linearity in the initial calibration standards of a run is another indication that column maintenance may need to be performed. Once again, check the autosampler first to determine that it is operating correctly.

C. High analyte breakdown

High breakdown of endrin to endrin ketone and endrin aldehyde, and of 4,4' DDT to 4,4' DDD and 4,4' DDE, in evaluation mixes run on the instrument are a definite sign that column maintenance needs to be performed. On capillary systems, high breakdown is an indication that injection port maintenance must also be performed (see Injection Port Maintenance).

D. Extraneous peaks

1. Extraneous peaks in chromatograms of standards are an indication of contamination somewhere in the system.

a. If extraneous peaks are present, first rebottle and reinject the standard to ensure that the extraneous peaks are not carryover from a previous injection or that the standard was not contaminated during bottling.

b. If the peaks are still present in the reinjection, clean the autosampler thoroughly and inject hexane to see if the peaks are still present.

c. If the peaks remain, make a hand injection of hexane.

d. If the peaks are not present, then the autosampler is contaminated and needs further cleaning. If the peaks are still present, then either the column, injection port, or detector is contaminated.

2. Steps to determine detector contamination on capillary systems.

a. Remove the column from the makeup gas adapter and plug the base of the adapter with a blank column nut.

b. Run the instrument through a program blank while collecting the signal.

c. If the contamination peaks appear, then the detector is contaminated and needs to be cleaned (see Detector Maintenance).

d. If the peaks do not appear, then the column or injection port is contaminated, requiring column and injection port maintenance.

E. Noisy baseline

1. A noisy baseline is another indication that column maintenance may have to be performed.

2. Baseline noise that has irregular frequency and magnitude is an indication of a leak in the system, and column maintenance must be performed to eliminate the leak.

3. Baseline noise of regular frequency and varying magnitude has been demonstrated to be the result of a capillary column connector leaking when the pressure had built up to a sufficient level to open the gap between the column and connector.

4. If a pattern of baseline noise of equivalent frequency and magnitude is seen in chromatograms, it is probably electronic noise.

5. When electronic noise is suspected:

a. First check all the connections between the instrument and the data collection system.

b. If all the connections are found to be tight, inspect all the internal connections to and from the electrometer and the motherboard of the instrument.

c. If the noise is still present, check the connection between the detector and the electrometer.

d. If all the connections have been checked and found to be tight, and the electronic noise remains, clean all the connections with a swab soaked in alcohol.

e. If electronic noise is still present, put in a work order to the equipment repair department and have them look at the instrument for problems with the boards.

F. Poor peak shape

1. Maintenance is required when analytes fail to have a sharp Gaussian peak shape, with little or no fronting or tailing.

2. Poor peak shape can be a result of injection port contamination, column leaks, or column phase degradation.

3. Peak shape directly affects the analyte peak heights and therefore, the analyte's response.

II Procedure for Maintenance:

A. Injection port septum or Merlin Microseal

1. Frequency of injection port septum changes:

a. The injection port septum should be changed regularly as preventative maintenance to avoid problems arising from retention time or response drift.

b. The septum life will vary from instrument to instrument.

c. A gradual retention time shift on consecutive chromatograms is an indication of a worn septum. The septum should be replaced whenever this occurs.

d. While regular septum changing is a necessary practice on capillary columns, the oxygen introduced to the column with each septum change degrades the column phase, shortens the life, and detracts from the column's performance. Therefore, only change the septum before a new initial calibration or when retention time shifts have occurred.

2. Changing:

a. On capillary column instruments, take the oven temperature down to 40°C.

b. Do not shut off the carrier and makeup gas flows.

(1) Keeping the gas flows on will minimize the time required for detectors to settle.

(2) The carrier gas flow also serves to cool the column to prevent it from overheating and purges any oxygen contamination that occurs during the septum change.

c. For EPC systems, the pressure must be turned to 0.

d. Change the septum as quickly as possible to minimize the amount of oxygen the column is exposed to.

e. To change the septum:

(1) Remove the septum retainer nut and remove the old septum with a septum puller.

(2) Place a new septum of the correct diameter in the injection port and retighten the septum nut.

f. After the septum has been changed:

(1) Set the EPC systems to the proper pressure.

(2) The oven temperature should remain at 40°C for at least 10 to 15 minutes, to purge the column of all the oxygen that was introduced during the septum change.

(3) After the 10 to 15 minutes have passed, raise the oven temperature back to the initial temperature program.

g. To change merlin microseal

(1) Remove retaining nut and old microseal.

(2) Place new microseal in injection port and tighten until pressure meets setpoint

(3) Tighten retaining nut an additional 30 degrees.

B. Column maintenance

1. Column maintenance should be performed as a preventative measure to ensure valid injections meet all the criteria necessary for the method being performed on the instrument.

2. The frequency of the maintenance will be dependent upon the type of samples being processed, the sensitivity of the analysis and detector to systemic contamination, sample matrix, and the volume of samples being processed.

3. To perform column maintenance:

a. On capillary column instruments, the oven and injection port temperature should be lowered to room temperature before any maintenance is performed on the column.

b. If ferrule is damaged, remove the column from the injection port by first loosening the column nut.

c. Slide the nut off the column, then remove and discard the ferrule in the nut.

d. Slide the nut with a new ferrule onto the column, pushing it back far enough so that it will not fall off during the following steps.

The nut and ferrule must be on the column before the final cut is made, since small amounts of graphite are shaved off and lodge in the column whenever the ferrule is slid over the column's end. This graphite may cause poor column performance and breakdown.

e. Using the capillary column cutter, remove the first 3" to 6" of the column.

(1) With a magnifying glass, inspect the cut to ensure that it is acceptable.

(2) An acceptable cut will appear smooth for the entire circumference of the column and will have no jagged edges.

(3) After the initial 3" to 6" have been removed, cut small increments of the column off until an acceptable cut is made.

f. After the liner has been inspected and, as is generally necessary, replaced (see Injection Port Maintenance), reinstall the column.

Once the column is held in place by the nut, verified by the column not sliding during gentle tugging, tighten the nut with a wrench another ¾ turn. Do not overtighten the ferrule. Overtightening will split it, cause leaking, and make it hard to remove from the nut the next time maintenance is performed.

g. The detector end of the column will rarely need maintenance. High bleed or column contamination unresolved by maintenance on the front of the column, are reason to perform detector

end maintenance.

(1) First remove the column from the detector.

(2) Slide the column nut down the column, after removing and replacing the old ferrule, so that it will not fall off during the following steps.

(3) Now follow the same procedure for the cutting of the column as outlined for the front end.

(4) Reinstall the column into the detector, checking to make sure that the appropriate length of column is inserted into the detector.

C. Injection port maintenance

1. Since the injection port greatly affects the performance of the column in a capillary system, whenever column maintenance is performed, the condition of the liner should be checked to determine whether or not it needs to be replaced.

Replacing the liner is highly recommended to limit active sites caused by previous sample contamination.

2. Maintenance of split/splitless injection port

a. Split/splitless injection ports consist of a glass liner which is held in place with an O-ring, and a gold-seal at the base which maintains inertness for EPC systems.

b. Turn the pressure to 0.

c. Use a ¼" wrench to remove the column nut from the injection port fitting in the oven.

d. Use a Torx™-driver to remove the insulated cover from over the port inside the oven.

e. Use a specialized wrench to loosen the fitting below the septum nut fitting to reveal the glass sleeve. Remove the sleeve and O-ring.

f. Use the ½" wrench to remove the injection port fitting which contains the gold seal. Using cotton swab wetted with solvent, clean the inside of the port and weldment.

g. Inspect the gold seal, and the washer which will be under it.

If tarnishing is evident, replace the seal, or clean it with a mild abrasive until no tarnish is evident.

h. Generally, replacement of the washer is required. Rinse the fitting, seals, and washer with methanol or hexane before re-installation.

(1) Insert the new washer into the fitting, followed by the gold seal.

(2) Attach the fitting, and tighten with a ½" wrench until it is just snug. Do not over-tighten.

(3) Attach an O-ring to a new glass sleeve, and install from the top of the port.

(4) Press the sleeve down until it hits the base. Re-attach the cover and tighten until snug.

(5) Take care not to cross-thread the nut.

i. Re-install the insulated cover inside the oven prior to installing the column.

j. Cut 3" to 6" off of the guard column after installing the column nut and ferrule.

Make sure that the cut is clean and straight using a magnifier.

k. Insert the column into the port, making sure the column does not fall below the ferrule.

l. Tighten fingertight plus one additonal ¼ turn with a ¼" wrench to set the ferrule.

m. Re-loosen the nut, and slide the column to a distance of 2 - 4 mm above the ferrule. This distance is critical for the performance of the system.

n. Make sure the column does not slide, and re-install the nut. Re-tighten to fingertight plus ¼ turn.

o. For EPC systems, turn the pressure back to operating pressure, and check for leaks.

p. Let the system equilibrate for 15 minutes at 40°C prior to elevating temperatures to allow any oxygen to evacuate.

D. Maintenance of electron capture detector

1. Detector maintenance should be performed only when column and injection port maintenance have not corrected the problems of poor reproducibility of response, poor linearity, or contamination.

When any of these problems are present after injection port and column maintenance have been performed, then the status of the detector should be investigated.

2. A good indication of detector problems is if the baseline of the detector is elevated to a high mV reading when the instrument is sitting at either its isothermal operating temperature or the lower temperature of its temperature program.

The detector should be thermally cleaned following the guidelines provided in the appropriate manufacturer's service manual.

3. If the problems are still present once the thermal cleaning is performed, then all of the steps taken to alleviate the problem should be closely examined and repeated to ensure that the detector is the cause of the problem.

4. Rarely will persistent contamination be caused by the detector.

5. Poor linearity and drifting response are problems frequently attributable to the detector.

a. All the steps of instrument maintenance should be performed, including thermal cleaning, before the detector is replaced in an attempt to rectify these problems.

b. In these situations, the detector may be replaced with greater certainty as the solution to the problem.

6. If a detector replacement is determined as being necessary, consult the appropriate manufacturer's service manual for the procedure.

End of document

Version history

Version	Approval	Revision information	
5	05.JUL.2011		
6	15.MAR.2017		
7	21.JAN.2019		

eurofins	Always check on-line for validity.	Level:
Document number: **T-PEST-WI10008**	**Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department**	**Work Instruction**
Old Reference: **1-P-QM-PRO-9015497; DOD - SOP-PP-029**		
Version: **6**		Organisation level: **5-Sub-BU**
Approved by: **UKA4** Effective Date: **17-MAY-2013**	Document users: **6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_HPLC Chemist**	Responsible: **5_EUUSLA_Pesticide Residue Analysis_Manager**

Revision Log
Reference
Purpose
Scope
Personnel Training and Qualifications
Procedure

Revision Log

Revision: 6		**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Throughout Document	Reflect re-identification of documents in EtQ	Replaced all prior Level 1, 2, 3, and 4 document numbers (analyses excluded) with EDR numbers
Reference	Reflects current instrumentation	Remove old instrument reference and added new instrumentation
Procedure	Reflects current autosampler	Removed information on injection port septum Added current information on the needle seat Removed information on syringes
Procedure B.	Reflects current post column reactor system	Changed pipette bulb to disposable syringe

Revision: 05		**Effective Date:** Apr 06, 2011
Section	**Justification**	**Changes**
Header	Formatting requirements per LOM-SOP-LAB-201	Added separate line item for revision number
Revision Log	Formatting requirements per LOM-SOP-LAB-201	Removed revision logs up to the previous version.
Throughout Document	Update Vendor ID	Change HP to Agilent
Reference	Update Vendor ID	Change HP to Agilent
Personnel Training and Qualifications	Formatting requirements per LOM-SOP-LAB-201	Added required text
Preventative Maintenance	Reflect current practice	Change #2 and 3 and 8 from 500 hours to periodically since hours not measured and task is done when needed.
Preventative Maintenance	Reflect current practice	Delete info on changing column frits – not done. Full column changes are done.

Reference

1. Hewlett Packard HP1100 Series instrument manuals ed. 11/1995.

2. Agilent 1200 Series instrument manuals ed. 02/2006 and 06/2010.

3. Waters e2695 Separations Module, Rev. A, 2008.

4. Waters e2795 Separations Module, Rev. A., 20083

Purpose
The purpose of this SOP is to outline the procedures and schedules used to perform preventative and corrective maintenance on HPLCs.

Scope
This SOP applies to all HPLCs in the Pesticide Residue Analysis Group.

Personnel Training and Qualifications
All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP.

The person being trained will work with an experienced analyst for hands-on training as maintenance opportunities arise until such time as they can independently perform the maintenance correctly. The trainee must read this SOP as well as the individual HPLC analysis methods. The trainee must be very familiar with reading the chromatograms for the analyses so that they know what constitutes optimum chromatography, and therefore can recognize problems in the chromatography. Proficiency is measured by having an experienced analyst watch the trainee perform the maintenance and by reviewing the next initial calibration data to be sure the chromatography is acceptable.

Procedure
A. Preventative maintenance

The easiest and most efficient manner to perform preventative maintenance on the check valves, pump seals, pistons, and piston diaphragms is to perform all of them simultaneously since the disassembly of the pump head for one type of preventative maintenance will provide an ideal opportunity to inspect the condition of the other parts.

1. Check valves

a. The inlet and outlet check valves on all analytical pumps can be removed, tested for acceptable performance, and cleaned periodically on an as needed basis.

b. Need for check valve replacement is possible when a retention time shift takes place.

c. Quick check for the functionality of the check valve:

(1) Shake the valve and listen carefully for movement of the bead.

(2) If no sound is evident, the valve is completely plugged. Clean and/or replace the valve.

d. Testing a check valve:

(1) Remove check valve from the pump head.

(2) Use a syringe with a proper fitting to engage the threads on the check valve, pass water through the valve in the direction of flow.

The water should pass through the valve without difficulty.

(3) Next, attach the syringe to the opposite side of the check valve and attempt to pass water through the valve in the direction opposite of flow.

The valve should not let any water pass in the opposite direction.

(4) If the valve allows water to pass in the opposite direction, clean the valve by sonication with 1:1 Methanol/H_2O.

(5) Retest the valve, if it still allows water to pass in the wrong direction, discard and replace the valve.

(6) Clean valves, which pass the test, to remove any trace particulate matter that may have accumulated during normal operation.

(7) Before reinstalling the check valve on the pump head:

Flush the valve with the appropriate organic solvent for the analysis being performed to ensure that no soap or solvent, which could cause analytical or mechanical problems, is present.

e. For the Agilent 1100 and 1200 systems, there is only one check valve. It should be replaced whenever piston seals are changed.

2. Pump seals

a. The condition of the pump seals can be checked periodically to ensure that they have not become worn.

b. Deterioration of the seals causes leaking and may allow particulate matter from a worn piston diaphragm behind the seal into the solvent system.

c. Check the condition of the pump seals.

(1) Remove the pump head from the pump.

(a) Evenly loosen the hex head screws that retain the head to the pump.

(b) This even release of the hex screws prevents unequal pressure being applied to the sapphire piston, which could severely damage it.

(2) Remove the plate in which the pump seal sits.

(a) Evenly loosen the screws, which hold it to the face of the pump.

(b) It is important to avoid applying unequal pressure to the piston.

(3) Inspect the condition of the seal to see if it is deformed or marred.

d. If the seal is damaged, remove it with the seal insertion tool.

e. If the seal is in acceptable condition:

(1) Moisten it and allow it to soak for a few minutes with methanol twice before sliding over the piston during reinstallation.

(2) The piston also needs to be moistened with methanol.

(3) The methanol acts as a lubricant to prevent scoring of the piston.

f. Installing the seal:

(1) Ensure the plate is held perpendicular to the face of the pump so that it does not bind against the piston.

(2) Evenly tighten the screws holding the retaining plate to the pump face to ensure that uneven pressure is not being applied to the piston.

(3) If the seal was removed due to damage, use a seal insertion tool to insert a new seal that has been soaked with methanol.

(4) Take care to ensure that the seal is not being inserted at an angle to the recess that it sits in.

(5) The seal fits snugly into the recess but does not require excessive force to be seated.

(6) Inspect the seal for deformation after it is seated, which would indicate that the seal was inserted at an angle.

(7) If any deformation of the seal is present, then remove it and replace with a new seal.

g. After a piston seal replacement and entire pump head reassembly:

(1) Run the pump at 0.1 mL/min for 5 minutes to allow the piston and seal to become completely aligned.

(2) Immediately running the pump at normal operating speed could snap the pump head if the seal is not properly seated yet.

3. Piston and piston diaphragm

a. The piston and piston diaphragm can be inspected periodically for wear or when leakage is evident.

b. To inspect the piston and piston diaphragm:

(1) Remove the pump head and seal mounting plate as described above in the seal preventative maintenance section.

(2) Once the piston is exposed, run the motor at 0.1 mL/min to cycle the pump until the piston is fully extended.

(3) Wash the piston with methanol several times and gently wipe it down with a clean lint-free cloth.

Do not touch the piston with your fingers. The oils on your hands will cause damage over time.

(4) Inspect the piston for scoring, chipping, or any other defect along its length.

c. If the piston is damaged, then replace.

Due to the extremely high cost of the pistons, check with another analyst with HPLC experience to confirm that the piston does need to be replaced before proceeding with the replacement procedure.

(1) Use a wrench to loosen the piston from the piston shaft then manually unscrew the piston.

(2) Manually screw in the new piston until snug then tighten with a wrench.

(a) The piston diaphragm fits snugly around the nut that holds the piston to the pump arm.

(b) The diaphragm must not have frayed edges and must be centered in the opening of the pump housing.

(c) Particulate accumulation at the base of the pump housing is an indication that the diaphragm is starting to wear and degrade.

d. To replace the diaphragm:

(1) Gently pull one of the edges of the diaphragm to break the seal between the diaphragm and the pump housing.

(2) Slide the diaphragm over the piston.

(3) Install a new diaphragm by sliding it over the piston and pressing it into place in the pump housing.

(4) Check to ensure that the correct side of the diaphragm is facing forward and the diaphragm is centered over the hexagonal piston nut.

4. Solvent reservoirs

a. Use only deionized water in the aqueous reservoirs to help reduce microbial growth and to minimize the amount of particulate contamination present in the water.

b. When 4-L solvent bottles are used for the organic solvent reservoir, they are discarded when empty and replaced with new 4-L bottles.

c. Degas aqueous solutions before use to help retard microbial growth.

5. Solvent sinker frits

a. Replace the sinker frits in both the organic and aqueous reservoirs every six (6) months with new sinker frits.

b. The pores in the sinker frits gradually become clogged over time from microscopic impurities in the water and organic solvents. As the frits become clogged, it becomes more difficult for the pump to draw a sufficient amount of solvent. The vacuum created by the pump's inability to draw a sufficient volume of solvent to fill the pump head pulls dissolved oxygen out of the solvent. These bubbles cause numerous chromatographic problems.

6. In-line frits

a. In-line frits remove any particulate matter that is too fine for the solvent sinker frits to filter out of the mobile phase solvents.

b. Replace the in-line frit on the HPLC system when a pressure reading is evident and the column is not connected.

(1) Remove the frit holder from the solvent line to the analytical column.

(2) Open the frit holder using two wrenches.

(3) Push out the old frit and install a new one.

(4) Check to ensure that an in-line frit and not a column frit is being installed.

(a) The in-line frit is a very small frit in the center of a Teflon holder the diameter of the inside of the holder.

(b) Column frits are large frits, almost the size of the holder, with a small Teflon edge around it.

(c) The reason the in-line frit is so much smaller is to reduce the amount of dead volume, which has a negative impact on chromatography, caused by the frit.

c. For the Agilent 1100 and 1200, the Teflon frit inside the purge valve must be replaced when noticeable pressure is observed while purging.

7. Guard column

a. The guard column reduces the amount of chemical impurities, which are being loaded onto the analytical column.

b. A guard column also provides a buffer for the analytical column from solvent pressure pulsations.

(1) Rapid changes in the pump speed send pressure pulsations throughout the entire system, which crush the packing of the analytical column.

(2) The guard column will absorb the majority of the pressure pulsations, protecting the analytical column.

c. Replace the guard column when a pressure increase is noted, or quality of chromatography declines.

d. To replace the guard column:

(1) Remove the guard column holder from the solvent line.

(2) Open the holder with two wrenches and tap out the spent guard column.

(3) Replace the guard column and reinstall the holder into the system.

8. Autosampler - Several parts require routine maintenance.

a. Needle seat

(1) Seals the needle to the port when the sample is being loaded.

(2) Change when signs of wear or leakage are observed.

(3) Follow the procedure outlined in the Agilent autosampler manual.

(4) Prevents the sample from leaking out while it is being loaded from the sample vial.

b. Flow line

(1) Holds the sample between the sampling from the vial and the injection into the loop.

(2) Inspect before every run for clogs or contamination.

(3) If the line is clogged or discolored:

(a) Rinse it several times with water and methanol to eliminate the contamination or clog.

(b) The rinse feature on the panel of the autosampler is used to perform the rinse.

9. Pumps

a. The HPLC and post column reactor pumps are to be lubricated regularly throughout the year.

b. Reference the applicable instrument manual for each pump for the proper procedure to follow for lubrication.

c. Failure to lubricate the motors on a regular basis will cause excessive wear and eventual pump failure.

d. When starting a pump after it has been sitting idle, the operator needs to listen to the pump to ensure that it is not making any unusual sounds, indicating a problem with its operation.

10. Column (replace column, unless urgent need for a particular column dictates column maintenance).

11. Autosampler and detector lubrication

a. At least once yearly, complete lubrication of all movable parts that require lubrication needs to be performed. This includes autosampler gears, as well as pumps as listed above.

b. This needs to be performed prior to the yearly maintenance if excessive noise is evident upon use of each component.

B. Corrective maintenance

1. Fluctuating RTs (Retention Time)

a. Two main causes for fluctuating RTs are variances in the temperature of the mobile phase or column and check valve failures.

Both temperature variations and the partial failure of a check valve will cause minor shifting of analytes' retention times.

b. Allow the mobile phase to equilibrate to room temperature before use to help eliminate retention time drift due to temperature changes incurred by a mobile phase which is colder or hotter than that used when the instrument was calibrated.

c. Place the analytical column in an oven to eliminate temperature shifting or, if it is in an oven, check to ensure that the oven is operating correctly.

The backpressure of the system will fluctuate in a sinusoidal pattern when a check valve has partially failed.

(1) When minor retention time shifting is observed, first check the system pressure to see if it is fluctuating.

(2) If the pressure is fluctuating, it is a definite sign that a check valve needs to be replaced.

d. Gross shifting of analytes' retention times is almost always attributable to the failure of a check valve.

e. When a check valve fails completely, the backpressure of the entire system will drop and the analytes will either elute very early or late, depending on whether a check valve controlling the aqueous or organic solvent fails.

(1) When a check valve controlling the aqueous solvent fails, all of the analytes will elute extremely early since the ratio of mobile phase will favor the organic solvent.

(2) Conversely, if a check valve regulating the organic solvent fails then all of the analytes will elute very late or not at all.

f. When it has been determined that one of the check valves has either partially or entirely failed, determine which valve has failed.

(1) First program the pump to pump either 100% aqueous or organic solvent dependent on the retention time shifting seen on the chromatograms.

If the retention time shifting was random drifting or not extreme enough to pinpoint which pump head was the cause, then pump 100% of the aqueous, then 100% of the organic solvents.

(2) When pumping the solvent with the bad check valve, the system pressure will fluctuate or fall to a very low value, dependent on how badly the check valve has failed.

g. To determine which check valve on the pump head has failed:

(1) Momentarily lift the solvent sinker frit out of the solvent reservoir, with the pump running, to allow an air bubble to be pulled into the solvent line.

(2) As the pump runs, watch the air bubble in the line to see if it is rhythmically pulled into the pump head.

(a) If the air bubble is pushed backwards towards the solvent reservoir, then that is an indication that the inlet check valve has failed and needs to be replaced because it is allowing the solvent to back flush past it on the pump's delivery cycle.

(b) If the air bubble is not pushed backwards between intake cycles, then the outlet check valve is the check valve that has failed.

h. Either replace the check valve or attempt to clean it as outlined in the preventative maintenance section.

2. Varying response

There are several possible causes for variance in the response of an analyte on the HPLC. The main areas of probability are:

a. Autosampler

(1) When the response of all of the analytes in a continuing calibration standard all increase or decrease by a similar factor in comparison to the initial calibration, check the operation of the autosampler to ensure that it is operating correctly.

(2) Check to ensure that bubbles are not being drawn into the flow line when sampling or that the needle seal or injection port septum are leaking.

(3) Check the flow line for kinks or clogs which could be preventing the entire sample from being loaded into the injection port.

(4) If a problem is detected with the autosampler

(a) Correct the problem by following the procedures outlined in the autosampler manual.

(b) Reinject the continuing calibration standard to verify that the problem has been eliminated.

(5) If the autosampler was operating correctly or the problem is still present, then further investigation into the other areas which could cause varying response needs to be undertaken.

b. Detector lamp problems

(1) UV and fluorescent detector lamps have a limited lifetime. Sensitivity of the detector will gradually decrease as the lamp emission falls off over the life of the lamp.

(2) A new lamp will require a settling in period while its emission levels off to a constant value

Analytical runs on a new lamp will decrease in detector sensitivity until the lamp has several hours of operation time.

(3) Sensitivity of the detector will gradually decrease for the majority of the life of the lamp, but the rate of change will be extremely slow and should not affect the response of calibration standards run throughout an analytical run.

(4) At the end of the lamp's lifetime its emissions will begin to fall off sharply causing drastic decreases in the sensitivity of the detector. In addition to losing much of the detector's sensitivity, the baseline will become extremely noisy, reflecting the inconsistent emission level of the lamp as it becomes completely expended.

(5) Investigate the number of hours the detector lamp has been in operation when the sensitivity of the system falls off in conjunction with the baseline becoming noisy.

(1) Depending on the detector, the detector will have kept track of the number of hours on the lamp or the lamp itself will have a gauge showing the number of hours it has been used.

(b) If the number of hours on the lamp is equal to or greater than the recommended lifetime of the lamp, replace it following the guidelines provided in the appropriate instrument manual.

(6) After the new lamp is installed and ready for operation, run a calibration standard to verify that the sensitivity and baseline noise problems has been corrected.

c. Post column

(1) A loss of sensitivity of all the analytes indicates possible problems with the post column reactor system.

(2) In general, when the sensitivity for the analytes decreases due to post column reactor problems, the response will drop to a flat baseline.

(3) The cause for this complete loss of sensitivity is due to:

(a) Total blockage of part of the post column reactor system.

(b) Complete consumption of one or both of the post column reagents.

(c) One or both of the post column reactor pump heads has an air lock and no reagent is being pumped.

(4) When a problem with the post column reactor system is suspected:

(a) Check for flow by loosening the line above the check valve and check for solvent flow out of the valve.

(b) If there is no flow, prime the valve using a disposable syringe with suction.

(c) Let pump a few seconds. If there's still no flow, a piston or seal problem may exist.

3. Baseline noise

When the system is exhibiting excessive baseline noise there are several causes which could be contributing to the problem.

a. Dirty solvents

(1) If a new batch of organic solvents or deionized water has been placed on the system and baseline noise is seen, it is possible that the solvent is contaminated.

(2) Remove the solvent reservoirs and clean them well.

(3) Place fresh solvent, preferably from a different solvent lot or deionized water in the reservoir and see if the problem is resolved.

b. Contaminated column

(1) After running samples with highly complex matrices and baseline noise is seen, it is possible that the guard or analytical columns has become contaminated.

(2) Replace the guard column first and then the analytical column following the procedure outlined above to eliminate the baseline noise.

c. Air bubbles in the flow cell

(1) Air bubbles will change the path length of the light passing through the flow cell of the detector, causing noise.

(2) Ways to remove air bubbles:

(a) Remove the exit tubing from the detector to allow air bubbles to be pushed out of the cell due to the reduction of backpressure after the detector.

(b) Remove the backpressure connection and rinse the cell with isopropanol to remove bubbles from the chamber.

d. Malfunctioning check valves

If the pressure of the system is fluctuating while the baseline is noisy, that is a good indication that one of the check valves is failing. In addition, the retention times of the system will also be shifting. Locate and replace the faulty check valve as outlined above.

e. Exhausted detector lamp

If the sensitivity of the system is very poor and the baseline is noisy, then follow the procedure outlined above to determine if the detector's lamp needs to be replaced.

4. Pressure problems

a. The main causes for pressure problems in an HPLC:

(1) Clogged lines or columns causing excessive backpressure.

(2) Malfunctioning pumps, or check valves causing extremely low backpressure.

b. When seeing excessive backpressure:

(1) First remove the guard and analytical columns from the system, leaving only the in-line frit.

(a) The system should pump through the frit with almost no backpressure.

(b) The frit should be replaced following the steps listed in the preventative maintenance section if even low levels of backpressure are seen.

(2) Next, install the guard column and check the backpressure of the system. Once again almost no backpressure should be seen.

(a) If necessary, replace the guard column following the procedure listed above in the preventative maintenance section.

(b) Then install the analytical column and check the backpressure.

(c) If the back pressure is above the expected range, then replace the frit on the front end of the analytical column following the procedure outlined above in the preventative maintenance section.

(d) If the backpressure of the system returns to the expected operating range when the entire system is assembled, then the problem has been solved.

(3) If the back pressure remains high and the in-line frit, guard column, and analytical column have all been checked to eliminate them as the cause of the problem, then further investigation as to the cause of the problem needs to be undertaken.

(a) Add the solvent transfer lines, one section at a time, checking the pressure, until the section causing the excessive backpressure is found.

(b) Replace the clogged section of tubing and check the system pressure to ensure that the backpressure has returned to the normal operating range.

(c) If none of the tubing causes the backpressure, then add the detector to the system and see if it causes the pressure problem.

(d) If the detector does cause the problem, then consult the appropriate instrument manual to correct the problem.

(4) When the system is exhibiting low pressure:

(a) Check to ensure that the solvents have not been consumed or that one of the pumps has an air lock and is pumping no solvent.

(b) If the pumps appear to be operating correctly, then check the entire system for leaks.

(c) If no leaks are found, then the cause of the problem is either a sheared pump head or malfunctioning check valve.

(d) Follow the procedure listed above for testing a check valve and replace the faulty check valve or broken pump head.

5. Leaks

a. While leaks are a readily apparent problem, which is easily solved, care should be taken when fixing leaks at tubing unions or column connections.

b. When replacing a length of tubing, installing a new column or in-line frit, the connector or union used should be checked to ensure that the insertion depth and ferrule taper match the ferrule type on the existing tubing to which the new piece is being joined.

If the insertion depth or ferrule taper does not match, at best, extra dead volume will be created in the system. At worst, the connection will have a leak, which cannot be stopped due to the poor union of the two pieces. In this instance no amount of tightening will solve the leak, and the tubing can be snapped off in the union due to over tightening of the nut in an attempt to stop the leak.

c. To ease the matching of ferrule to the connector, it is best to replace parts with the identical piece or when a change is necessary, use the nuts and ferrules supplied with the union or column.

6. Peak problems

While the ideal peak shape is a perfect gaussian curve in general practice this is never achieved, there is almost always some asymmetry to the peak shape. These guidelines are for when the peaks are exhibiting asymmetry greater than that expected on the system.

a. Peak fronting

(1) The normal cause for peak fronting is that the analytical column has exceeded its useful lifetime or has been damaged due to misuse or poor handling.

(2) Replacing the analytical column should correct the problem of peak fronting.

(3) If an adjustment of the initial organic content of the gradient has just been made and the early peaks only are exhibiting peak fronting then that is an indication that the initial organic content is too high and needs to be reduced.

b. Peak tailing

(1) When all of the peaks on a system exhibit severe tailing or "ghosting" then it is an indication that either the inlet frit on the analytical column is clogged or the analytical column has a gap in the packing.

(2) The clogged inlet frit and void volume both cause the tailing because the analytes are not being loaded evenly on to the head of the column.

(3) If one of the peaks on a chromatogram is exhibiting severe tailing, it is possible that the sample is overloading the column and needs to be diluted to a lower concentration so the column can handle the mass being injected on to it.

7. Resolution problems

a. When the resolution of peaks on a system gradually decreases with time until the resolution between two closely eluting peaks is lost, replace the column as it has lost its resolving power with use.

b. If loss of resolution is abrupt, and is accompanied by gross retention time shifting of all peaks, investigate the performance of the check valves and pumps to determine if they are operating correctly.

c. If maintenance has just been performed on the system, investigate to ensure that the dead volume of the system wasn't increased due to improperly performed maintenance.

d. If the system is operating correctly and new solvents have been placed on the system, check to ensure that the correct solvents were added or actually contained in the solvent bottles used.

C. Maintenance log

1. All preventative or corrective maintenance performed on the HPLC must be recorded in the maintenance log by the person who performed the maintenance event.

2. If a repair technician performs the work, it is acceptable for the person operating the HPLC to record the maintenance in the log instead of the repair technician.

3. The information entered needs to include who performed the work, what work was performed, the reason the work was performed, if the issue is resolved and the instrument is back in specifications, the date, and the initials of the person making the entry into the logbook.

End of document

Version history

Version	Approval	Revision information	
6	17.MAY.2013		

eurofins	Always check on-line for validity. **% Moisture Calculation and % Solids Calculation (Gravimetric)**	Level: **Work Instruction**
Document number: **S-SS-WI10697**		
Old Reference: **1-P-QM-WI-9015065**		
Version: **19**		Organisation level: **5-Sub-BU**
Approved by: **UCSS** Effective Date **14-MAY-2021**	Document users: **5_EUUSLA_Sample Support_Manager, 6_EUUSLA_ Sample Support_Moisture/Puck Mill**	Responsible: **5_EUUSLA_Sample Support_Manager**

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Revision Log
Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Calibration
Procedure
Calculations
Quality Assurance/Quality Control

Revision Log

Revision:	19	**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision log up to previous version
Procedure A	Clarification		Clarified the oven documentation
Reference	Requirement		Removed 2540 G references, added local method
Calibration	Clarification		Changed the balance type used
Sample Collection, Preservation, and Handling	Requirement		Added section on dealing with samples possibly containing explosives

Revision:	18	**Effective Date:**	08 Jun 2020
Section	**Justification**		**Changes**

Revision:	18	**Effective Date:**	08 Jun 2020
Revision Log	Formatting requirement		Removed revision log up to previous version.
Scope	Requirement Clarification		Added EPA Region 1 process Removed obsolete account# and added new LIMS method references
Procedure A.	Clarification		Moved %moisture process to section A. Changed process for TALS
Procedure B.	Requirement		Added EPA Region 1 process
Apparatus and Equipment	Clarification		Changed the balance type used

Reference
1. Moisture - Percent Moisture, Local Method. Determination of dry weight correction reporting.

2. *Chemical Hygiene Plan*, current version.

Scope
This method is for the determination of moisture in most solid and semisolid samples. Percent solids are then determined by calculation.

If clients request EPA Region 1 guidance regarding solid and sediment samples, %solids evaluation and centrifuging/decanting is performed as needed following Procedure B. in this SOP.

Basic Principles
A measured amount of sample is placed in an empty tared pan and dried in an oven at 103° to 105°C. The decrease in weight of the sample, after drying, is calculated as the moisture content of the sample.

Reference Modifications
The method has been modified by using purchased aluminum foil pans that are not preconditioned, as this step is unnecessary.

%Moisture- Dry Wt Calculation requires multiple weights to be taken until the change in weight from the previous weight is within 4% or 50 mg (whichever is less). The modification is based on a study that was performed which determined that a constant weight was achieved after the initial drying cycle and therefore multiple weights were not necessary.

Interferences
The determination of moisture in solid and semisolid materials is subject to error due to loss of ammonium carbonate and volatile organic matter during drying.

Non-representative, nonhomogeneous materials, such as stones, are excluded from the analysis if their inclusion is not desired in the final result.

Safety Precautions and Waste Handling
All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local state laws and regulations.

See Chemical Hygiene Plan for general information regarding employee safety, waste management and pollution prevention.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP.

Initially, each technician performing the analysis must work with an experienced technician for a period of time until they can independently perform the analysis.

Sample Collection, Preservation, and Handling

Samples for moisture analysis must be kept in an unpreserved container and refrigerated at 0 to 6°C, not frozen.

Samples submitted for explosives must have a visual check performed by the analyst looking for any discolorations in the soil or small objects that look like metal. If observed a supervisor must be informed to review the sample before proceeding.

Apparatus and Equipment

1. Disposable aluminum foil pans, or equivalent

2. Oven maintained at 103° to 105°C. Adjust as needed to stay in this range.

3. Top Loading balance

4. Desiccators, or equivalent.

5. 6 X 3/4 Tongue Blades or equivalent

6. 1/10 inch opening pipette

7. TALS is computer program that integrates a PC with a balance to collect data directly from the balance. It also organizes the data, performs calculations and transmits the final results to the central computer system.

Calibration

Refer to routine lab practices for calibration procedures for top loading balances.

Procedure

A. Percent Moisture

1. Verify that the balance calibration check has been performed each day before use.

2. Set up the batch in TALS creating a SRF if requesting the samples. Moisture can be done in conjunction with sample splitting by scanning the samples to a batch as you go.

3. Number (for identification) the purchased disposable aluminum foil pans before use.

4. Place one aluminum foil pan on a zeroed balance. Record the weight

5. With the aluminum foil pan remaining on the balance, place soil in the foil pan and using the print button on the balance send the weight to TALS

NOTE: Most samples allow the use of a tongue blade for sampling but a pipette with a 1/10 inch opening must be used when sampling liquid sludge’s or any matrix with significant amounts of liquid. These sample

types must be shaken vigorously before sampling. The sample aliquot must be taken from the middle of the sample directly after shaking the sample.

8. Record the date and time on the TALS batch worksheet and then place the pans containing sample into the oven.

a. Dry at 103° to 105°C for 8 to 48 hours.

b. Oven temperatures are monitored and logged in the TALS System through the use of a stationary thermometer.

9. Record the date and time on the LLENS batch worksheet, and then remove the pans containing dried sample from the oven.

10. Cool in a desiccator for 1 hour.

NOTE: Check desiccant to verify that the indicator crystals are still blue and not pink.

11. Again, verify that the balance calibration check has been performed each day before use.

12. Use tongs to place the pan containing dried sample on a zeroed balance. Record weight of pan and dried sample.

B. Client Requested EPA Region 1 Guidance

1. Sample with >70% Moisture must be segregated to be decanted

2. Observe the sample to determine if the sample needs to be centrifuged. If centrifugation is required, contact your supervisor.

3. If there is an aqueous layer on the sediment/soil, decant the aqueous layer.

4. Perform Percent Moisture following Procedure A. on the decanted sample.

Calculations

$$\%moisture = \frac{A - B}{C} \times 100$$

Where:

A = Weight of sample and container before drying (in grams)

B = Weight of sample and container after drying (in grams)

C = Weight of sample before drying (in grams)

Percent solids = 100 - %moisture

Quality Assurance/Quality Control

Calibration verification of the balances must be performed each day before use.

End of document

Version history

Version	Approval	Revision information
17	21.MAR.2019	
18	27.MAY.2020	
19	30.APR.2021	

eurofins	Always check on-line for validity. **Separatory Funnel Extraction by Method 3510C, 608, or 608.3 for Pesticides and PCBs in a Wastewater**	Level: **Work Instruction**
Document number: **T-OE-PEST-WI10920**		
Old Reference: **1-P-QM-WI -9015079**		
Version: **22**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **15-APR-2022**	Document users: **5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Pest/PCB Waters, 6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_OC Pesticide C, 6_EUUSLA_Pesticide Residue Analysis_PCB Chemist**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Purpose
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Preparation of Glassware
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision 22		**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Replaced references to old LIMS with the new LIMS
Throughout Document	Update	Removed references to 8141/622 testing
Procedure	Update	Removed references to 1L pesticide prep
Procedure 19a, 22a	Reflects current practice	Changed concentration timer from 10 minutes to 8 minutes

Revision 22		**Effective Date:** This version
Sample Collection, Preservation, and Handling	Update	Updated hold time statement to reflect accurate hold times
Procedure 22b	Clarification	Added that the sample should be brought up to volume with Methylene Chloride
Procedure 24-27	Clarification	Changed references for which prep to the analytical common name instead of the SOP

Revision 21		**Effective Date:** December 02, 2019
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure 7.a.	Reflects current procedure	Changed verbiage from shake to swirl

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3510C, Rev. 3, December 1996.
2. USEPA, 40 CFR Part 136, Appendix A, Method 608.
3. USEPA, 40 CFR Part 136, Appendix A, Method 608.3, December 2016. MUR Effective September 2017.
4. USEPA, 40 CFR Part 136, Appendix A, Method 622.
5. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-PEST-WI9998	Pesticides in Water by Method 8081A and 8081B using GC-ECD
T-PEST-WI9843	CLIENT SPECIFIC - Captan and Captafol by Method 8081A in Waters and Solids using GC-ECD
T-PEST-WI11971	Polychlorinated Biphenyls (PCBs) by Method 608.3 or 8082 in Waters
T-PEST-WI9997	Pesticides in Aqueous Samples by Method 608
T-PEST-WI9238	Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD
T-PEST-WI9961	Low Level PCBs in Water by Method 8082/8082A using GC-ECD
T-OE-PEST-WI11410	Pesticide Extract Cleanup Using GPC by Method 3640A
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling
T-OE-GEN-FRM23822	Instructions for Checking pH During Extraction Procedures

Purpose

The purpose of this SOP is to provide clear instructions for performing the separatory funnel extraction procedure on samples that are to be analyzed for pesticides and PCBs.

Scope

This procedure is for the extraction of organochlorine and organophosphorous pesticides and PCBs from wastewaters.

Basic Principles

An aliquot of the sample is placed into a separatory funnel. The volume of sample extracted is adjusted (if appropriate) depending on the physical appearance of the sample and the volume sent for analysis. A surrogate standard is added to the sample to monitor recovery. The sample is then extracted with methylene chloride. The extract is dried, concentrated, and exchanged to hexane. Several cleanup procedures are available to eliminate matrix interferences before the sample is analyzed. They include sulfuric acid treatment, copper treatment, florisil, and Gel-Permeation Cleanup (GPC).

Reference Modifications

1. Surrogate and matrix spiking solutions are not added before the transfer to the extractor. For several reasons:

   a. Samples must be poured from the amber bottles to determine the matrix and volume of sample to use for each extraction.

   b. Many sample bottles have no headspace and there is no room to add surrogate to the sample in the bottle.

   c. Due to the volume of samples extracted, a separate graduated cylinder for each sample is unrealistic.

   d. To maintain consistency with all extractions, no samples are spiked in the bottle or graduated cylinders.

2. In Procedure Step 19 the joint of the KD is not rinsed with fresh solvent when the ampule is removed. Quad and MDL studies have shown that this step is unnecessary.

Interferences

Impurities in solvents, reagents, glassware, or other hardware used in sample processing interfere with the method. All glassware must be rinsed with solvent before use. A method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

Extracts are concentrated on a steam bath; caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or disposed of in the designated containers. These are transferred to the lab wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) is disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is

maintained in the employees training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the extraction and analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four laboratory control samples, or one blind sample.

Sample Collection, Preservation, and Handling

Samples are collected in amber glass bottles with PTFE-lined lids, preserved with sodium thiosulfate, and stored refrigerated at 0 - 6°C, not frozen. The sample hold times are 365 days unless collected from New Jersey or requested as shorter by the client for PCB samples. The sample hold times are 7 days starting from day of collection for Pesticide samples. Extracts are stored frozen at less than or equal to -10°C.

Apparatus and Equipment

1. Separatory funnel for extracting organic components from an aqueous matrix

2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during the extraction

3. Water bath – VWR/LLI Model #1127 or equivalent

4. Sodium sulfate column with extra course frit

5. Nitrogen evaporation (N-Evap) with nitrogen supply – Organomation Associates or equivalent

6. pH paper – Wide range

7. Automatic shaker – Glass Col or equivalent, capable of holding 2-L separatory funnels

8. Pipettes – Class A, assorted sizes

9. Graduated cylinders – Class A, assorted sizes

10. Pipettes – Disposable

11. Solvent dispenser – Brinkmann, adjustable or equivalent

12. Balance – Capable of weighing to 0.01 g

13. Centrifuge – Beckman GS-6 or equivalent

14. Micro-Snyder columns

15. Wash bottles – Teflon

16. Vials – Assorted sizes

17. Teflon boiling chips

18. Syringes - Assorted sizes

19. Micro-pipetter

20. Automated Water Extraction Bench – capable of holding separatory funnels for 250 mL extractions.

21. Rapid-Vap Evaporators – for concentration of 250 mL extractions

22. Rapid-Vap Evaporator Tubes – Class A

Reagents and Standards

1. Methylene chloride (CH2Cl2) – Pesticide grade or equivalent. Store at room temperature for up to 1 year.

2. Acetone – Pesticide grade or equivalent. Store at room temperature for up to 1 year.

3. Hexane – Pesticide grade or equivalent. Store at room temperature for up to 1 year.

4. 10N Sodium hydroxide (NaOH) – Lab Chem or equivalent. Store at room temperature. Follow manufacturer's expiration date.

5. Sulfuric acid (H2SO4) – ACS grade or equivalent. Store at room temperature. Follow manufacturer's expiration date.

6. Sodium Sulfate (Na2SO4) – Reagent grade or equivalent. Bake at approximately 400°C for a minimum of 4 hours in a shallow pan to remove organic contaminants. Store in a glass jar at room temperature for up to 1 year after baking.

7. Reagent water – water in which an interferent is not observed at or above the reporting limit for parameters of interest. In general, the reagent water supplied at the taps in the laboratory meets this criterion. If the reagent water does not meet the requirements, see your supervisor for further instructions.

8. Extraction fluid – Prepared and delivered by the leachate department. Store refrigerated at 0-6°C, not frozen, in a glass container with a PTFE-lined lid.

9. All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the standards database. Detailed instructions can be found in *T-PEST-WI9998*, *T-PEST-WI9843*, *T-PEST-WI11971*, *T-PEST-WI9997*, *T-PEST-WI9238*, *T-PEST-WI9961*.

Calibration

Not applicable to this procedure.

Preparation of Glassware

See SOP *T-OE-GEN-WI10864*.

Procedure

1. Determine the volume of sample to be used for each extraction. Typically, this is 1L or 250 mL. For 1311/8081: 50 mL of sample is measured from the sample bottle and diluted to 250 mL in a sep funnel.

1 Liter Analyses: *T-PEST-WI9961*

250 mL Analyses: *T-PEST-WI9998*, *T-PEST-WI9843*, *T-PEST-WI11971*, *T-PEST-WI9997*, *T-PEST-WI9238*

a. If uncertain of the volume to extract for any sample, ask your supervisor.

b. Use one full bottle for all analysis scans (with the exception of 1311/8081) unless the matrix is poor (thick, lots of sediment, extremely foul odor).

(1) If using reduced volume due to matrix, take as much as possible while trying to minimize matrix problems, document why the reduced volume was used.

(2) Reduced volume aliquots due to matrix are typically are 500, 200, or 100 mL (100, 50, or 25 mL for 250 mL extractions).

c. For 1311/8081:

(1) If the sample bottle contains at least 100 mL of sample, measure 50 mL.

(2) If the sample bottle contains <100 mL of sample, use 1/2 of the available volume or 10 mL, whichever is greater.

(3) If a matrix spike (MS) or MS/matrix spike duplicate (MSD) is required for the sample, use 50 mL each.

(4) After adding the 50 ml of sample add approximately 200 mL of Di water to bring the volume in the sep funnel to 250 mL.

d. The background, MS, and MSD are performed on three separate aliquots of a field sample.

2. Prepare the blank, laboratory control sample (LCS), laboratory control sample duplicate (LCSD) (if applicable) with 1 L of reagent water (or 250mL for 250 mL extractions) measured into the separatory funnel.

Exception: For 1311/8081 - The blank, LCS, and LCSD (if applicable) are prepared using 50 mL of extraction fluid measured into the separatory funnel. Add approximately 200 mL of DI water to bring the volume to 250 mL.

3. For samples using 1 entire bottle:

a. Weigh the entire bottle including the cap on a balance and record in gross weight column in the LIMS.

b. Shake the bottle vigorously and then pour the contents into a separatory funnel.

4. For all samples requiring a specified volume:

a. Shake each bottle vigorously.

b. Use a clean graduated cylinder to measure the desired volume.

c. Pour the sample from the graduated cylinder into the sep funnel.

d. Record any comments about the sample appearance or odor. Also record comments if a reduced volume was taken due to sample matrix or insufficient available sample.

e. If <1000 mL (or <250mL for 250mL extractions) of sample is used, use a graduated cylinder to add enough reagent water to bring the volume in the separatory funnel to 1-L (or 250mL for 250mL extractions).

5. Use pipettes to add surrogate standards and spiking solutions to the aqueous sample in the separatory funnel.

a. Be certain the standard drips directly into the aqueous sample without touching the glass side of the separatory funnel to avoid poor recoveries.

b. Surrogates – Surrogates are added to all samples, blanks, and spikes.

The type of surrogate is determined by the analysis scan number. Typically they are as follows:

(1) For *T-PEST-WI9961* – 0.1 mL of SW-846 Surrogate.

(2) For *T-PEST-WI11971*, *T-PEST-WI9843*, *T-PEST-WI9997*, *T-PEST-WI9238*, *T-PEST-WI9998* – 0.25 mL of SW-846 Surrogate.

(3) For *T-PEST-WI9998* by 1311/8081- Use 1.0 mL of Mini Sep. SW846 Surrogate

c. Spiking Solutions – Spiking solutions are added to the LCS, LCSD (if applicable), MS, and MSD.

(1) The type of spike is determined by an analysis number. Typically they are as follows:

(a) For *T-PEST-WI11971*, *T-PEST-WI9238* – 0.25 mL PCB Spike.

(b) For *T-PEST-WI9998*, *T-PEST-WI9997* – 0.25 mL SW-846 Spike.

(c) For *T-PEST-WI9998* by 1311/8081 – 1.0 mL of Mini TCLP Pesticides Spike regardless of initial volume

(d) For *T-PEST-WI9843* – 1.0 mL Captan/Captafol Spike

(e) For *T-PEST-WI9998* – 0.25 mL Chlordane Spike

(f) For *T-PEST-WI9961* – 0.1 mL of PCB Spike

(2) Spike details can be found in the corresponding analytical SOP(s)

(3) This is changed to accommodate specific-client requirements, if appropriate.

(4) If a sample requires any special compounds in addition to the standard list, an appropriate spike containing those compounds is added at this time.

(5) See SOP *T-OE-GEN-WI10876* for storage and handling of spikes.

6. Measure the pH of the sample using wide-range pH paper. Record the pH of the sample in the initial pH column of the LIMS. See *T-OE-GEN-FRM23822* for instructions to check and adjust pH.

a. If necessary, adjust the pH to between 5 and 9 using 10N NaOH (to bring up the pH) or concentrated H2SO4 (to lower the pH).

b. To adjust the pH, add a few drops of the appropriate solution with a disposable pipette, swirl the separatory funnel and re-check the pH.

c. If the pH now falls between 5 and 9, record the adjusted pH in the 1st pH column of the LIMS.

d. If the pH is still out of range, continue adding small aliquots of base or acid, shaking and checking the pH until it is within the specified range.

e. Record the adjusted pH in the 1st pH column of the LIMS.

NOTE: Any samples from North Carolina require that the volume of acid or base added to the sample to adjust the pH to be recorded in the LIMS.

7. If the original sample bottle is empty:

a. Use a solvent pump to measure 60 mL (15 mL for 250 mL extractions) of methylene chloride. Add the methylene chloride to the sample bottle and swirl the bottle to rinse the interior of the bottle with methylene chloride. Add the solvent to the separatory funnel.

b. Weigh the entire bottle including the cap on a balance and record in the tare weight column in the LIMS.

c. The initial volume automatically calculates in the initial volume of the LIMS.

8. If the sample container is not empty, measure 60 mL (15 mL for 250mL extractions) of methylene chloride to the graduated cylinder used to measure out the sample volume and add it to the separatory funnel.

9. Cap the funnel, invert it, and vent immediately. With the cap on shake the separatory funnel and vent. Continue shaking and venting until the pressure in the funnel has equalized.

10. For 1 Liter Analyses: Place the sample on the automatic shaker and shake at the designated speed for 2 minutes with the stopcocks closed.

For 250 mL Analyses: Separatory funnels remain on the Automated Water Extraction Bench. Press the green "start" button to lower the hood and activate the Automated Water Extraction Bench. The bench will tumble for 2 minutes. The sash will rise after the samples have tumbled.

NOTE: Shaker speeds vary greatly between instruments so the proper setting is marked on each.

11. For 1 Liter Analyses: Place the separatory funnel on the rack and allow it to sit undisturbed until the solvent layer (bottom layer) has separated from the water layer (top layer). For 250 mL Analyses: the separatory funnel will sit undisturbed on the Automated Water Extraction Bench.

a. The time required for extracts to set undisturbed is based upon visual confirmation that the layers are adequately separated.

b. If an emulsion forms and is greater than 1/3 of the volume of the solvent layer, mechanical techniques such as stirring and centrifugation must be employed to complete the separation.

12. Removing the Solvent Layer.

a. For 1 Liter analyses: Remove the solvent layer by opening the stopcock and collect the solvent in a metal beaker then pour through approximately 10cm of sodium sulfate into a K-D apparatus containing Teflon boiling chips.

b. For 250 mL analyses: drain the solvent layer directly into the sodium sulfate column containing approximately 5cm of sodium sulfate. This drains into a Rapid-Vap Evaporator Tube.

NOTE: Do not use more than the recommended quantity of sodium sulfate and take care not to transfer water into the column. Excessive sodium sulfate and/or water in the column results in low aldrin recovery.

13. Use a solvent pump to add 60 mL (15mL for 250mL extractions) of methylene chloride to the separatory funnel and repeat Procedure Steps 10 through 13, venting only as necessary.

14. Again, use a solvent pump to add 60 mL (15 mL for 250mL extractions) of methylene chloride to the separatory funnel and repeat Procedure Steps 10 through 13, venting only as necessary.

15. For 1L extractions only, rinse the metal beaker that was used for solvent collection with approximately 20 mL of methylene chloride. Pour into salt column.

16. Rinse salt column with approximately 20 mL (5mL for 250mL extractions) of methylene chloride.

17. Concentrating extracts for 1 Liter analyses

a. Attach a 3-ball Snyder column to the K-D, wet with solvent, and concentrate the extract to approximately 3 to 5 mL on a steam bath at 85° to 99°C. Adjust the vertical position of the apparatus and the water temperature, as required, to complete the concentration in 10-20 minutes. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood. This steam bath temperature ensures concentration in a reasonable length of time.

Note: Do not allow the extracts to reach a point off dryness. Loss of analytes may occur.

b. Add 50 mL of hexane directly through the Snyder column after the apparent volume in the ampule reaches 3-5 mL. Continue concentrating on the steam bath until an apparent volume of 3-5 ml is reached. Allow the extracts to cool for 10 minutes prior to removing the ampule from the KD.

Note: Do not allow the extracts to reach a point off dryness. Loss of analytes may occur.

c. Bring the extracts to a final volume of 5 mL in the ampule with hexane.

d. Go to Procedure 23 for details on cleanup procedures.

18. Concentrating extracts for 250 mL analyses for samples that do not require GPC.

Note: For samples that require GPC go to Procedure 22

a. Place the Evaporator Tube containing the solvent extract into the pre-heated (approximately 80°C) Rapid-Vap Evaporator. Set the timer for 8 minutes and speed at 75% (the speed is the rotation within the unit while the sample is evaporating). Confirm that the nitrogen is set at 15 psi (this is adjusted on the regulator attached to the nitrogen line).

b. Concentrate the extract in the Rapid-Vap Evaporator until a volume of approximately 3 mL is reached.

c. Add 50 mL of hexane to the rapid vap tube. When adding the 50 mL of hexane make sure to rinse down the inside of the rapid vap tubes. This ensures all analytes sticking to the glass are rinsed into the extract.

d. Continue concentrating until the volume in the rapid vap tube is approximately 3 mL.

Exception: All samples for *T-PEST-WI9998* by 1311/8081 should be concentrated to approximately 1 mL.

e. Quantitatively transfer the extract to a class A volumetric using hexane to a final volume of 5.0 mL.

Exception: All samples for *T-PEST-WI9998* by 1311/8081 are brought to a final volume of 2.0 mL in a class A volumetric using hexane.

f. Go to Procedure 23 for details on cleanup procedures.

22. Concentrating samples that require GPC for 250ml analysis

a. Place the Evaporator Tube containing the solvent extract into the pre-heated (approximately 80°C) Rapid-Vap Evaporator. Set the timer for 8 minutes and speed at 75% (the speed is the rotation within the unit while the sample is evaporating). Confirm that the nitrogen is set at 15 psi (this is adjusted on the regulator attached to the nitrogen line).

b. Allow samples to concentrate to approximately 7 mL and then bring to final volume of 10.0 mL in a class A volumetric using Methylene Chloride. Make sure to mix the extract thoroughly to ensure the extract is homogenous.

c. Filter the extracts using a Whatman 0.45 µm filter (part number 6875-2504) and 10 mL Fisher disposable syringe (part number 14955459) into 12 mL glass screw top vials. Place the extract into the appropriate GPC queuing area for storage until the cleanup is performed

d. Perform GPC cleanup following SOP *T-OE-PEST-WI11410*

23. Perform cleanup procedures following Steps 24 through 27 as needed.

24. If the extract is scheduled for PCB analysis (8082), treat the extract with sulfuric acid as described in *T-OE-PEST-WI10281*.

25. If the extract is scheduled for Pesticide analysis (8081), florisil the sample 2 mL to 2 mL as described in the Pesticide Florisil section of SOP *T-OE-PEST-WI10281*.

a. Pesticide florisil is also performed for *T-PEST-WI9843* if required due to matrix or client request.

26. If the extract is scheduled for PCB analysis, florisil the extract following the PCB Florisil section of *T-OE-PEST-WI10281*.

27. If the extract has a sulfur odor, perform copper cleanup of the extract as described in *T-OE-PEST-WI10281* for Pest and PCB (8081, 8082, or 608) samples only. Other samples are cleaned up with GPC.

Calculations
See analysis method as listed in the Cross Reference section.

Statistical Information/Method Performance
See analysis method as listed in the Cross Reference section.

Quality Assurance/Quality Control
A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared.

For each batch of samples extracted a blank, an LCS, an MS and an MSD must be extracted. For method 608, the laboratory must, on an ongoing basis, spike at least 10% of the samples, if enough sample volume is received, to assess accuracy. If there is limited sample preventing the preparation of the MS/MSD, an LCSD must be prepared instead. If the batch contains only field or equipment blank samples, the LCS/LCSD QC pairing must be used.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed instead.

10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10864 Glassware Cleaning for Organic Extractions
10876 Organic Extraction Standards Storage and Handling
11410 Pesticide Extract Cleanup Using GPC by Method 3640A
11971 Polychlorinated Biphenyls (PCBs) by Method 608 or 8082 in Waters
23822 Instructions for Checking pH During Extraction Procedures
9238 Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD
9843 CLIENT SPECIFIC - Captan and Captafol by Method 8081A in Waters and Solids using GC-ECD
9961 Low Level PCBs in Water by Method 8082/8082A using GC-ECD
9997 Pesticides in Aqueous Samples by Method 608
9998 Pesticides in Water by Method 8081A and 8081B using GC-ECD

End of document

Version history

Version	Approval	Revision information	
20	22.MAR.2019		
21	02.DEC.2019		
22	01.APR.2022		

eurofins	Always check on-line for validity.	Level:
Document number: **T-OE-PEST-WI10926**	**Microwave Extraction Method 3546 for Pesticides in a Solid Matrix**	**Work Instruction**
Old Reference: **1-P-QM-WI -9015103**		
Version: **11**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **12-APR-2022**	Document users: **5_EUUSLA_Organic Extraction_All, 6_EUUSLA_ Organic Extraction_Pest/PCB Soils, 6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_OC Pesticide C**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Preparation of Glassware
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision: 11	**Effective Date:**	This Version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Apparatus and Equipment	Reflects current practice	Added 1fl oz. medicine cup
Procedure 1f	Reflects current practice	Identified medicine cup as means of creating QC

Revision: 10	**Effective Date:**	27-MAR-2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Replaced references to Parallax with new LIMS
Procedure 3	Reflects current practice	Removed reference to alachlor spike
Procedure 8	Enhancement	Added microwave programs based on type of microwave used. Removed reference to Table I.
Table I	Obsolete	Deleted and replaced with text contained in Procedure step 11

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3546, Revision 0, February 2007.

2. MARS Operation Manual, Revision 2, February 2006.

3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-OE-GEN-WI7154	Food and Tissue Preparation
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-PEST-WI10864	Glassware Cleaning for Organic Extractions
T-OE-PEST-WI10871	Pesticide Extract Concentration Using a Zymark TurboVap II Concentration Workstation
T-OE-PEST-WI10876	Organic Extraction Standards Storage and Handling
T-OE-PEST-WI11410	Pesticide Extract Cleanup Using GPC by Method 3640A
T-PEST-WI9232	Analysis of Pesticides by 8081B in Solid Samples using GC-ECD
T-PEST-WI9992	Pesticides by Method 8081A in Solid Samples using GC-ECD

Scope

This procedure is used for the extraction of organochlorine pesticides from soils, tissues, or solid wastes.

Basic Principles

A portion of sample is placed in an extraction vessel. Surrogate standards are added to each sample to monitor recovery. The vessel is then loaded into the instrument and extracted. The organic compounds present in the soil dissolve in the solvent, which is then removed. The extract is then concentrated and bottled.

Several cleanup procedures are used as needed to eliminate matrix interferences before the sample is analyzed. They include: florisil, copper, carbon cleanup, and gel-permeation cleanup (GPC).

Reference Modifications

The joint of the K-D is not rinsed with fresh solvent when the ampule is removed. Quad and MDL studies have shown that this step is unnecessary.

Definitions

1. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) – A sample of known composition analyzed with each batch of samples to demonstrate laboratory accuracy. The samples either naturally contain the analytes of interest or are clean samples fortified with known concentrations. This is used to demonstrate laboratory accuracy. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

2. Matrix spike/matrix spike duplicate (MS/MSD) – A sample created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the accuracy of the method in light of the matrix analyzed. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

3. Surrogates – Organic compounds which are similar to the analytes of interest but are not naturally occurring in environmental samples. Surrogates are spiked into all standards and every field and QC sample prior to extraction and analysis to provide information regarding the effects of the sample

Interferences

Method interferences are caused by impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware must be rinsed with solvent before use. A method blank is performed with each batch of sample to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

The extracts are concentrated on a steam bath. Caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or disposed of in the designated containers. These are transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) is disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Proficiency is measured through an Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that are carried through all steps of the procedure and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Samples are collected in wide-mouth glass jars with PTFE-lined lids and stored under refrigeration at 0º to 6ºC, not frozen, prior to extraction. Samples must be extracted within 14 days of collection. Extracts are stored in the freezer at ≤-10°C.

Apparatus and Equipment

1. MARS Xpress – CEM Corp. or equivalent
2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during extraction
3. Steam bath, VWR/LLI Model #1127 or equivalent
4. N-Evap with nitrogen supply
5. Beakers – stainless steel, assorted sizes
6. Pipettes – Class A, assorted sizes
7. Pipettes – disposable
8. Balance – capable of weighing to 0.01 g
9. Teflon®-wash bottles
10. Vials – assorted sizes
11. Teflon®-boiling chips
12. Forceps
13. Scoop
14. TurboVap II concentration workstation w/appropriate concentration tubes – Zymark or equivalent
15. Funnels – stainless steel or Teflon®
16. Extraction vessels
17. Frits – various
18. Sodium Sulfate Columns
19. GPC – J2 Scientific or equivalent
20. 1 fl oz. medicine cup

Reagents and Standards

1. Hexane – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt.

2. Acetone – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt.

3. Methylene Chloride (CH_2Cl_2) – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt.

4. Sodium Sulfate (Na_2SO_4) – Reagent grade or equivalent. Bake at 400ºC for a minimum of 4 hours in a shallow pan prior to use to remove organic contaminants. After baking, store in a glass jar at room temperature for up to 1 year.

5. All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the reagent module in the LIMS. Detailed instructions can be found in the corresponding analytical SOPs *T-PEST-WI9232* and *T-PEST-WI9992*.

Preparation of Glassware

See *T-OE-PEST-WI10864*

Calibration

Not applicable to this procedure.

Procedure

1. Sample aliquot

   a. If Sample Registration has pre-weighed the sample into a glass jar, add approximately 5g of sodium sulfate, mix and proceed.

   b. If the sample is not pre-weighed, weigh 30.0 - 30.5 g of sample into a labeled stainless steel beaker. (If sample matrix is tissue, weigh 15.0 - 15.5 g.)

      (1) Record the initial weight and any comments about the sample in the LIMS.

      (2) Alternative sample weights may be used to meet certain reporting limits. However, if sample weight greater than 30.5 is used the sample must be divided among multiple vessels and the extracts combined.

   c. Process all tissues as outlined in *T-OE-GEN-WI7154* prior to extraction.

   d. The background, MS, and MSD are performed on three separate aliquots of a field sample.

   e. Add approximately 5 g of sodium sulfate to each sample and mix until a free-flowing consistency is reached.

      (1) If the sample has a high water content or is a clay-like soil, add additional sodium sulfate until a free-flowing consistency is achieved.

   f. The Blank, LCS, and LCSD (if applicable) are prepared by scooping approximately a full medicine cup of sodium sulfate into an extraction vessel. (If sample matrix is tissue, use 15.0-15.5 g tilapia and add approximately 5 g sodium sulfate. Then mix.)

      (1) For non-tissue samples: Record 30 g in the LIMS.

2. Carefully place each sample into its clearly marked corresponding extraction vessel. A funnel is used to prevent spillage and loss of sample.

3. Use pipettes to add surrogate standards and spiking solutions.

   a. Surrogates – 1.0 mL of SW-846 surrogate (OP_SW_SS) is added to all samples, blanks, and spikes.

   b. Spiking solutions – 1.0 mL of SW-846 spike (OP_SW846_MS) is added to the LCS, LCSD (if applicable), MS, and MSD samples.

      (1) These may change to accommodate specific client requirements as appropriate.

      (2) See *T-OE-PEST-WI10876* for storage and handling of spikes.

4. Add 30 mL of 50% acetone in methylene chloride to each vessel.

5. Cap each vessel according to manufacturer's guidelines.

6. Invert each vessel to ensure mixing of sample and solvent.

7. Place the vessels into the carousel. When all samples are loaded, place the carousel into the microwave.

8. Run the appropriate method based on the microwave used. Verify that the run reached 100°C and document in the LIMS.

   a. Microwaves are programmed with a 30 minute warm-up to 100ºC, 10 minutes at temperature, followed by a 15 minute cool-down time.

   b. MARS 6 - Press the 'Classic Methods', '100C', and then 'START'

   c. MARS 5 - Press 'Start' from the home screen to run 'LLISOILS'.

9. Uncap the cooled vessel.

10. Pour the extract and sample into a column filled with approximately 10cm of sodium sulfate on top of a Kuderna-Danish (K-D) assembly containing Teflon®-boiling chips. Rinse the vessel with approximately 10 mL of methylene chloride from a wash bottle and pour through salt column. Rinse the column with approximately 10 mL of methylene chloride.

11. Place a 3-Ball Snyder column on the K-D set-up and concentrate over a steam bath at 85° to 99°C. This steam bath temperature ensures concentration in a reasonable length of time.

12. **If the sample requires GPC, skip this Step. Proceed to Procedure step 14 b.**

When the apparent volume in the ampule is 3 to 5 mL, use a bottle-top dispenser to add approximately 50 mL of hexane directly to the KD through the Snyder column.

Do not allow the ampule to go dry since loss of analytes will result.

13. When the apparent volume in the ampule again reaches 3 to 5 mL remove the sample from the bath and allow to cool for approximately 10 minutes until the K-D setup reaches ambient temperature.

14. Remove the ampule and use a wash bottle to adjust the final volume.

a. Samples that do not require GPC: Adjust final volume to exactly 10 mL with hexane in a calibrated ampule. Mix thoroughly with a disposable pipette. Proceed to 14. c.

b. Samples that require GPC: Adjust the final volume to exactly 10 mL with methylene chloride. Mix thoroughly with a disposable pipette.

(1) Perform GPC cleanup following *T-OE-PEST-WI11410*.

(2) When GPC cleanup is complete, concentrate the extract to final volume 5 mL using a TurboVap as described in T-OE-GEN-WI10871.

(3) Florisil the sample 2 mL to 2 mL as described in the Pesticide Florisil Cleanup section of *T-OE-PEST-WI10281*.

NOTE: DO NOT florisil samples that have Kepone as a compound of interest.

(4) Bottle twice in appropriately labeled crimp-top autosampler vials.

(5) Place the remaining extract in an appropriately labeled screw-cap vial.

(6) Store all extracts in the freezer at ≤-10ºC.

c. Samples that require carbon cleanup:

(1) Perform carbon cleanup on the sample 2 mL to 2 mL as described in the Carbon Cleanup section of *T-OE-PEST-WI10281*.

(2). Perform copper cleanup to remove sulfur interference from extracts. See *T-OE-PEST-WI10281* for this procedure.

Calculations

See analysis method.

Statistical Information/Method Performance

See analysis method.

Quality Assurance/Quality Control

A batch is defined as the samples to be extracted in any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared.

For each batch of samples extracted, a blank, an LCS, MS, and MSD must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead.

If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10864 Glassware Cleaning for Organic Extractions
10871 Pesticide Extract Concentration Using a Zymark TurboVap II Concentration Workstation
10876 Organic Extraction Standards Storage and Handling
11410 Pesticide Extract Cleanup Using GPC by Method 3640A
7154 Food and Tissue Preparation
9232 Analysis of Pesticides by 8081B in Solid Samples using GC-ECD
9992 Pesticides by Method 8081A in Solid Samples using GC-ECD

End of document

Version history

Version	Approval	Revision information	
9	13.MAR.2020		
10	12.APR.2021		
11	30.MAR.2022		

eurofins	Always check on-line for validity. **Microwave Extraction Method 3546 for PCBs in a Solid Matrix**	Level: **Work Instruction**
Document number: **T-OE-PEST-WI10927**		
Old Reference: **1-P-QM-WI -9015104**		
Version: **10**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **08-NOV-2021**	Document users: **5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Pest/PCB Soils, 6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_PCB Chemist**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Preparation of Glassware
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I

Revision Log

Revision	10	**Effective Date:**	This version

Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Replaced references to old LIMS/data recording with new LIMS
Sample Collection, Preservation, and Handling	Reflects current procedure	Updated hold time from 14 days of collection to 1 year.

Revision	10	**Effective Date:**	This version
Apparatus and Equipment	Reflects current procedure		Removed steam bath, boiling chips, TurboVap concentrators, and frits. Added MARS 6 microwave, tongue depressors, Rapid-Vap and Rapid-Vap tubes.
Procedure 1f	Reflects current procedure		Clarified Blank/LCS/LCSD measurement process
Procedure	Reflects current procedure		Removed steam bath concentration process for Rapid-Vap concentration.

Revision	09	**Effective Date:**	31-OCT-2019
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
LIMS ID	Reflects current practice		Added preps 13998, 14114, and 14652
Throughout procedure	Reflects current practice		Clarified weights to use for each prep number
Procedure 3	Reflects current practice		Added spiking procedure for prep 14652

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3546, Revision 0, February 2007.

2. *Chemical Hygiene Plan*, current version.

3. MARS Operation Manual, Revision 2, February 2006.

Cross Reference

Document	Document Title
T-PEST-WI11972	Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes
T-OE-GEN-WI7154	Food and Tissue Preparation
T-OE-PEST-WI11410	Pesticide Extract Cleanup Using GPC by method 3640A
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-PEST-WI10281	Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling

Scope

This procedure is applicable for the extraction of PCBs from soils, tissues, or solid wastes.

Basic Principles

A portion of sample to be analyzed is placed in an extraction vessel. Surrogate standards are added to each sample to monitor recovery. The vessel is then loaded into the microwave and extracted. The organic compounds present in the sample dissolve in the solvent, which is then removed. The sample is then concentrated and bottled.

Several cleanup procedures may be required to eliminate matrix interferences before the sample can be analyzed. They include: sulfuric acid treatment, florisil, copper, and gel-permeation cleanup (GPC).

Reference Modifications

The KD is not removed from the steam bath and cooled before adding hexane. The Snyder column is not removed for the solvent addition; therefore, the KD does not have to be cool.

Double volumes of surrogates and matrix spiking solutions are not added when a sample requires gel-permeation cleanup. Instead, the extract is concentrated to one-half the normal final volume after GPC to make up for the loss on GPC and maintain the limit of quantitation.

The Joint of the K-D is not rinsed with fresh solvent when the ampule is removed. Quad and MDL studies have shown that this step is unnecessary.

Definitions

1. GPC – Gel Permeation Cleanup

2. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) – A sample of known composition analyzed with each batch of samples to demonstrate laboratory accuracy. The samples either naturally contain the analytes of interest or are clean samples fortified with known concentrations. Used to demonstrate laboratory accuracy. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

3. Matrix spike/matrix spike duplicate (MS/MSD) – A sample created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the accuracy of the method in light of the matrix analyzed. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

4. Surrogates – Organic compounds which are similar to the analytes of interest but are not naturally occurring in environmental samples. Surrogates are spiked into all standards and every field and QC sample prior to extraction and analysis to provide information regarding the effects of the sample

Interferences

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware is rinsed with solvent before use and a method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound must be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.
Since the extracts are concentrated on a steam bath, caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or must be disposed of in the designated containers. These will then be transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the technicians training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that are carried through all steps of the procedure and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Samples are collected in wide-mouth glass jars with PTFE-lined lids and stored under refrigeration at 0º to 6º C, not frozen, prior to extraction. Samples must be extracted within 1 year. Extracts are stored in the freezer at -10° to -15°C.

Apparatus and Equipment

1. MARS Xpress, MARS 6 – CEM Corp. or equivalent

2. Disposable Tongue Depressors or equivalent

3. N-Evap with nitrogen supply

4. Beakers – stainless steel, assorted sizes

5. Pipettes – class A, assorted sizes

6. Pipettes – disposable

7. Balance – capable of weighing to 0.01 g

8. Teflon®- wash bottles

9. Vials – assorted sizes

10. Forceps

11. Scoop

12. Funnels – stainless steel or Teflon®

13. Teflon® extraction vessels

14. Labconco - Rapid-Vap Evaporators

15. Rapid-Vap evaporator tubes - class A

16. Sodium sulfate Columns

17. Glass vial inserts

Reagents and Standards

1. Hexane – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt

2. Acetone – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt

3. Methylene Chloride (CH_2Cl_2) – Pesticide grade or equivalent. Fisher Optima grade or equivalent, stored in a FisherPak at room temperature for one year after receipt

4. Sodium Sulfate (Na_2SO_4) – Reagent grade or equivalent. Bake at 400°C for a minimum of 4 hours in a shallow pan prior to use to remove organic contaminants. After baking, store in a glass jar at room temperature for up to 1 year.

5. All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the standards database. Detailed instructions can be found in the corresponding SOP *T-PEST-WI11972*.

Preparation of Glassware
See ***T-OE-GEN-WI10864***

Calibration
Not applicable to this procedure

Procedure
1. Sample aliquot

a. If Sample Registration has pre-weighed the sample into a glass jar, add 5g of sodium sulfate, mix and proceed to step 2.

b. If the sample is not pre-weighed:

(1) For preps 3546, 3546_PCB: weigh 30.0 - 30.5 g of sample into a labeled stainless steel beaker. (If matrix is tissue, weigh 15.0 - 15.5 g)

(2) For prep 3546_PCB_10: weigh 10.0 - 10.5 g of sample into a labeled stainless steel beaker.

(3) For prep 3546_PCB_3: weigh 3.0 - 3.5 g of sample into a labeled stainless steel beaker.

(4) Record the initial weight and any comments about the sample in the extraction log.

(5) Alternative sample weights may be used to meet certain reporting limits. However, if sample weight greater than 30.5 is used, the sample must be divided among multiple vessels and the extracts combined.

c. If sample is a wipe: record "wipe" in the matrix type section of the extraction log and enter the amount as 1 wipe in both the extraction log and the extractables database.

(1) Remove wipe from the vial with clean forceps and place in a stainless steel beaker along with any solvent in the vial.

(2) Use a wash bottle to rinse the vial with a few mL of acetone/methylene chloride and add the rinsate to the beaker.

(3) Record any comments about the sample in the extractables database.

d. Process all tissues by analysis Homogenize_Tiss prior to extraction.

e. Add approximately 5 g of sodium sulfate to each sample and mix.

(1) If the sample has high water content or is a clay-like soil, add additional sodium sulfate until a free-flowing consistency is reached.

(2) Mix the sodium sulfate and sample with a disposable tongue depressor or equivalent until a free-flowing consistency is reached.

f. The Blank, LCS, and LCSD (if applicable) are prepared by:

(1) For preps 3546, 3546_PCB: filling a Teflon® extraction vessel with one medicine scoop (approximately 30g) of sodium sulfate. Record 30 g on the extraction log. If sample matrix is tissue, use 15.0-15.5 g tilapia and add approximately 5 g sodium sulfate. Then mix.

(2) For prep 3546_PCB_10: filling a Teflon® extraction vessel with 10.0 - 10.5 g sodium sulfate. Record 10 g on the extraction log. (The sodium sulfate used for the QC samples is measured out as 15.0 grams to account for the 10 gram "sample" plus the 5 grams of sodium sulfate.)

(3) For prep 3546_PCB_3: filling a Teflon® extraction vessel with 3.0 - 3.5 g sodium sulfate. Record 3 g on the extraction log. (The sodium sulfate used for the QC samples is measured out as 8.0 grams to account for the 3 gram "sample" plus the 5 grams of sodium sulfate.)

2. Carefully place each sample into its clearly marked corresponding extraction vessel. A funnel is used to prevent spillage and loss of sample.

3. Use pipettes to add surrogate standards and spiking solutions. These may change to accommodate specific client requirements.

a. Surrogates – 1.0 mL of OP_SW_SS surrogate is added to all samples (including QC).

b. Spiking solutions:

(1) 1.0 mL of OP_PCB_MS spiking solution is added to the LCS, LCSD if applicable, MS, and MSD.

c. See ***T-OE-GEN-WI10876*** for storage and handling of spikes.

4. Add 30 mL of 50% acetone in methylene chloride to each vessel.

5. Cap each vessel according to manufacturer's guidelines.

6. Invert each vessel to ensure mixing of sample and solvent.

7. Place the vessels into the carousel. When all samples are loaded, place the carousel into the microwave.

8. Run the appropriate method based off the microwave used. Verify that the run reached 100°C and document in the LIMS. See Table I for Instrument conditions.

a. Microwaves are programmed with a 30 minute warm-up to 100°C, 10 minutes at temperature, followed by a 15 minute cool-down time.

b. MARS 6 - Press the 'Classic Methods', '100C', and then 'START'

c. MARS Xpress - Press Start from the home screen to run LLISOILS.

9. Uncap the cooled vessel. Pour the extract and sample into a column filled with approximately 10cm of sodium sulfate on top of the Rapid-Vap evaporator tubes with matching sample identification. If more than one extraction vessel was used in the microwave, pour volumes into separate evaporator tubes.

10. Rinse the vessel twice using 10-20 mL of Methylene Chloride from a wash bottle. Add each rinse to appropriate salt column.

11. Rinse the salt columns using two additions of approximately 5-10 mL down the insides of the salt column. These rinses help to improve compound recovery that would otherwise stick to the glassware.

NOTE: Use a methylene chloride rinse bottle to bring sample volumes to visually the same amount in the evaporator tube before placing in Rapid-Vap Evaporator. This will prevent an issue with some of the samples going dry and others needing more concentration.

12. Place the evaporator tube containing the solvent extract into the pre-heated (approximately 80°C) Rapid-Vap Evaporator. Set the timer for 10 minutes and speed at 75% (the speed is the rotation within the unit while the sample is evaporating). Confirm that the nitrogen is set at approximately 15 PSI (this is adjusted on the regulator attached to the nitrogen line).

Do not allow the evaporator tube go dry since loss of analytes will result.

a. Open the Rapid-Vap Evaporator. Extract volume will be approximately 3-5mL. If not, continue concentrating in 2 minute increments till a volume of 3-5mL is achieved.

(1) **If the sample requires GPC (3640)**, quantitatively transfer the extract to a class A volumetric using MeCl2 and disposable pipettes. Adjust the final volume to 10.0 mL with MeCl2. **Skip to step 14**.

(2) **If a sample was split between two evaporator tubes**, quantitatively transfer to one tube and concentrate to 3-5mL.

(3) For other samples, rinse down the inside of extractor tubes with 50mL of hexane using a solvent pump. This ensures all analytes sticking to the glass are rinsed into the extract.

e. Set a 6 minute timer on the Rapid-Vap and continue concentrating until the volume in the rapid vap tube is approximately 7mL.

f. Quantitatively transfer the extract to a class A volumetric using hexane and disposable pipettes. Adjust the final volume to 10.0mL with hexane.

g. Mix thoroughly with a disposable pipette.

13. Record the final volume in the LIMS. Skip to step 15 if GPC (3640) not required.

14. If the sample requires GPC, perform GPC cleanup following ***T-OE-PEST-WI11410*****.** When GPC cleanup is complete, concentrate the extract as described above including Step 12. However, concentrate the sample to approximately 3mL in step 12d. In step 12e. adjust the final volume to exactly 5 mL with hexane instead of 10mL.

15. Treat the 10 mL extract with sulfuric acid as described in ***T-OE-PEST-WI10281*****.**

16. Perform the copper and florisil cleanup on the extract as described in ***T-OE-PEST-WI10281*****.**

17. Bottle in three appropriately labeled crimp-top autosampler vials (one with an insert), and place the remaining extract in an appropriately labeled screw-cap vial.

18. All extracts are stored in the freezer.

Calculations
See analysis method.

Statistical Information/Method Performance
See analysis method.

Quality Assurance/Quality Control

A batch is defined as the samples to be extracted in any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared.

For each batch of samples extracted, a blank, LCS, MS, and MSD must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead.

If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Table I

Power:	1600W
Ramp Temperature:	100°C
Ramp Time:	30 minutes
Hold Time:	10 minutes
Cool Down Time:	20 minutes

10281 Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)
10864 Glassware Cleaning for Organic Extractions
10876 Organic Extraction Standards Storage and Handling
11410 Pesticide Extract Cleanup Using GPC by Method 3640A
11972 Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes
7154 Food and Tissue Preparation

End of document

Version history

Version	Approval	Revision information	
8	17.APR.2018		
9	24.OCT.2019		
10	25.OCT.2021		

eurofins	Always check on-line for validity. **Microwave Extraction by Method 3546 for Semivolatiles**	Level: **Work Instruction**
Document number: **T-OE-SVOA-WI10928**		
Old Reference: **1-P-QM-WI -9015105**		
Version: **14**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **15-APR-2022**	Document users: **5_EUUSLA_GC/MS Semivolatiles_Manager, 5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Semivolatile Soils, 6_EUUSLA_GC/MS Semivolatiles_Analysts**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Preparation of Glassware
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I

Revision Log

Revision 14	**Effective Date:**	**This version**
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Update LIMS references to new terminology
Cross Reference	Update	Change document reference to current analysis SOP
Apparatus and Equipment	Update	Removed Frits
Throughout Document	Update	Removed Analysis #10962, 11622
Procedure 6	Update	Compiled spiking amounts in reflection for analysis consolidation
Procedure 20	Reflects current practice	Changed boiling chip to boiling chips

Revision 14	**Effective Date:**	**This version**
Procedure 1a	Update	Removed wording to allow the process to flow better
Procedure 17	Clarification	Specified solvent used to rinse the evaporator tube
Procedure 24	Clarification	Specified how low to allow sample to concentrate GPC samples for tissue
Procedure 25	Clarification	Specified final volumes for solid samples vs tissue samples
Cross Reference	Update	Updated document titles to current document titles

Revision 13	**Effective Date:**	**March 20, 2019**
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	Update	Removed "DOD"
Throughout procedure	Reflects current practice	Added amounts for tissue samples/QC
Apparatus and Equipment	Reflects current equipment	Added Rapid Vap evaporators and Rapid Vap evaporator tubes.
Procedure 1.b.2	Clarification	Replaced "less than" with "greater than"
Procedure 2, 2.a	Clarification	Added "approximately"
Procedure 13 through 18	Reflects current procedure	Added rapid vap concentration technique to replace steam bath.

Reference

1. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 3546, Revision 0, February 2007.

2. *MARS Operation Manual*, Revision 2, February 2006.

3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-SVOA-WI9623	Semivolatile Organic Compounds by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC/MS
T-OE-GEN-WI7154	Food and Tissue Preparation
T-SVOA-WI9587	Tetraethyl Lead (TEL) in Water and Solids by 8270D/E by GC/MS
T-SVOA-WI9995	Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS
T-SVOA-WI9252	Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270C/D/E SIM by GC/MS
T-SVOA-WI9617	Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS
T-OE-SVOA-WI10554	Semivolatile Extract Cleanup Using GPC by Method 3640A
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling

Scope

This procedure is used to clearly outline the steps taken for the extraction of semivolatile compounds from soils or solid wastes using microwave technology.

Basic Principles

A portion of sample is placed in an extraction vessel. Surrogate standards are added to each sample to monitor recovery. The vessel is then loaded into the instrument and extracted. The organic compounds present in the sample dissolve in the solvent, which is then removed. The extract is concentrated to about 1 mL. At this time, it is determined if the sample requires gel-permeation cleanup (GPC). If needed, the extract is diluted to 10 mL, then cleaned using GPC and concentrated to 0.5 mL. If GPC is not necessary, the extract is brought to 1.0 mL and bottled. The extract is stored in an amber-autosampler vial in the freezer until analysis.

Reference Modifications

Base/Neutral and Acid compounds are added at a concentration of 50 ppm in the matrix spiking and LCS solutions so that the concentrations in the extract are within calibration range.

After Procedure Step 24, the joint of the K-D is not rinsed with fresh solvent when the ampule is removed. Quad and MDL studies have shown that this step is unnecessary.

Interferences

Impurities in solvents, reagents, glassware, or other hardware used in sample processing can interfere with the method. All glassware must be rinsed with solvent before use. A method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

Extracts are concentrated on a steam bath; caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or disposed of in the designated containers. These are then transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) is disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meet the defined acceptance criteria. The criteria for the LCSs include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation and Handling

Samples are collected in glass wide-mouth jars with PTFE-lined lids and stored under refrigeration at 0° to 6°C, not frozen, prior to extraction. Samples must be extracted within 14 days of sample collection. Extracts are

stored in the freezer at ≤-10° C and must be analyzed within 40 days of the date extracted.

Apparatus and Equipment

1. MARS Xpress – CEM Corp. or equivalent

2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during the extraction

3. Steam bath, VWR/LLI Model #1127 or equivalent

4. Balance – Capable of weighing to 0.01 g

5. Beakers – Stainless steel – Assorted sizes

6. Scoop

7. Pipettes – Class A, assorted sizes

8. Wash bottles – Teflon®

9. Teflon®-boiling chips

10. Micro Snyder columns

11. Disposable pipettes

12. Autosampler vials – Amber, crimp top

13. Funnels – Stainless steel or Teflon®

14. Extraction vessels

15. Sodium sulfate columns

16. Rapid-Vap Evaporators – Labconco model number 7910000 or equivalent.

17. Rapid-Vap Evaporator Tubes – Class A

Reagents and Standards

1. Methylene chloride (CH_2Cl_2) – Pesticide grade or equivalent. Store at room temperature for up to one year.

2. Acetone – Pesticide grade or equivalent. Store at room temperature for up to one year.

3. Sodium Sulfate (Na_2SO_4) – Reagent grade or equivalent. Bake at 400°C for a minimum of 4 hours in a shallow pan to remove contaminants. Store in a glass jar for up to 1 year after baking.

4. Ottawa sand - Bake at ~ 400° C for a minimum of 4 hours to remove organic contaminants. Store in a glass jar for up to 1 year after baking.

NOTE: All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the standards database. Detailed instructions can be found in the corresponding analytical analyses for scans *T-SVOA-WI9623*, *T-SVOA-WI9587*, *T-SVOA-WI9995*, *T-SVOA-WI9252*, *T-SVOA-WI9617*

Calibration

Not applicable to this procedure.

Preparation of Glassware

See *T-OE-GEN-WI10864*.

Procedure

1. Sample aliquot

a. If Sample Registration has pre-weighed the sample into a glass jar, proceed to procedure step 2.

b. If the sample is not pre-weighed, weigh 30.0 - 30.5 g of sample into a labeled stainless steel beaker. If sample matrix is tissue, use 15.0 - 15.5 g.

(1) Record the initial weight and any comments about the sample in the LIMS.

(2) Alternative sample weights may be used to meet certain reporting limits. However, if sample weight greater than 30.5 g is used the sample must be divided among multiple vessels and the extracts combined.

c. Process all tissues by Analysis *T-OE-GEN-WI7154* prior to extraction.

2. Add approximately 5 g of sodium sulfate to each sample and mix.

a. If the sample has high water content or is a clay-like soil, add an additional 10 g (approximate) of sodium sulfate.

b. Mix the sodium sulfate and sample until a free-flowing consistency is reached.

3. Perform the background, matrix spike (MS), and matrix spike duplicate (MSD) on three separate aliquots of a field sample.

4. Prepare the Blank, laboratory control sample (LCS), and laboratory control sample duplicate (LCSD) (if applicable) by filling a Teflon® extraction vessel with 35 g of sodium sulfate. Use 15.0 g tilapia if matrix is tissue.

NOTE: For samples from SC, use Ottawa Sand for the preparation of the Blank, LCS, and LCSD (if applicable).

Record 30.0 g in the LIMS (or 15.0 for tissue samples). (The sodium sulfate used for the QC samples is measured out as 35.0 g to account for the 30 g "sample" plus the 5g of sodium sulfate.)

5. Place each sample into its clearly marked corresponding extraction vessel. Use a funnel to prevent spillage and loss of sample.

6. Add surrogate standards and spiking solutions using pipettes. Add surrogates to all samples, blanks and spiked samples. Add spikes to the LCS, LCSD (if applicable), MS, and MSD samples. Typically they are as follows:

a. Analysis *T-SVOA-WI9623* – Surrogate: 1.0mL of BNA surrogate. Spike: 1.0mL of LCS spike. If required, spike 1.0 mL of Benzenthiol spike in a separate LCS/LCSD. If required, Spike 1.0 mL of AppIX Mix #1 in a separate LCS/LCSD. If required, Spike 1.0 mL of AppIX Mix #2 in a separate LCS/LCSD.

b. Analysis *T-SVOA-WI9995* – Surrogate: 1.0mL of BNA surrogate. Spike: 1.0mL of SIM LCS spike.

c. Analysis *T-SVOA-WI9587* – Surrogate: 1.0mL of BNA Surrogate. Spike: 1.0mL of TEL/TML spike.

d. Analysis *T-SVOA-WI9252* – Surrogate: 1.0 mL of BNA surrogate. Spike: 1.0 mL of "Client Specified" spike. If required, 1.0 mL of DPnB spike.

NOTE: If the sample is being analyzed for Benzoic Acid, a separate LCS/LCSD must be created with 1.0 mL of Appendix IX Mix#1 spike.

See *T-OE-GEN-WI10876* for storage and handling of spikes and *T-SVOA-WI11998* for SVOA spiking and calibration standards.

NOTE: If the sample is being divided among multiple vessels, the spike must be divided among the vessels as well.

7. Add 30 mL of 50% acetone in methylene chloride to each vessel.

8. Cap each vessel according to manufacturer's guidelines.

9. Invert each vessel to ensure mixing of sample and solvent.

10. Place the vessels into the carousel. When all samples are loaded, place the carousel into the microwave.

11. Run Program "LL Soils". See Table I for Instrument conditions. Verify that the run reaches the 100 °C temperature requirement and document in the LIMS.

12. Uncap the cooled vessel.

13. Pour the extract and sample from the vessel into a salt column filled with approximately 10 cm of sodium sulfate on top of an evaporator tube.

14. Rinse the microwave vessel with 10 to 20 mL of methylene chloride from a wash bottle and pour it into the salt column.

15. Allow the salt column to drip dry into the evaporator tube.

16. Place the evaporator tube containing the solvent extract into the pre-heated (approximately 90°C) Rapid-Vap Evaporator. Set the timer for 15 minutes and speed at 75%(the speed is the rotation within the unit while the sample is evaporating). Confirm that the nitrogen is set at 15 psi (this is adjusted on the regulator attached to the nitrogen line).

17. Allow the samples to concentrate to around 5.0 mL and rinse the sides of the evaporator tube down with Methylene Chloride. This ensures that all the analytes sticking to the glassware are rinsed down into the evaporator tube.

Note: Failure to rinse down the sides of the evaporator tube may cause poor recoveries.

18. After rinsing down the sides of the evaporator tubes continue concentrating the extracts to just below 1.0 mL.

19. If GPC is not needed, go to Procedure Step 25.

a. For samples that require GPC bring the final volume to 10.0 mL with methylene chloride in a class A volumetric. Filter extracts into a 100 mm. screw cap tubes using a 10mL Luer-Lok glass syringe and a disposable 0.45-micron filter (Whatman catalog number 6874-2504 or equivalent).

b. Place the extract into the appropriate GPC queuing area for storage until the cleanup is performed. See *T-OE-SVOA-WI10554*.

c. Once the GPC clean up is completed, go to Step 20.

20. Place the extract in a Kuderna-Danish containing Teflon®-boiling chips.

21. Place a 3-ball Snyder column on the set-up, wet the column with methylene chloride.

22. Concentrate over a steam bath at 80° to 90°C until the apparent volume reaches 1 to 2 mL.

23. Allow the sample to cool at least 10 minutes. Approximately 3 mL condenses into the ampule at this time.

24. Attach the ampule of the K-D to a micro-Snyder column, and concentrate the extract to below 0.5 mL (concentrate extract to below 1.0 mL if matrix of sample is tissue). Allow the sample to cool.

25. Bring to a final volume of 1.0 mL (0.5 mL if GPC was performed on standard solid sample matrix; 1.0 mL if GPC was performed on tissue matrix) with methylene chloride in a labeled amber GC vial.

a. The final volume is determined by placing the extract into an amber-autosampler vial and comparing the level in the vial to a reference vial containing the exact targeted final volume.

b. The vials used for bottling must be the same lot number as the reference vial.

c. Methylene chloride is added to the extract using a disposable pipette until exactly the same level is in both vials.

d. If too much solvent is added to the sample vial, remove the extract from the vial and concentrate it by micro-snydering to slightly less than the targeted final volume and rebottle.

e. Cap the vial and store in the freezer until analysis.

f. Record the final volume in the LIMS.

Calculations
See analysis method.

Statistical Information/Method Performance
See analysis method.

Quality Assurance/Quality Control
For each batch of samples extracted, a method blank, an LCS, an unspiked background sample, an MS, and an MSD must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead.

A batch is defined as the samples to be extracted on any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Table I

Instrument Conditions

Power:	1600W
Ramp Temperature:	100°C
Ramp Time:	30 minutes
Hold Time:	10 minutes
Cool Down Time:	20 minutes

10554 Semivolatile Extract Cleanup Using GPC by Method 3640A
10864 Glassware Cleaning for Organic Extractions
10876 Organic Extraction Standards Storage and Handling
11998 Semivolatile Spiking and Calibration Standards
7154 Food and Tissue Preparation
9252 Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270C/D/E SIM by GC/MS

9587 Tetraethyl lead (TEL) in Water and Solids by 8270D/E by GC/MS
9617 Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS
9623 Semivolatile Organic Compounds by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC/MS
9995 Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS

End of document

Version history

Version	Approval	Revision information	
12	31.MAY.2017		
13	20.MAR.2019		
14	01.APR.2022		

eurofins	Always check on-line for validity. **Extraction of Nitroaromatics and Nitroamines by Method 3535A in Water**	Level: **Work Instruction**
Document number: **T-OE-PEST-WI10942**		
Old Reference: **1-P-QM-WI -9015171**		
Version: **15**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **25-AUG-2022**	Document users: **5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Explosives Waters and, 6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_Explosive Chem**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log

Revision: 15	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reagents and Standards	Reflects current practice	Removed sulfuric acid and the making of 10% sulfuric acid
Procedure 1	Reflects current practice	Removed sulfuric acid rinsing. All glassware will be rinsed with acetone

Revision: 14	**Effective Date:**	August 01, 2022
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Removed references to Parallax and replaced with TALS and/or D4 references
Reference	Unnecessary	In the previous revision, the method reference was updated from 8330 to 3535A, however the 8330 method references were never removed from this section. These references have now been removed.

Revision: 14	**Effective Date:**	August 01, 2022
Section	**Justification**	**Changes**
Cross Reference	Obsolete	Per document feedback, removed reference to T-PEST-WI9982 as samples are no longer being analyzed under 8330A
Apparatus and Equipment	Reflects vials used	Changed screw cap autosampler vials to clear crimp cap autosampler vials per Procedure 14.a.
Procedure	Reflects current practice	Added spikes to use if additional special compounds are requested

Reference

1. Solid-Phase Extraction (SPE), EPA SW-846 Method 3535A, February 2007.

2. "Analyze Nitroaromatic and Nitroamine Explosives in Groundwater Using Solid Phase Extraction and HPLC," Waters, 1994.

3. *Test Methods for Evaluating Solid Wastes*, EPA SW-846 Method 8330B, Rev. 2, October 2006.

4. *Chemical Hygiene Plan,* current version.

Cross Reference

Document	Document Title
T-PEST-WI9981	Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling

Scope

The method is for the extraction of trace levels of nitroaromatics and nitroamines from explosives in water samples.

Basic Principles

A portion of the sample is passed through a Porapak RDX cartridge. The cartridge is then eluted with acetonitrile and the extract is brought to exactly 5 mL. The extract is diluted to 10 mL using a calcium chloride solution.

Interferences

Impurities in solvents, reagents, glassware, or other hardware used in sample processing interfere with the method. All glassware must be is rinsed with solvent before use. A method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or disposed of in the designated containers. These are then transferred to the lab-wide disposable facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) is disposed of in the normal solid waste collection containers.

Samples suspected of being high in explosives must be handled with extreme care.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the technicians training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Samples are collected in 1-L, unpreserved, amber glass bottles with PTFE-lined lids and stored refrigerated at 0° to 6°C, not frozen, prior to extraction. Samples must be extracted with 7 days of collection. The extract is stored in a clear autosampler vial in a refrigerator at 0° to 6°C, not frozen, for up to 40 days after extraction.

Preparation of Glassware

See *T-OE-GEN-WI10864*.

Apparatus and Equipment

1. Porapak RDX Sep-pak extraction cartridges – Waters
2. SPE vacuum manifold system – Baker or equivalent
3. Disposable pipettes – glass
4. Volumetric pipettes – Class A, assorted sizes
5. Graduated cylinders – Class A, assorted sizes
6. Disposable cartridge membrane filters – 0.2-µm Teflon
7. Clear crimp cap autosampler vials
8. 12-mL screw cap vials
9. Volumetric flask – Class A, assorted sizes
10. Filter paper – Fisher glass fiber or equivalent
11. Buchner funnel

Reagents and Standards

1. Acetonitrile (ACN) – HPLC grade. Store at room temperature for up to 1 year.
2. Calcium Chloride ($CaCl_2$) – Reagent grade.
   a. To prepare solution:
      (1) Add 5.0 g $CaCl_2$ to approximately 800 mL of reagent water.
      (2) Shake until the $CaCl_2$ goes into solution.
      (3) Dilute to 1000 mL with reagent water.
   b. Store at room temperature in a glass bottle. Reagent is stable 1 year.
   c. Preparation of larger volumes is acceptable if equivalent volumes are used.

d. Document all reagent preps in the appropriate logbooks.

4. All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the reagent module of the LIMS. Detailed instructions can be found in the corresponding analytical SOP *T-PEST-WI9981*.

Calibration

Not applicable to this procedure.

Procedure

1. Rinse all glassware with acetone using a wash bottle.

2. Measure 500 mL of each sample into 500-mL volumetric flasks.

3. Measure 500 mL reagent water into 500-mL volumetric flasks for the blank, Laboratory Control Sample (LCS), and Laboratory Control Sample Duplicate (LCSD) if applicable.

4. If necessary, filter the samples through a Buchner funnel and filter paper.

If any samples are filtered, the blank, LCS, and LCSD must also be filtered.

5. Use pipettes to add surrogate standards and spiking solutions.

   a. Surrogates are added to all samples (including all QC).

   b. Spikes are added to the LCS, LCSD (if applicable), Matrix Spike (MS), and Matrix Spike Duplicate (MSD) samples.

   c. The surrogates and spikes are as follows:

      (1) Surrogate: 0.5 mL Explosives Water Surrogate (OP_EXPW_SS)

      (2) Spike: 0.5 mL 8330B Explosives Spike (OP_8330B_MS)

      (3) If 2,4-diamino-6-nitrotoluene or 2,6-diamino-4-nitrotoluene are requested, create an additional LCS/LCSD. Add 0.1 mL of OP_246DIA_STK and OP_264DIA_STK to both.

   d. See *T-PEST-WI9981* for spike details.

   e. See *T-OE-GEN-WI10876* for storage and handling of spikes.

6. Assemble the SPE vacuum manifold with the Porapak RDX cartridges.

7. With the valves closed, use a graduated cylinder to add 15 mL of ACN to each reservoir.

   a. Elute the solvent through the cartridge at 10 mL/min.

   b. Empty the waste in the chamber into the appropriate solvent waste container.

8. Again, with the valves closed, use a graduated cylinder to add 30 mL of reagent water to each reservoir.

Elute the water through the cartridge at 10 mL/min.

9. Pull all samples through the cartridge at 10 mL/min. Empty the chamber as needed so it does not overflow.

10. Place labeled 5-mL volumetric flasks, numbered to match the cartridges, into the tube holder.

   a. Place the tube holder into the vacuum chamber.

   b. Place the top onto the vacuum chamber; the drip tips must go into the top of the volumetric flasks.

11. Use a graduated cylinder to elute the cartridge with 5 mL of ACN.

   a. Disassemble the vacuum chamber.

   b. Bring each sample to exactly 5.0 mL with ACN.

12. Use a disposable pipette to transfer the extract to a 10-mL volumetric flask.

13. Use $CaCl_2$ solution to rinse the 5-mL volumetric flask and add the rinseate to the 10-mL flask.
    a. Add enough $CaCl_2$ solution to the flask to bring the extract to exactly 10.0 mL.
    b. Mix thoroughly.
14. Filter the extract through a 0.2-µm filter into a clear screw cap 12-mL vial.
    a. Bottle a portion of the extract into two clear crimp cap auto sampler vials.
    b. Verify that all vials are labeled with the appropriate sample number.

Calculations

See analysis method.

Statistical Information/Method Performance

See analysis method.

Quality Assurance/Quality Control

A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in any day an additional batch must be prepared.

For each batch of samples extracted a blank, an LCS, an MS and an MSD must be extracted. If there is limited sample preventing the preparation of the MS/MSD, then an LCSD must be prepared instead. If the batch contains only field or equipment blank samples, the LCS/LCSD QC pairing must be used.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed instead.

10864 Glassware Cleaning for Organic Extractions
10876 Organic Extraction Standards Storage and Handling
9981 Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection

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End of document

Version history

Version	Approval	Revision information	
13	26.FEB.2020		
14	12.APR.2021		
15	11.AUG.2022		

eurofins	Always check on-line for validity. **Ultrasonic Extraction of Nitroaromatics and Nitroamines by Method 8330B in Solids**	Level: **Work Instruction**
Document number: **T-OE-PEST-WI10943**		
Old Reference: **1-P-QM-WI -9015173**		
Version: **18.1**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **30-MAR-2022**	Document users: **5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Explosives Waters and, 6_EUUSLA_Pesticide Residue Analysis_All Management, 6_EUUSLA_Pesticide Residue Analysis_Explosive Chem**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Preparation of Glassware
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision: 18	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout Document	New LIMS	Replaced references to old LIMS/data recording with new LIMS
Procedure	Reflects current practice	Updated all instances of 10.4g to 10.5g
Procedure A.7 and B.7	Reflects current practice	Separated centrifugation step into two parts. First centrifuge at 1000 rpm for 15 minutes. If further centrifugation is required, centrifuge at up to 1500 rpm for 20 minutes.

Revision	17	**Effective Date:**	28-DEC-2020
Section		**Justification**	**Changes**
Revision Log		Formatting requirement	Removed revision logs up to the previous version
Header		Deactivated methods	Removed 8330 and 8330A methods

Revision	17	**Effective Date:**	28-DEC-2020
LIMS ID	Deactivated analyses		Removed 6917 and 11138
Reference	Deactivated methods		Removed references to methods 8330 and 8330A
Cross Reference	Deactivated methods		Removed SOP linked to methods 8330/A
Sample Collection, Preservation, and Handling	Clarification		Added lack of preservation
Reagents and Standards 6	Deactivated analyses		Removed 6916, 6918, 10595, and 10596
Procedure	Deactivated analyses		Removed section A - methods no longer in use
Procedure A.6	Reflects current practice		Changed desired water level in ultrasonic bath

Reference

1. *Test Methods for Evaluating Solid Wastes*, EPA SW-846 Method 8330B, Rev. 2, October 2006.
2. *Chemical Hygiene Plan,* current version.

Cross Reference

Document	Document Title
T-PEST-WI9981	Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling
S-SS-WI11268	Sample Preparation of Solid Samples Including Sieving and Milling for Extraction and Analysis

Scope

This method is applicable for the extraction of trace levels of nitroaromatics and nitroamines from explosives in solid samples.

Basic Principles

A portion of sample to be analyzed is placed in a vial and dried with sodium sulfate. Acetonitrile (ACN) is added and the sample is vortexed to suspend the soil in the solvent. The sample is then placed into a chilled ultrasonic bath and sonicated for 18 hours. After sonication, it is centrifuged for 15 to 20 minutes and a portion of the ACN is removed from the vial. The volume of the removed aliquot is doubled by adding an equal volume of calcium chloride solution. The extract is then filtered.

Reference Modifications

Drying during homogenization results in loss of the analytes of interest, therefore, the samples are not dried or crushed with a mortar and pestle or passed through a 30-mesh sieve. Sodium sulfate is added to absorb any water that may be present in the sample.

The sample is centrifuged to provide better separation of the soil and solvent.

Filtration through a 0.45-µm filter is sufficient to remove particles from the extract for samples that are not puck milled, since the sample is not ground with a mortar and pestle and passed through a sieve. A 0.1-µm filter is required for samples that are puck milled.

Interferences

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware is rinsed with solvent before use and a method blank is performed with each batch of sample to demonstrate that the extraction system is free of contaminants.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Samples suspected of being high in explosives must be handled carefully. Soil samples must not be dried in an oven and not ground with a mortar and pestle if high concentrations of explosives are suspected. Method 8510 is used to screen for high levels of explosives if suspected. Lumps of material that have a chemical appearance must be suspect and not ground. Explosives are generally a finely ground, grayish-white material.

Prior to performing moisture analysis, all soil samples must be found to contain less than 1% by weight total explosives. If samples are found to contain greater than this level, wet weight results must be reported. If moisture determination is deemed safe, contact client services to add moisture analysis to sample.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or must be disposed of in the designated containers. These will then be transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the technicians training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Samples are collected in unpreserved, wide-mouth glass jars with PTFE-lined lids. They must be extracted within 14 days of collection. All samples must be stored refrigerated 0°to 6°C, not frozen.

Apparatus and Equipment

1. Top loader balance – Capable of weighing to 0.01 g
2. Disposable pipettes
3. Pipettes – Class A, assorted sizes
4. Disposable syringes – 20-mL
5. Disposable cartridge membrane filters – 0.45-µm PTFE filters, Whatman brand catalog #6875-2504 or equivalent

6. Volumetric flasks – Class A, assorted sizes
7. Glass vials – 25 mL
8. Vortex mixer
9. Temperature controlled ultrasonic bath
10. Glass bottles
11. Wash bottles
12. Glass jars
13. Syringes – Assorted sizes
14. Graduated cylinders – Class A, assorted sizes
15. Centrifuge – Beckman Allegra or equivalent
16. Disposable cartridge membrane filters - 0.1-µm PTFE filters, Whatman brand catalog #6798-2501 or equivalent
17. Centrifuge tubes- 15 ml disposable centrifuge tubes, Fisher brand catalog #05-539-5 or equivalent

Reagents and Standards

1. Acetonitrile (ACN) – HPLC grade. Store at room temperature for up to one year.
2. Calcium chloride ($CaCl_2$)– Reagent grade.
    a. To prepare solution, add 5.0 g $CaCl_2$ to approximately 800 mL of reagent water in a 1,000-mL volumetric flask. Shake until the $CaCl_2$ goes into solution. Use a wash bottle to dilute to 1,000 mL with reagent water.
    b. Store at room temperature in a glass bottle. Reagent is stable 1 year.
    c. Larger volumes may be prepared as long as equivalent volumes are used.
    d. Document all reagent preparation in the appropriate logbooks or the TALS reagent module.
3. Sodium sulfate (Na_2SO_4) – Reagent grade or equivalent. Bake at approximately 400°C for a minimum of 4 hours in a shallow pan prior to use to remove organic contaminants. After baking, store in a glass jar at room temperature for up to 1 year.
4. Sand – Standard Ottawa or equivalent. Bake at approximately 400°C for a minimum of 4 hours prior to use to remove organic contaminants. After baking, store in a glass jar at room temperature for up to 1 year.
5. Acetone - Pesticide grade or equivalent. Store at room temperature for up to 1 year.
6. All QC standards added during extraction process are prepared by Organic Extractions using instructions generated by the TALS reagent module. Detailed instructions can be found in the corresponding analytical work instruction *T-PEST-WI9981*.
7. Certified Reference Material (CRM)- To be used for the Laboratory Control Sample Incremental Sampling Method (LCSISM) that is required on each batch of samples that are puck milled.
    a. To create the CRM, a 5 mL custom spike from Phenova is added to 500 grams of a clean solid material, puck milled (see *S-SS-WI11268*), and stored in a glass screw top jar at 0° to 6°C, not frozen. The expiration for the CRM is 7 days from the creation date.
8. Custom 8330B standard - Phenova custom 5 mL spiking solution containing 17 analytes at a final spiked concentration of 2000 ug/kg (with Nitroglycerin and PETN at a final spiked concentration of 10,000 ug/kg) in Acetonitrile, or equivalent. Each standard is provided as a pre-measured 5.00 mL spike flame sealed in a 10 mL

amber ampoule, designed for "snap and spike" use where quantitative transfer of 100% of the 5 mL is applied to 500 g clean solid matrix to create the CRM.

9. Clean soil matrix – Blank soil matrix for 8330B purchased from Phenova or equivalent. The clean soil matrix is used to create the CRM.

Preparation of Glassware

See *T-OE-GEN-WI10864*.

Calibration

Not applicable for this procedure

Procedure

NOTE: All samples must be properly prepared prior to extraction. The preparation could include homogenization, drying, etc. Please ask your group leader if you have any questions.

A. For samples that do not require puck mill

1. Weigh 10.0 to 10.5g of sample into a 40-mL glass vial.

   a. Record the initial weight and any comments about the sample in the LIMS.

   b. The background, MS, and MSD are performed on three separate aliquots of a field sample.

2. The Blank, LCS, and LCSD (if applicable) and Diamino LCS and Diamino LCSD are prepared by weighing 10.0 to 10.5 g of sand into a vial. Record the weight in the LIMS.

3. Add approximately 2 g of sodium sulfate to all vials and mix. More sodium sulfate can be added if samples are wet. Sodium sulfate should be added until a free flowing mixture is observed.

4. Use pipettes to add surrogate standards and spiking solutions.

   a. Surrogates are added to all samples (including all QC).

   b. Spikes are added to the LCS, LCSD (if applicable), MS, and MSD samples. Diamino Stocks are added to the Diamino LCS and Diamino LCSD.

   c. Typically, the surrogates and spikes are as follows:

      (1) Surrogate: Add 0.5mL Explosive Soil Surrogate (OP_EXPS_SS).

      (2) Spike: Add 0.5 mL 8330B Explosives spike (OP_8330B_MS) into LCS, LCSD, MS and MSD, if applicable.

      (3) Stocks: If 2,4-diamino-6-nitrotoluene or 2,6-diamino-4-nitrotoluene are requested, add 0.18 mL of 2,6-Diamino-4-nitrotoluene (OP_2,4D6N_STK) and 0.18 mL of 2,6-Diamino-6-nitrotoluene (OP_2,6D4N_STK) stocks into Diamino LCS and Diamino LCSD.

   d. See *T-PEST-WI9981* for spike details.

   e. See *T-OE-GEN-WI10876* for storage and handling of spikes.

5. Use a graduated cylinder to add 20.0 mL of ACN and vortex swirl the sample for approximately 1 minute to suspend the soil in the ACN.

6. Place the sample in a cooled (<30°C) ultrasonic bath that contains a level of water equal to the level of sample in the vial and sonicate for 18 hours.

   Document the temperature of the bath when the samples are placed in the bath and the temperature of the bath when the samples are removed in the LIMS.

7. After sonication, centrifuge the sample at 1,000 rpm for 15 minutes. If further centrifuging is required because the sample is not separating, centrifuge at up to 1,500 rpm for 20 minutes.

8. Use a pipette to place 5.0 mL of calcium chloride solution (5 g/L) into a 10-mL volumetric flask that has been rinsed with acetone.

    a. Use a disposable pipette to bring to volume using the solvent layer of the centrifuged sample.

    b. Mix thoroughly.

    c. Allow the mixture to stand 15 minutes.

9. Filter all the samples, including QC samples, through 0.45-µm PTFE filters (Whatman brand catalog # 6874-2504 or equivalent) using a 10-mL disposable syringe.

    a. Discard the first 3 mL.

    b. Filter into two clear GC vials.

    c. Filter the remaining sample into a clear 12 mL vial.

    d. Store in the refrigerator at 0° to 6°C, not frozen, until analysis.

    e. Document the final volume as 40.0 mL in the LIMS.

B. For samples that require puck mill (See *S-SS-WI11268* for puck mill instructions.)

1. Weigh 10.0 to 10.5 g of sample into a 40-mL glass vial.

    a. Record the initial weight and any comments about the sample in the LIMS.

2. Quality control samples:

    a. The background, MS, and MSD are performed on three separate aliquots of a field sample weighed out at 10.0 to 10.5 g.

    b. The Blank, LCS, and LCSD (if applicable) and Diamino LCS and Diamino LCSD are prepared by weighing 10.0 to 10.5 g of sand into a 40-mL glass vial.

    c. An LCSISM is required on each scheduled batch of samples. The LCSISM is prepared by weighing out 10.0 to 10.5 g of CRM into a 40-mL glass vial. See document number *S-SS-WI11268* for details on creating CRM.

    d. One sample is required to be prepared in triplicate on each scheduled batch. The sample to be prepared in triplicate is assigned three unique sample numbers at the time of sample entry. The triplicate samples are weighed out at 10.0 to 10.5 g. The triplicate samples are scheduled on batches through the LIMS. See document number *S-SS-WI11268* for details on creating the triplicate samples.

    e. Puck mill blanks are created each time samples are processed through the puck mill. The puck mill blank is given a unique sample number and is scheduled on batches through the LIMS. The puck mill blanks are weighed out at 10.0 to 10.5 g. See document number *S-SS-WI11268* for details on creating the puck mill blank.

    f. Record the weights of all QC samples in the LIMS.

3. Add approximately 2 g of sodium sulfate to all vials and mix.

4. Use pipettes to add surrogate standards and spiking solutions.

    a. Surrogates are added to all samples (including all QC).

    b. Spikes are added to the LCS, LCSD (if applicable), MS, and MSD samples. Diamino Stocks are added to the Diamino LCS and Diamino LCSD.

    c. Typically, the surrogates and spikes are as follows:

(1) Surrogate: Add 0.5mL Explosive Soil Surrogate (OP_EXPS_SS).

(2) Spike: Add 0.5 mL 8330B Explosives spike (OP_8330B_MS) into LCS, LCSD, MS and MSD, if applicable.

(3) Stocks: If 2,4-diamino-6-nitrotoluene or 2,6-diamino-4-nitrotoluene are requested, add 0.18 mL of 2,6-Diamino-4-nitrotoluene (OP_2,4D6N_STK) and 0.18 mL of 2,6-Diamino-6-nitrotoluene (OP_2,6D4N_STK) stocks into Diamino LCS and Diamino LCSD.

d. See *T-PEST-WI9981* for spike details.

e. See *T-OE-GEN-WI10876* for storage and handling of spikes.

5. Use a graduated cylinder to add 20 mL of ACN and vortex swirl the sample for approximately 1 minute to suspend the soil in the ACN.

6. Place the sample in a cooled (<30°C) ultrasonic bath that contains a level of water equal to the level of solvent in the vial and sonicate for 18 hours.

7. Document the temperature of the bath when the samples are placed in the bath and the temperature of the bath when the samples are removed in the LIMS.

8. After sonication, centrifuge the sample at 1,000 rpm for 15 minutes. If further centrifuging is required because the sample is not separating, centrifuge at up to 1,500 rpm for 20 minutes.

9. Use a pipette to place 5 mL of calcium chloride solution (5 g/L) into a 10-mL volumetric flask that has been rinsed with acetone.

   a. Use a disposable pipette to bring to final volume of 10-mL in the 10-mL volumetric flask containing the 5-mL of calcium chloride solution using the solvent layer of the centrifuged sample.

   b. Mix thoroughly.

   c. Allow the mixture to stand for 15 minutes.

   d. Transfer the 10-ml of extract into a 15ml centrifuge tube (Fisher brand catalog #05-539-5 or equivalent).

   e. Centrifuge the samples between 1,000 and 1,500 rpm for 5 minutes.

10. Filter all samples,, including QC samples, through 0.1-µm PTFE filters (Whatman brand catalog # 6798-2501 or equivalent) using a 10-mL disposable syringe.

    a. Discard the first 3 mL.

    b. Filter into two clear GC vials.

    c. Filter the remaining sample into a clear 12 mL vial.

    d. Store in the refrigerator at 0° to 6°C, not frozen, until analysis.

    e. Document the final volume as 40.0 mL in the LIMS.

Calculations

See analysis method.

Statistical Information/Method Performance

See analysis method.

Quality Assurance/Quality Control

A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. For each batch of samples extracted, a blank, LCS, MS, and MSD must be extracted. If there is limited sample that prevents the preparation of the MS/MSD, then an LCSD must be prepared instead. If the batch contains only field or equipment blank samples, the LCS/LCSD QC pairing must be used.

If any client, agency, or state has more stringent QC or batch requirements, these must be followed instead.

10864 Glassware Cleaning for Organic Extractions
10876 Organic Extraction Standards Storage and Handling
11268 Sample Preparation of Solid Samples Including Sieving and Milling for Extraction and Analysis
9981 Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection

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End of document

Version history

Version	Approval	Revision information	
17	14.DEC.2020		
18	22.MAR.2021		
18.1	29.MAR.2022		

eurofins	Always check on-line for validity. **Preparation of Vials for Field Preservation of Soils for Volatile Analysis**	Level: **Work Instruction**
Document number: **T-VOA-WI11242**		
Old Reference: **1-P-QM-WI-9015073**		
Version: **18**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **20-JAN-2022**	Document users: **6_EUUSLA_GC/MS Volatiles_VOA Prep**	Responsible: **5_EUUSLA_GC/MS Volatiles_Manager**

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Procedure
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Revision Log

Revision	18	**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Basic Principles	LIMS update		Updated LIMS program
Definitions	LIMS update		Removed old program reference
Procedure	LIMS update		Updated LIMS program
Procedure	Updated reporting		Method for reporting issues to PM updated

Revision	17	**Effective Date:**	3/22/2018
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout document	Applicable to the procedure		Updated frozen temp to = -10°C

Reference

1. USEPA, 40 CFR Part 60, Appendix A, Method 25D

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 5035, December 1996.

3. Test Methods for Evaluating Solid Wastes, SW-846, Method 5035A, July 2002.

4. *Method for the Field Extraction/Preservation of Soil Samples with Methanol for Volatile Organic Compounds*, New Jersey DEP, February 1997.

5. Method AK101 for the Determination of Gasoline Range Organics, April 8, 2002.

6. USEPA, 40 CFR Part 60, Appendix A, Method 25D

7. WI PVOC PUBL-SW-140 09/95, *Wisconsin DNR Modified GRO*.

8. *Chemical Hygiene Plan*, current version.

Purpose

The purpose of this SOP is to provide detailed instructions for the preparation of vials used for field-preservation of soil samples to be analyzed for volatiles.

Scope

This procedure applies to analysts who prepare pre-preserved containers used in the field for soil sampling of volatile analyses.

Basic Principles

An aliquot of preservative is placed in a volatile-free container and weighed. The weight of the container and preservative is then captured using the Analyst Desktop program in LIMS. When requested, the container is sent to the client for use in field preservation of a solid sample. When the container and the soil sample are returned to the lab, it is re-weighed and the actual sample weight is calculated. Samples are then spiked with the appropriate surrogate as determined by the analysis being performed.

Definitions

Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) – A sample of known composition analyzed with each batch of samples to demonstrate laboratory accuracy. The samples either naturally contain the analytes of interest or are clean samples fortified with known concentrations used to demonstrate laboratory accuracy. A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test.

Interferences

Sample contamination can occur if the vial preparation is not performed in a volatile-free environment; therefore, this process must be performed in one of the designated volatile-free laboratories. Samples also become contaminated if volatiles diffuse through the sample vial septum. A trip blank carried through sampling, storage and handling acts as a check of such contamination.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

Methanol is flammable. Containers of this solvent must be kept away from any sources of open flames or sparks. Due to the potentially toxic nature of samples received from clients for analysis, safety precautions must be observed when handling samples. Safety glasses, lab coats, and gloves are required. Weighing out of the samples must always take place in a hood.

The solvents utilized in this procedure are disposed of in a solvent waste container which is transferred to the lab-wide disposal facility. Expired standards in methanol are disposed of as hazardous waste. Bulk sample containers and methanolic sample preparations are returned to the sample storage area for future disposal. Other wastes generated by Lancaster Labs are disposed of via incineration at EPA licensed facilities.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP.

The initial training consists of observing the procedure being carried out by an experienced analyst/technician. Next, the trainee performs the procedure while the experienced person watches, answers questions, and gives feedback. Following the initial training, experienced individuals are available as a resource until no longer required. Analysts are considered proficient when they are able to perform the procedure independently.

Sample Collection, Preservation, and Handling

Sample containers must be refrigerated at 0° to 6°C, not frozen, after preparation. Containers containing surrogates are not kept for more than 2 weeks before being discarded or sent into the field for use in sample collection. Packaging of sample containers must follow all DOT regulations. When returned, samples must be preserved and refrigerated unfrozen at 0° to 6°C or frozen in reagent water at = -10° within 48 hours of collection. See individual technical area SOPs for method specific hold times.

Apparatus and Equipment

1. 40-mL vials with Teflon™-lined septa and screw caps
2. 40-mL vials with stir bars, Teflon™-lined septa, and screw caps
3. 125-mL amber glass wide mouth jar with Teflon™-lined septa and screw caps
4. Pipette capable of dispensing up to 25 ± 0.25 mL.
5. 50-µL syringe
6. 1000-mL volumetric flask, class A
7. Analytical balance capable of weighing ±0.01 g.
8. Label printer/labels

9. LIMS VOA prep application and Reagent, Solution, and Balance Applications which integrates a PC with an analytical balance to collect data directly from the balance. It organizes the data, performs calculations, and stores final results in the Laboratory Information Management System (LIMS).

Reagents and Standards

NOTE: A rinse using reagent water followed by methanol must be performed on the pipette dispensers before adding a new lot of solution or standards.

1. Methanol – Purge and trap grade.

   a. Store at room temperature and re-analyze yearly.

   b. Use methanol that has been previously tested and approved for use by the labs.

2. 8260A/B Surrogate Mix, Restek Catalog #30340 (2500 µg/mL) or equivalent.

   a. Store at = -10°C for up to 1 year.

   b. Use standard as is, or diluted in methanol to a final concentration of 2.5 µg/mL. Diluted standard must be stored at = -10°C for up to 6 months.

   c. This standard is used for the GC/MS analyses.

3. Custom a,a,a-trifluorotoluene (TFT), Restek Catalog #54357 (15,000 µg/mL) or equivalent.

   a. Dilute standard in methanol to a final concentration of 750 µg/L for the working solution. A prep dilution of 0.5 mL of TFT to 10 mL of methanol is used when spiking returned field preserved containers.

   b. Store at = -10°C for up to 30 days.

   c. This standard is used for the GC analyses.

4. Sodium hydrogen sulfate anhydrous powder, Fluka, Catalog #2316657 or equivalent.

   a. Store at room temperature and re-analyze yearly.

   b. If compounds are detected above the method detection limit (MDL), prepare another vial and repeat the analysis. If compounds are still detected above the MDL, a new container must be tested and used.

5. Sodium Bisulfate Solution –

   a. Prepare by diluting 200 ±0.5 g of the Sodium hydrogen sulfate anhydrous into 1000 mL of reagent water in 1000-mL volumetric flask. Cap and invert at least 10 times to mix.

   b. Store at room temperature and re-analyze every 6 months if supply remains.

   c. If compounds are detected above the method detection limit (MDL), repeat the analysis. If compounds are still detected above the MDL, remake the solution and test before using.

6. Reagent water – water in which target analytes are not detected at or above the reporting limit for parameters of interest. In general, the deionized water supplied at the taps in the laboratory meets criteria. If the reagent water does not meet the requirements, see your supervisor for further instructions.

7. Polyethylene glycol (PEG) – Average molecular weight 400 amu, EM Science preferred.

   a. Any lot/vendor must meet a cleanliness level of <50 mg/kg volatile content.

   b. Store at room temperature and re-analyze each year if supply remains.

Calibration

Not applicable to this procedure.

Procedure

A. Prepare preservative containers

NOTE: Pre-purchased vials can be used for selected preps. Vials containing 5 mL of DI Water, vials containing 5 mL of Sodium Bisulfate and vials containing 5, 10 and 15 mL of methanol are available for field preserved analyses. The vials contain the initial tare weight, vial lot number, and the preservative lot number.

1. Check to make sure the pipette calibration has been performed.

2. Use the pipette to add the appropriate amount of preservative to a clean container. A 40-mL vial is used unless otherwise indicated on T-VOA-FRM10681.

a. For AK101 and 10mL DE Vials for 8260 the appropriately diluted surrogate solution must be added at this time using a pipette.

b. For NJ 25mL vials for 8260 use a syringe to add the ampulated 8260A/B surrogate standard plus methanol into a 40-mL vial. Use 1 µL of 8260A/B surrogate for every 1 mL of methanol in the vial.

3. Seal the container with a screw cap and septum seal.

4. Label the container with the tracking number.

5. Check to make sure the balance has been calibrated each day before use.

6. Place the container on a zeroed balance and capture the weight electronically to the nearest 0.01 g using Analyst Desktop.

7. Store the prepared containers in the designated area in the Volatile Prep room. Vials containing surrogates must be stored in the freezer, vials containing just methanol are stored at room temperature or refrigerated.

8. Pull vials as requested via e-mail from client services and place on the designated shelf in the bottles room storage area. The containers are now ready to be sent into the field for sample collection.

9. Send a reply e-mail to the client service representative to notify them that the order has been completed.

B. Re-weigh preservative containers after return from the field

1. Using Analyst Desktop application, scan the tracking number on the container. This brings up the information documented from the preparation step described above.

NOTE: If using purchased pre-tarred vials insert the vial ID, preservative, and tare weight information on the Pre-Tarred tab within the Volatile Prep Application.

2. Check to make sure the balance has been calibrated each day before use. Place the container on a zeroed balance and capture the second weight electronically using the VOA Prep application.

3. Analyst Desktop calculates the net weight. (weight of vial, solution, and soil minus the weight of the vial and solution).

4. If there are any holding-time issues or if weights are outside of the Action Requirement, an NCM should be generated and the PM contacted.

5. Record any unusual observations about the sample in the comment section.

C. Sample spiking

NOTE: Wipe samples do not require a surrogate to be spiked into the methanol.

A 1:1 ratio of µL to mL is required when spiking surrogate into methanol, except for analysis 0388 MA-VPH samples which require 30 µL to the 15 mL of methanol.

1. Determine the amount of methanol in the sample. This is determined by the analysis number and the mL of methanol printed on the tracking number.

2. Fill the syringe with the appropriate surrogate slightly past the amount of µL needed.

a. Add the appropriate surrogate based on the bottle code entered and the department receiving the sample.

b. GC requires a TFT surrogate mix to be used, bottle code 64.

c. GC/MS requires an 8260A/B surrogate mix to be used, bottle codes 14 and 66.

3. Dispense the surrogate from the syringe until the required level of µL is reached. This assures no air bubbles are present and the syringe contains surrogate.

a. Tilt the vial so the methanol comes toward the top of the vial, spike through the septa, submerging the tip of the syringe into the methanol.

b. Shake the vial to disperse the surrogate throughout the sample.

c. Put an "S" on the vial label to indicate surrogate has been added.

d. Clean the syringe before proceeding to the next sample.

D. Deliver samples to the labs

Once the sample containers have been re-weighed, they must be transported to the laboratory for analysis. Each department has a designated refrigerated drop-off spot. All trip blanks and field blanks submitted must follow the sample containing the same preservative. Blanks submitted as waters are to be stored in the designated volatile refrigerator.

NOTE: Any sample designated for prescreen must be taken to the appropriate refrigerator and placed in a box sorted in numerical order in groups of 21 or 42 when applicable. If a methanol sample is designated for prescreen and a corresponding methanol trip blank or field blank is submitted the blanks must follow the associated samples through the entire process including sample prescreen.

Calculations

Calculation of sample weight : Wn = Ws - Wf

Where:

Wf = weight of container + solution (first weight)

Ws = weight of container + solution + soil (second weight)

Wn = net weight of soil sample

Statistical Information/Method Performance

Not applicable to this procedure.

Quality Assurance/Quality Control

The number of containers requested from Client Services includes the appropriate amount of extra bottles to serve as matrix quality control (QC) for volatile analyses requested. The matrix QC spiking for this process is noted in Procedure C. All other QC samples such as the LCS, LCSD, and method blanks are prepared as outlined in the individual technical area's SOPs.

End of document

Version history

Version	Approval	Revision information	
16	30.SEP.2016		
17	08.MAR.2018		
18	06.JAN.2022		

eurofins	Always check on-line for validity. **Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater**	Level: **Work Instruction**
Document number: **T-OE-SVOA-WI11432**		
Old Reference: **1-P-QM-WI-9015076**		
Version: **19**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **29-JUL-2022**	Document users: **5_EUUSLA_GC/MS Semivolatiles_Manager, 5_EUUSLA_Organic Extraction_Manager, 6_EUUSLA_ Organic Extraction_Semivolatile Waters, 6_EUUSLA_GC/MS Semivolatiles_Analysts**	Responsible: **5_EUUSLA_Organic Extraction_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I
Table II

Revision Log

Revision: 19	**Effective Date:**	This Version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Cross Reference	Correction	Updated WI9252 to current name
Procedure 3 and 8	Current Procedure	Updated to reflect current practice
Procedure	Clarification	Updated throughout to say LIMS in place of logbook
Reagents and Standards	Addition	Added reagents used in esterification with Diazald
Procedure 24c	Addition	Added notes and process for esterification with Diazald

Revision: 18	**Effective Date:**	25.FEB.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version

Revision: 18	**Effective Date:**	25.FEB.2021
Section	**Justification**	**Changes**
Throughout Procedure	New LIMS	Changed record information 'on the extraction log' to record information 'in the LIMS'
Reagents and Standards	Reflects current process	Added acetone
Procedure 1.	Reflects current process	Added extra rinse steps for the Dinoseb_ATP prep
Procedure 6.a.	Reflects current process	Updated spike amount for Dinoseb surrogate
Procedure 7.f.	Reflects current process	Updated spike name and amount for RV SIM LCS/D MS/D
Procedure 8.b.	Reflects current process	Clarified that Dinoseb_ATP is only extracted with acid adjustment
Quality Assurance/Quality Control	Clarification	Changed statistical limit evaluation from every 6 months to as frequently as defined in the analytical method
TablesI/II	Reflects current standards	Updated reagent analyte lists, as spike compositions have changed

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3510C, Rev 3, December 1996.
2. Test Methods for Evaluating Solid Wastes, SW-846 Method 8151A, December 1996
3. Chemical Hygiene Plan, current version.

Cross Reference

Document	Document Title
T-OE-GEN-FRM23822	Instructions for Checking pH During Extraction Procedures
T-OE-GEN-WI10864	Glassware Cleaning for Organic Extractions
T-OE-GEN-WI10876	Organic Extraction Standards Storage and Handling
T-SVOA-WI11998	Semivolatile Spiking and Calibration Standards
T-SVOA-WI13634	The Determination of 1,4-Dioxane by GC/MS using Isotope Dilution and Selective Ion Monitoring (SIM) by Method 8270C/D/E
T-SVOA-WI9252	Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270C/D/E SIM by GC/MS
T-SVOA-WI9623	Semivolatile Organic Compounds by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC/MS
T-SVOA-WI9617	Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS
T-SVOA-WI9995	Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS
T-SVOA-WI34848	Client Specific Dinoseb by 8270C in Water Using GC/MS
T-SVOA-WI31758	Client Specific Methylphenols by Method 8270D in Water Using GC/MS

Scope

This method is for the extraction of semivolatile organic compounds at low ppb to low ppm levels in aqueous samples that are not prone to emulsions. High levels of organic compounds and/or extreme alkalinity or acidity in the sample often interfere with normal detection limits.

Basic Principles

A sample is placed into a separatory funnel. Surrogate standards are added to each sample to monitor recovery. The pH of the sample is adjusted to >11 and the sample is serially extracted with methylene chloride. The pH is then adjusted to <2 and the

sample is again serially extracted with methylene chloride. The solvent fractions are combined, and the extract is concentrated to 1.0 mL.

Procedural changes to use a reduced sample aliquot while maintaining the default reporting limits are permitted as long as the reagent aliquots are reduced proportionally and a demonstration of capability study is performed and on file.

Reference Modifications

Surrogate and matrix spiking solutions are not added before the transfer to the separatory funnel for several reasons:

1. Samples must be poured from the amber bottles to determine the matrix and volume of sample to use for each extraction.
2. Many sample bottles have no headspace and there is no room to add surrogate to the sample in the bottle.
3. Due to the volume of samples extracted, a separate graduated cylinder for each sample is unrealistic.
4. To maintain consistency with all extractions, no samples are spiked in the bottle or graduated cylinders.

Interferences

High levels of organic compounds in the sample lead to interferences with normal detection limits.

Impurities in solvents, reagents, glassware, or other hardware used in sample processing lead to interferences with the method. All glassware must be rinsed with solvent before use. A method blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants. See *T-OE-GEN-WI10864* for glassware cleaning instructions.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Each chemical compound must be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves.

Extracts are concentrated on a steam bath or rapid vap; caution must be exercised while working around these apparatuses.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or disposed of in the designated containers. These are transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) is disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the employees training records.

Initially, each technician performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC consists of four laboratory control samples that are carried through all steps of the extraction and analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four laboratory control samples, or one blind sample.

Sample Collection, Preservation, and Handling

Samples must be collected in amber glass bottles with PTFE-lined lids and stored under refrigeration at 0º to 6ºC, not frozen, prior to extraction. Samples must be extracted within 7 days of collection. The extract is stored in an amber autosampler vial in the freezer at ≤-10 °C for up to 40 days prior to analysis.

Apparatus and Equipment

1. Separatory funnel for extracting organic components from an aqueous matrix
2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during the extraction

3. Water bath – VWR/LLI Model #1127 or equivalent
4. Graduated cylinders – Class A, assorted sizes
5. Pipettes – Class A, assorted sizes
6. Pipettes – Disposable
7. Solvent pumps – Beckman, adjustable
8. Balance – Capable of weighing to 0.01 g
9. Automatic shaker – Capable of holding 2L separatory funnels
10. Centrifuge – Beckman GS-6 or equivalent
11. Sodium sulfate columns with extra course frits
12. Micro-snyder columns
13. Wash bottles – Teflon™
14. Amber autosampler vials with crimp caps
15. Teflon™ boiling chips
16. Teflon™ separatory funnel
17. pH paper - wide range or Hydrion (or equivalent) 10 to 12 range and 1 to 2.5 range.
18. Automated Water Extraction Bench – capable of holding separatory funnels for 250-mL extractions.
19. Rapid-Vap Evaporators – for concentration of 250-mL extractions
20. Rapid-Vap Evaporator Tubes – Class A
21. N-evap nitrogen evaporator with nitrogen supply
22. Erlenmeyer flasks - 250mL

Reagents and Standards

Unless otherwise noted, use ACS grade reagents or equivalent. See *T-OE-GEN-WI10876* for storage and handling of spikes.

1. Methylene chloride ($MeCl_2$ or CH_2Cl_2) – Pesticide grade or equivalent. Store at room temperature for up to one year.
2. Methanol (MeOH) - pesticide grade or equivalent. Store at room temperature for up to 1 year.
3. Hexane - Pesticide grade or equivalent. Store at room temperature for up to 1 year.
4. Acetone - Pesticide grade or equivalent. Store at room temperature for up to 1 year.
5. 10N Sodium hydroxide (NaOH) – Lab chem or equivalent. Store at room temperature for up to one year.
6. Sulfuric acid(H_2SO_4) – ACS grade or equivalent, concentrated. Store at room temperature for up to one year.
7. Sodium sulfate – Anhydrous reagent grade or equivalent. Bake at approximately 400°C for a minimum of 4hours in a shallow pan prior to use to remove organic contaminants. After baking, store in a glass jar at room temperature for up to 1year.
8. Tap water - In general the laboratory tap water has been shown not to contribute interferences at or above the reporting limits for parameters of interest.
9. Reagent water – Deionized water (DIH_2O) in which interferences are not observed at or above the reporting limit for parameters of interest. In general, the reagent water supplied at the DIH_2O taps in the laboratory meets this criterion. If the reagent water does not meet the requirements, see your supervisor for further instructions.
10. Trimethylsilyldiazomethane (TMSD) - Follow manufacturer's storage and expiration information
11. Silicic Acid - Follow manufacturer's storage and expiration information
12. Diazald (N-methyl-N-nitroso-*p*-toluenesulfonamide) - Follow manufacturer’s storage and expiration information

13. Potassium Hydroxide (KOH) – ACS Certified, Fisher Chemical or equivalent. Store at room temperature for up to 5 years

14. Reagent Alcohol GR. Store at room temperature for up to 1 year

All QC standards added during extraction process are prepared by the organic extraction department using the Reagent module in TALS as a guide. Detailed instructions can be found in *T-SVOA-WI11998*.

Calibration

Not applicable to this procedure

Procedure

1. Prepare the glassware to be used as outlined in *T-OE-GEN-WI10864*. If the sample is entered for analytical method Dinoseb_ATP, perform a thorough acid rinse of the separatory funnel through the stopcock, followed by a thorough water rinse and finally, a thorough solvent rinse using 1:1 Acetone/Hexane prior to extraction.

2. Determine the volume of sample to be used for each extraction. Ideally, one full bottle is used. (Typically, this is 1 L for routine extraction or 250 mL for mini-extractions).

    a. Samples being extracted using 1 L are entered for 3510C.

    b. Samples being extracted using 250 mL are entered for 3510C_LVI.

3. If using one full bottle:

    a. Place the full sample bottle with the cap on the scale. Record this weight in the LIMS as the gross weight.

    b. Shake the bottle vigorously.

    c. Pour the sample into a separatory funnel.

    d. Record any comments about the sample in the LIMS.

    NOTE: Reduced volumes of sample are only used with prior approval by the client or if the matrix of the sample does not allow the extraction to proceed using the full volume. The sample must then be diluted with reagent water to 1 L or 250 mL depending on the extraction.

4. The method blank, laboratory control sample (LCS), and laboratory control sample duplicate (LCSD) (if applicable) are prepared using 1 L (or 250 mL for mini-extractions) of tap water (except for isotope dilution (ID) analytical methods 8270C_SIM_MS_ID, 8270D_SIM_ID_D5, 8270D_SIM_ID_DK, 8270D_SIM_MS_ID which are prepared with reagent water) measured into the separatory funnel.

5. The background, MS, and MSD are prepared on three separate aliquots of a field sample.

6. Surrogates

Unless noted otherwise, surrogate spike is added to all samples, blanks, LCS, LCSD (if applicable), MS, and MSD (if applicable). See *T-SVOA-WI11998* for preparation of spikes. See *T-OE-GEN-WI10876* for storage and handling of spikes.

    a. For samples entered for any of the 8270 methods referenced in the cross reference section of this SOP paired with extraction method 3510C (1 L) - Add 1.0 mL BNA surrogate (OP_BNA_SS). Exception: Any samples entered for analytical method Dinoseb_ATP - Add 0.2 mL Mini BNA surrogate.

    b. For samples entered for any of the 8270 methods referenced in the cross reference section of this SOP paired with extraction method 3510C_LVI (250 mL) – Add 1.0 mL of Mini BNA surrogate (OP_MINIBNA_SS). Exception: for isotope dilution methods listed in step 4 - Add 0.25 mL of Mini 1,4- Dioxane-d8 Surrogate (OP_14DX-d8_SS).

    NOTE: The standard must drip directly into the aqueous sample without touching the glass side of the separatory funnel to avoid poor recoveries.

7. Spiking solutions

Unless noted otherwise, spiking solutions are added to the LCS, LCSD (if applicable), MS, and MSD (if applicable).

    a. For methods 8270C, 8270D, 8270D_DKQP, 8270D_DOD5, 8270DEL, 8270E, 8270MCP, 8270RCP paired with extraction method 3510C, add 1.0 mL of LCS Spike Mix #1 (OP_LCS1_MS). The analytes contained in this mix can be found in Table I. The following additional spikes may also be added as indicated below dependent upon the requested analyte list.

        i. Add 1.0 mL of LCS Spike Mix #2 (OP_LCS 2_MS) if benzaldehyde, atrazine, or caprolactam are requested analytes.

ii. Add 1.0 mL of Benzenethiol Spike (OP_BENTHIO_MS) if phenylmercaptan is requested. This will be spiked into a separate LCS/D.

iii. Add 1.0 mL of APPIX Mix #1 (OP_APPIX1_MS) if any analytes contained in Table II are requested. This will be spiked into a separate LCS/D.

iv. Add 1.0 mL of APPIX Mix #2 (OP_APPIX2_MS) if p-Phenylenediamine is requested. This will be spiked into the same LCS/D as APPIX Mix #1. Note: APPIX Mix #2 will not be requested without APPIX Mix #1.

b. For methods 8270C, 8270D, 8270D_DKQP, 8270D_DOD5, 8270D_MPhenols, 8270DEL, 8270E, 8270MCP, 8270RCP paired with extraction method 3510C_LVI, add 1.0 mL of Mini LCS Spike Mix #1 (OP_MINLCS1_MS). The analytes contained in this mix can be found in Table I. The following additional spikes may also be added as indicated below dependent upon the requested analyte list.

i. Add 1.0 mL of Mini LCS Spike Mix #2 (OP_MINLCS2_MS) if benzaldehyde, atrazine, or caprolactam are requested analytes.

ii. Add 0.25 mL of Benzenethiol Spike (OP_BENTHIO_MS) if phenylmercaptan is requested. This will be spiked into a separate LCS/D. Note: A spiking solution is not prepared at a lower concentration for reduced volume analysis.

iii. Add 1.0 mL of Mini APPIX Mix #1 (OP_MINAPP1_MS) if any analytes contained in Table II are requested. This will be spiked into a separate LCS/D.

iv. Add 0.25 mL of APPIX Mix #2 (OP_APPIX2_MS) if p-Phenylene diamine is requested. This will be spiked into the same LCS/D as APPIX Mix #1. Notes: APPIX Mix #2 will not be requested without APPIX Mix #1. A spiking solution is not prepared at a lower concentration for reduced volume analysis.

c. For the isotope dilution methods listed in Step 4, add 0.25 mL of 1,4-Dioxane LCS Spike (OP_1,4-D_MS).

d. For Dinoseb_ATP add 0.08 mL Mini APPIX #1 Spike (OP_MINAPP1_MS).

e. For methods 8270_SIMMCP, 8270_SIMRCP, 8270C_SIM, 8270D_SIM, 8270D_SIM_DKQP, 8270D_SIM_DOD5, 8270E_SIM paired with extraction method 3510C, add 1.0 mL of SIM spiking solution (OP_SIMLCS_MS).

f. For methods 8270_SIMMCP, 8270_SIMRCP, 8270C_SIM, 8270D_SIM, 8270D_SIM_DKQP, 8270D_SIM_DOD5, 8270E_SIM paired with extraction method 3510C_LVI, add 0.25 mL of SIM spiking solution (OP_SIMLCS_MS).

g. For methods 8270C_SIM_Alkyl, 8270D_SIM_Alkyl, 8270D_SM_Alk_D5 paired with extraction method 3510C, add 1.0 mL of Alkyl PAH spike (OP_ALK_PAH_MS).

h. If the sample requires analytes in addition to those found in the above mixes and in Tables I and II, add 1.0 mL (or 0.25 mL for 250-mL extractions) of the appropriate spiking solution.

NOTE: The standard must drip directly into the aqueous sample without touching the glass side of the separatory funnel to avoid poor recoveries.

8. Adjusting the pH of samples

a. See *T-OE-GEN-FRM23822* for instructions on checking the pH of samples.

b. For samples entered for analytical method Dinoseb_ATP, only the acid fraction is extracted. If samples are entered with a LabNote requesting 'reverse pH prep', or if the sample is acid-preserved, the acid fraction is extracted first, followed by the base-neutral fraction.

c. For all other analytical methods, the base-neutral fraction is extracted first.

9. Adjusting the pH of samples to >11 for 1 L extractions:

a. Add approximately 12 drops of 10 N sodium hydroxide to all batch QC and samples using a disposable Pasteur pipette. Swirl to mix.

b. Check the pH of samples using Hydrion 10 to 12 range pH paper or equivalent to check if pH of >11 has been attained.

c. If a pH of >11 is not observed, add approximately 6 to 7 drops of 10 N sodium hydroxide using a disposable Pasteur pipette. Swirl and re-check the pH with Hydrion 10 to 12 range pH paper or equivalent. See a supervisor if a pH of >11 is not achieved after repeating the 10 N sodium hydroxide addition five times. Note any issues in the LIMS batch for any samples that are difficult to pH adjust.

10. Adjusting the pH of samples to >11 for 250 mL extractions:

a. Add approximately 4 drops of 10 N sodium hydroxide to all batch QC and samples using a disposable Pasteur pipette. Swirl to mix.

b. Check the pH of samples using Hydrion 10 to 12 range pH paper or equivalent to check if pH of >11 has been attained.

c. If a pH of >11 is not observed, add approximately 2 to 3 drops of 10N sodium hydroxide using a disposable Pasteur pipette. Swirl and re-check the pH with Hydrion 10 to 12 range pH paper or equivalent. See a supervisor if a pH of >11 is not achieved after repeating the 10 N sodium hydroxide addition five times. Note any issues in the LIMS batch for samples that are difficult to pH adjust.

11. If the original sample bottle is empty:

    a. Use a solvent pump to measure 60 mL of methylene chloride for 1 L extractions (15 mL for 250-mL extractions).

    b. Rinse the sample bottle by adding the methylene chloride to the bottle. Swirl the bottle to rinse the interior of the bottle with methylene chloride.

    c. Transfer the solvent to the separatory funnel.

    d. Place the empty sample bottle, with the cap, on the scale.

    e. Record this weight in the LIMS as the tare weight. The initial weight is automatically calculated.

    f. If the sample container is not empty, use a solvent pump to measure 60 mL of methylene chloride (15 mL for 250 mL extractions) and add the solvent to the graduated cylinder or directly to the separatory funnel.

12. Cap the funnel, invert it, and vent immediately.

13. Handshake and vent frequently until the pressure is stable.

14. For 1 L extractions - Place the funnel on the automatic shaker and shake at the designated speed for 2 minutes with the stopcocks closed.
    For 250 mL extractions – Separatory funnels remain on the Automated Water Extraction bench. Press the green “start” button to lower the hood and activate the Automated Water Extraction Bench. The bench will tumble for 2 minutes. The sash will rise after the samples have tumbled.
    NOTE: Shaker speeds vary greatly between instruments; the proper setting is marked on each.

15. For 1 L extractions - Place the separatory funnel on the rack and allow it to sit undisturbed until the methylene chloride layer (bottom layer) has separated from the water.
    For 250 mL extractions - the separatory funnel will sit undisturbed on the Automated Water Extraction Bench.
    The time required for extracts to sit undisturbed is based upon visual confirmation that the layers are adequately separated.
    Additional time may be necessary for samples with unusually high density (i.e. high salt content).
    If an emulsion forms and is >1/3 of the volume of the solvent layer, mechanical techniques such as stirring and centrifugation must be employed to complete the separation.

16. For 1L extractions, drain the solvent layer into a metal beaker and pour it through approximately 10 cm (~4 inches) of sodium sulfate into a K-D apparatus containing Teflon™-boiling chips.
    For 250 mL extractions, drain the solvent layer directly into the sodium sulfate column containing approximately 5 cm of sodium sulfate (~2 inches). This drains into a Rapid-Vap evaporator tube.

17. Use a solvent pump to add 60 mL of methylene chloride (15 mL for 250 mL extractions) to the separatory funnel and repeat Procedure 14 through 16, venting only as necessary.

18. Use a solvent pump to add another 60 mL of methylene chloride (15 mL for 250 mL extractions) to the separatory funnel and repeat Procedure 14 through 16, venting only as necessary, a second time for the third of three methylene chloride extractions.

    NOTE: The acid extract is also added to this K-D (or evaporator tube for 250 mL extractions).

19. Adjusting the pH of samples to <2 for 1 L extractions:

    a. Add approximately 1 mL (1/2 full disposable Pasteur pipette) of concentrated sulfuric acid to all batch QC and samples using a disposable glass pipette. Swirl to mix.

    b. Check the pH of samples using Hydrion 1 to 2.5 range pH paper or equivalent to check if pH of <2 has been attained.

    c. If a pH of <2 is not observed, add approximately 10 to 11 drops of concentrated sulfuric acid using a disposable Pasteur pipette. Swirl and re-check the pH with Hydrion 1 to 2.5 range pH paper or equivalent. See a supervisor if a pH of <2 is not achieved after repeating the concentrated sulfuric acid addition six times. Note any issues in the LIMS for samples that are difficult to pH adjust.

20. Adjusting the pH of samples to <2 for 250 mL extractions:

    a. Add approximately 12 drops of concentrated sulfuric acid to all batch QC and samples using a disposable glass pipette. Swirl to mix.

    b. Check the pH of samples using Hydrion 1 to 2.5 range pH paper or equivalent to check if pH of <2 has been attained.

c. If a pH of <2 is not observed add approximately 3 to 4 drops of concentrated sulfuric acid using a disposable Pasteur pipette. Swirl and re-check the pH with Hydrion 1 to 2.5 range pH paper or equivalent. See a supervisor if a pH of <2 is not achieved after repeating the concentrated sulfuric addition six times. Note any issues in the LIMS for samples that are difficult to pH adjust.

21. After a pH of <2 has been attained: Using three 60-mL aliquots of methylene chloride (15 mL for 250 mL extractions), serially extract the sample as described in Procedure 14 through 16, venting only as necessary.

22. Collect the solvent in a K-D setup (or evaporator tube for the 250 mL extractions). For 1 L extractions, rinse the metal beaker with approximately 20 mL of methylene chloride and pour into the sodium sulfate column.

23. Use a wash bottle to rinse the sodium sulfate column with approximately 20 mL of methylene chloride (approximately 5 mL for 250 mL extractions).

24. For 1 L extractions:

a. Attach a 3-ball Snyder column to the K-D, wet with solvent, and concentrate the extract to approximately 2-mL on a steam bath at 80° to 90°C. At the proper rate of distillation, the balls of the column will actively chatter, but the chambers will not flood. Adjust the vertical position of the apparatus and the water temperature as needed to complete the concentration in 10 - 20 min. Allow the extracts to cool for approximately 10 minutes.

NOTE: This steam bath temperature ensures concentration in a reasonable length of time. Do not allow the ampule to go dry.

b. If extracting samples entered for client-requested analytical method Dinoseb_ATP, the extracts are methylated at this time. For all other extractions, proceed to step 24d. The methylation steps outlined below must be followed utilizing a hood containing no electrical appliances or steam baths. Additional heat and electrical hazards must be avoided. **Note:** In the case of limited availability of TMSD, the use of Diazomethane for esterification can be used. If using Diazomethane, skip step 24b and go to step 24c.

i. After allowing the 2-3 mL of extract to cool for 10 minutes, add 1 mL TMSD.

ii. Add 0.5 mL MeOH, mix with a Pasteur pipette, and let sit for 10 minutes.

iii. Quench with approximately 10 mg of silicic acid.

iv. Quantitatively transfer to a new ampule to remove the extract from the silicic acid.

v. Concentrate on N-evap nitrogen evaporator to bring the extract below 1 mL.

vi. The extract is quantitatively transferred from the ampule using a Pasteur pipette to a 2 mL amber autosampler vial using hexane. The final volume of 1 mL is quantified by comparing the extract auto sampler vial to a reference auto sampler vial containing exactly 1 mL of hexane.

vii. If too much solvent is added to the sample vial, the extract from the vial should be transferred back into the ampule. Concentrate on N-evap nitrogen evaporator to bring the extract below 1 mL. The previous step is then repeated to bring the extract to 1 mL.

viii. Cap the vial securely and store in the freezer at ≤-10°C.

ix. Record the final volume in the LIMS.

NOTE: TMSD is flammable and acutely toxic. Only open the container in a drawn hood. If the solution is spilled, leave the area immediately and contact safety. Wear gloves at all times during this procedure. Additional protection such as a safety shield is also recommended. All glassware used in this procedure must be taken directly to wash room personnel. Do not place it on a cart with other dirty glassware.

c. Set up diazomethane generator and esterify the extract as described below:

Safety precautions

i. Diazald is a carcinogen. **Wear gloves at all times during this procedure**.
ii. Perform esterification in a hood with the sash down. Additional protection, such as a safety shield, is recommended. **Avoid inhalation of diazomethane.**
iii. Avoid using etched or scratched glassware, ground glass joints, and glass stirrers - **EXPLOSION may result**.
iv. **To avoid explosion do not heat over 90°C.**
v. All glassware used in this procedure must be taken directly to wash room personnel, not placed on cart of dirty glassware.
vi. The generator must be set up in a hood containing no electrical appliances or steam baths. Additional heat and electrical hazard must be avoided.

Diazomethane Generator Procedure

i. Prepare the KOH solution.

Reagents must be mixed in the following order:

(a) Place 5 g of KOH in a 125-mL Erlenmeyer flask.
(b) Use a graduated cylinder to add 8 mL of reagent water and swirl to dissolve the KOH.
(c) **Allow the solution to cool.**
(d) Use a graduated cylinder to add 25 mL of reagent alcohol.
(e) Use a graduated cylinder to add 25 mL of ethyl ether.
(f) The amount of KOH solution needed depends on the number of samples extracted. One solution can be used for eight to ten samples. If more than ten samples are to be extracted, prepare a second solution for use during esterification.

ii. Fill 40-mL vials with ethyl ether for rinsing the generator between samples. Use 1 vial per 3 samples.

iii. Prepare the diazomethane solution under a hood and just prior to starting the procedure:

(a) Add approximately 3 g of diazald powder to each KOH solution.
NOTE: Add the diazald powder immediately before use.
(b) Clamp the Erlenmeyer in place.

iv. Fill a plastic beaker with warm water from the steam bath (not to exceed 80º to 85ºC for safety concerns using diazomethane) and hold under the Erlenmeyer containing the diazomethane solution. At the same time, hold a rinse vial of ethyl ether at the end of the generator.

v. When the rinse vial begins to turn yellow, remove the vial and begin placing samples at the end of the generator.

(a) Use a rinse vial to rinse the generator between samples.
(b) Be sure each sample turns bright yellow before going on to the next sample. This ensures that esterification is complete.
(c) If the yellow color does not persist in all of the samples after methylation is complete, remethylate the samples that are no longer yellow.

vi. After esterification, N-Evap the samples below 1 mL.

vii. The extract is quantitatively transferred from the ampule using a Pasteur pipette to a 1 mL amber autosampler vial using hexane. The final volume of 1 mL is quantified by comparing the extract auto sampler vial to a reference auto sampler vial containing exactly 1 mL of hexane.

viii. Cap the vial securely and store in the freezer at≤-10ºC.

ix. Record the final volume in the LIMS.

d. Attach a microsnyder to the ampule and concentrate on a steam bath to slightly below 1 mL.

e. The extract is quantitatively transferred from the ampule using a Pasteur pipette to a 2 mL amber autosampler vial using methylene chloride. The final volume of 1 mL is quantified by comparing the extract auto sampler vial to a reference auto sampler vial containing exactly 1 mL of methylene chloride.

f. If too much solvent is added to the sample vial, the extract from the vial should be transferred back into the ampule. A microsnyder is then attached to the ampule and the extract is concentrated on a steam bath to around 0.5 mL. The previous step is then repeated to bring the extract to 1 mL.

g. Cap the vial securely and store in the freezer at ≤-10°C.

h. Record the final volume in the LIMS.

25. For 250-mL extractions:

a. Place the evaporator tube containing the solvent extract into the pre-heated (approximately 80°C) Rapid-Vap Evaporator. Set the timer for 10 minutes and speed at 75% (the speed is the rotation within the unit while the sample is evaporating). After 10 minutes, rinse the tube with approximately 5-7 mL methylene chloride and set the timer for 10 more minutes. Confirm that the nitrogen is set at approximately 15 PSI (this is adjusted on the regulator attached to the nitrogen line). Allow samples to concentrate to around 0.5 mL.

NOTE: The temperature, timer, and speed settings can be adjusted as necessary to accommodate difficult sample matrices, etc.

b. The extract is quantitatively transferred from the evaporator tube using a Pasteur pipette to a 2 mL amber autosampler vial using methylene chloride. The final volume of 1 mL is quantified by comparing the extract auto sampler vial to a reference auto sampler vial containing exactly 1 mL of methylene chloride.

c. If too much solvent is added to the sample vial, the extract from the vial should be transferred back into the evaporator tube and concentrated on the rapid vap down to around 0.5 mL. The previous step should then be repeated to bring the

extract to 1 mL.

d. Cap the vial securely and store in the freezer at ≤-10°C.

e. Record the final volume in the LIMS.

Calculations

See analysis method.

Statistical Information/Method Performance

See analysis method.

Quality Assurance/Quality Control

A batch is defined as the samples to be extracted on any given day but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batch requirements, these must be followed instead.

Each extraction batch (up to 20 samples) must contain a method blank, a LCS, and an unspiked background sample, MS, and MSD. An LCSD is required if insufficient sample volume is submitted for a background/MS/MSD. If the batch contains only field or equipment blank samples, the LCS/LCSD QC pairing should be used.

QC limits for surrogates, LCS/LCSD, and MS/MSD are established through statistical analysis of historical data. The limits are evaluated as frequently as defined in the analytical method and updated as needed. The limits are maintained in the LIMS for the relevant analysis numbers.

Table I

LCS Mix #1 Reagent Analyte List

1,1'-Biphenyl
1,2,4,5-Tetrachlorobenzene
1,2,4-Trichlorobenzene
1,2-Dichlorobenzene
1,2-Diphenylhydrazine
1,3-Dichlorobenzene
1,3-Dinitrobenzene
1,4-Dichlorobenzene
1,4-Dioxane
1-Methylnaphthalene
1-Methylphenanthrene
2,3,4,6-Tetrachlorophenol
2,2'-oxybis[1-chloropropane]
2,3-Dichlorobenzeneamine
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dichlorophenol
2,6-Dinitrotoluene
2-Chloronaphthalene
2-Chlorophenol
2-Methylnaphthalene
2-Methylphenol
2-Nitroaniline
2-Nitrophenol
3,3'-Dichlorobenzidine
3-Methylphenol
3-Nitroaniline
4,6-Dinitro-2-methylphenol
4-Bromophenyl phenyl ether
4-Chloro-3-methylphenol
4-Chloroaniline
4-Chlorophenyl phenyl ether
4-Methylphenol
4-Nitroaniline
4-Nitrophenol
Acenaphthene
Acenaphthylene
Acetophenone
Alpha Methyl Styrene
Alpha-Terpineol
Aniline
Anthracene
Benzidine
Benzo[a]anthracene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[g,h,i]perylene
Benzo[k]fluoranthene
Benzoic acid
Benzyl alcohol
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-ethylhexyl) phthalate
Butyl benzyl phthalate
Carbazole
Chrysene
Dibenz(a,h)anthracene
Dibenzofuran
Diethyl phthalate
Dimethyl phthalate
Dimethylformamide
Di-n-butyl phthalate
Di-n-octyl phthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexadecane
icosane
Indene
Indeno[1,2,3-cd]pyrene
Isophorone
Naphthalene
n-Decane
n-Docosane
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine
n-Octadecane
n-Tetradecane
Octachlorostyrene
Pentachlorophenol
Phenanthrene
Phenol
Phenyl ether
Pyrene
Pyridine

Table II

APPIX Mix #1 Reagent Analyte List

1,3,5-Trinitrobenzene
1,4-Dinitrobenzene
1,4-Naphthoquinone
1-Chloronaphthalene
1-Naphthylamine
2,3,5,6-Tetrachlorophenol
2-Acetylaminofluorene
2-Naphthylamine
2-Picoline
2-Toluidine
3,3’-Dimethylbenzidine
3-Methylcholanthrene
4,4'-Methylene bis(2-chloroaniline)
4-Aminobiphenyl
4-Nitroquinoline-1-oxide
6-Methylchrysene
7,12-Dimethylbenz(a)anthracene
alpha,alpha-Dimethyl phenethylamine
Aramite, Total
Chlorobenzilate
Diallate
Dibenz[a,h]acridine
Dibenz[a,j]acridine
Dimethoate
Dinoseb
Disulfoton
Ethyl methanesulfonate
Ethyl Parathion
Famphur
Hexachloropropene
Isodrin
Isosafrole
Kepone
Methapyrilene
Methyl methanesulfonate
Methyl parathion
N-Nitro-o-toluidine
N-Nitrosodiethylamine
N-Nitroso-di-n-butylamine
N-Nitrosomethylethylamine
N-Nitrosomorpholine
N-Nitrosopiperidine
N-Nitrosopyrrolidine
o,o',o''-Triethylphosphorothioate
p-Dimethylamino azobenzene
Pentachlorobenzene
Pentachloroethane
Pentachloronitrobenzene
Phenacetin
Phorate
p-Phenylene diamine
Pronamide
Quinoline
Safrole, Total
Sulfotepp
Thionazin

10864 Glassware Cleaning for Organic Extractions
10876 Organic Extraction Standards Storage and Handling
11998 Semivolatile Spiking and Calibration Standards
13634 The Determination of 1,4-Dioxane by GC/MS using Isotope Dilution and Selective Ion Monitoring (SIM) by Method 8270C/D/E
23822 Instructions for Checking pH During Extraction Procedures
31758 Client Specific Methylphenols by Method 8270D in Water Using GC/MS
34848 Client Specific Dinoseb by 8270C in Water Using GC/MS
9252 Parent and Alkyl Substituted PAHs and Geochemical Biomarkers by 8270C/D/E SIM by GC/MS
9617 Semivolatile Organic Compounds by Method 8270D/E in Aqueous and Non-Aqueous Matrices using GC-MS
9623 Semivolatile Organic Compounds by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC/MS
9995 Semivolatiles in Waters and Soils by Methods 8270C/D/E SIM and 625.1 SIM by GC/MS

End of document

Version history

Version	Approval	Revision information	
17	30.OCT.2020		
18	25.FEB.2021		
19	22.JUL.2022		

eurofins	Always check on-line for validity. **Multi-Parameters in Solids and Waters by ManTech Multi-Parameter System**	Level: **Work Instruction**
Document number: **T-WC-WI11475**		
Old Reference: **1-P-QM-WI-9013112**		
Version: **16.1**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **08-OCT-2021**	Document users: **6_EUUSLA_Water Quality_24/48 Hour Analyst, 6_EUUSLA_Water Quality_24/48 Hour Verification**	Responsible: **5_EUUSLA_Water Quality_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I

Revision Log

	Revision: 16.1	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Personnel Training and Qualifications	Clarification	Added laboratory IDOC criteria
Table I	TNI2016	Removed additional CCV concentrations

	Revision: 16	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Scope	Method reactivation	Added acidity prep analysis
Reagents and Standards A.20.	Current Process	Removed lab preparation of EDTA
Apparatus and Equipment 3.	Method reactivation	Added step 3.
Calibration B. Calibration E.	Current process TNI2016	removed calibration process for 2340C Added percent error requirement and acceptance criteria

	Revision: 16	**Effective date:** This version
Section	**Justification**	**Changes**
Procedure I.B.	Method reactivation	Added acidity prep analysis
Calculation	Correction	Replaced 'mLs EDTA used' with 'A' and 'EDTA constant' with 'B.' Defined A and B. Clarified stoichiometry.
Quality Assurance / Quality Control	Clarification	Clarified that CCVs must be at or below the mid-point

Revision	15	**Effective Date:**	22.APR.2021
Section	**Justification**	**Changes**	
Revision Log	Formatting requirement	Removed revision logs up to the previous version	
Throughout document	Current process	Update to new LIMS	
Cross-Reference	Higher level documents are not required to be referenced	Removed QA-SOP-11880, *QA-SOP11188*, *QA-SOP11913*	
Scope / Reference	Deactivated analysis	Removed SM2340A, 13414(total acidity prep)	
Apparatus and Equipment 3.	Deactivated analysis	Deleted step 3.	
Calibration C, D, E	Current process	Added instructions to attach calibration data to the analytical batches	
Procedure I.B	Deactivated analysis	Removed total acidity prep instructions	
Calculation G.	Deactivated analysis	Deleted non-carbonate hardness calculation. Moved Un-ionized ammonia to G, correcting for the 2 H. calculations	

Reference

1. Standard Methods for the Examination of Water and Wastewater, Method 2310 B-2011.
2. Standard Methods for the Examination of Water and Wastewater, Method 2310 B-1997.
3. Standard Methods for the Examination of Water and Wastewater, Method 2320 B-2011.
4. Standard Methods for the Examination of Water and Wastewater, Method 2320 B-1997.
5. Standard Methods for the Examination of Water and Wastewater, Method 2340 C-2011.
6. Standard Methods for the Examination of Water and Wastewater, Method 2340 C-1997.
7. Standard Methods for the Examination of Water and Wastewater, Method 2510 B-2011.
8. Standard Methods for the Examination of Water and Wastewater, Method 2510 B-1997.
9. Standard Methods for the Examination of Water and Wastewater, Method 2550 B-2010.
10. Standard Methods for the Examination of Water and Wastewater, Method 4500-CO2 D-2011.
11. Standard Methods for the Examination of Water and Wastewater, Method 4500-F B-2011.
12. Standard Methods for the Examination of Water and Wastewater, Method 4500-F C-2011.
13. Standard Methods for the Examination of Water and Wastewater, Method 4500-F C-1997.
14. Standard Methods for the Examination of Water and Wastewater, Method 4500 H+ B-2011.
15. Standard Methods for the Examination of Water and Wastewater, Method 4500-H+ B-2000.
16. Standard Methods for the Examination of Water and Wastewater, Method 4500 NH3 B-2011.
17. Standard Methods for the Examination of Water and Wastewater, Method 4500 NH3 D-2011.

18. Standard Methods for the Examination of Water and Wastewater, Method 4500 NH3 D-1997.
19. Standard Methods for the Examination of Water and Wastewater, 8010 F-2015 (Table 8010:VI.)
20. Method 120.1, Methods for Chemical Analysis of Water and Wastes USEPA 600, rev 1982
21. Method 130.2, Methods for Chemical Analysis of Water and Wastes USEPA 600.
22. Method 150.1, Methods for Chemical Analysis of Water and Wastes USEPA 600.
23. Method 170.1 Methods for Chemical Analysis of Water and Wastes USEPA 600 rev 1974
24. Method 305.1, Methods for Chemical Analysis of Water and Wastes USEPA 600.
25. Method 305.2, Methods for Chemical Analysis of Water and Wastes USEPA 600.
26. Method 310.1, Methods for Chemical Analysis of Water and Wastes USEPA 600, rev 1974
27. Method 340.2, Methods for Chemical Analysis of Water and Wastes USEPA 600.
28. Method 350.3, Methods for Chemical Analysis of Water and Wastes USEPA 600.
29. Test Methods for Evaluating Solid Wastes, SW-846 Method 9040B.
30. Test Methods for Evaluating Solid Wastes, SW-846 Method 9040C.
31. Test Methods for Evaluating Solid Wastes, SW-846 Method 9050A, December 1996.
32. Test Methods for Evaluating Solid Wastes, SW-846 Method 9214.
33. ManTech Associates, Inc. PC-Titration Plus Instruction and Operation manual, January 25 2000.
34. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-WC-WI10425	Bellack Distillation for Fluoride in Waters and Solids by SM 4500-F B–1997 or EPA 340.1 Procedure 6.1
T-WC-WI11519	pH Probes and Meters
T-WC-WI10348	Fixed Volume Hand-Held Pipettes
T-WC-WI9897	Adjustable Volume Handheld Pipettes
T-WC-WI11585	Standardization of 0.02 Normal Sodium Hydroxide
T-WC-WI10362	Standardization of 0.02 and 0.1 Normal Sulfuric Acid
T-WC-WI10360	Quality Control Data for Wet Chemistry
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits

Scope

This SOP uses the ManTech Multi-Parameter System for sample analyses. The ManTech Multi-Parameter System is an instrument used for the determination of the following analytes (see table below) in drinking waters, surface waters, and wastewater samples.
The table below lists the name and LIMS ID number of the analyses that are included in this SOP and the method references associated with each.

Table of Analyses and Reference Methods

Analysis Name	LIMS ID	Analysis Method
Acidity to pH 3.7 and pH 8.3 (titrimetric)	305.2	EPA 305.2
Fluoride	340.2	SM 4500-F C-2011

	4500_F_C	SM 4500-F C-1997 EPA 340.2
Fluoride (distilled)	340.2_Dist 4500_F_B	SM 4500-F C-2011 SM 4500-F C-1997 EPA 340.2 SW-846 9214
Total Acidity	SM2310B 305.1	SM 2310 B-2011 SM 2310 B-199 EPA 305.1
Specific Conductance	2510B 120.1 9050A	SM 2510 B-2011 SM 2510 B-1997 EPA 120.1 SW-846 9050A
Total Hardness	2340C 130.2	SM 2340C-2011 SM 2340C-1997 EPA 130.2
Carbonate Alkalinity	2320B	SM 2320B-2011 SM 2320B-1997
Bicarbonate Alkalinity	2320B	SM 2320B-2011 SM 2320B-1997
Total Alkalinity	2320B 310.1	SM 2320B-2011 SM 2320B-1997 EPA 310.1
Temperature of pH	170.1 SM2550B	EPA 170.1, SM 2550B-2010
pH	SM4500_H+ 9040C 9040B	SM 4500-H+ B-2011 SM 4500-H+ B-2000 SW-846 9040B SW-846 9040C
pH	150.1	EPA 150.1
Ammonia-Nitrogen	SM4500NH3_D 350.3	SM 4500-NH3D-2011 SM 4500-NH3 D-1997 EPA 350.3
Ammonia-Nitrogen Distilled	SM4500NH3_D 350.3	SM 4500-NH3 D-2011 SM 4500-NH3 D-1997 EPA 350.3
Phenolphthalein Alkalinity	2320B 310.1	SM 2320B-2011 SM2320B-1997 EPA 310.1
Preparation /Calculations		**Method**
Free Carbon Dioxide	SM4500_CO2_D	SM 4500-CO2 D-2011
Hydroxide Alkalinity	2320B	SM 2320 B-2011, SM 2320 B-1997
Fluoride distillation	4500_F_B 340.2_Dist	SM 4500-F B-2011, SM 4500-F B-1997 EPA 340.1
Unionized Ammonia	SM8010F_NH4	SM 8010 F-2011 (Table 8010:VI)
Ammonia Distillation	SM4500NH3_B	SM 4500-NH3 B-2011 EPA 350.3
Total Acidity	SM2310B_Prep	SM 2310 B-2011 SM 2310 B-1997 EPA 305.1

Basic Principles

Samples are analyzed using the ManTech Multi-Parameter System, which has been designed to test for specific analytes. The system is able to be configured in different ways to optimize sample volumes required, and analysis times. The ManTech system is able to analyze for one parameter or multi-parameters at the same time.

Reference Modifications

The following analyses have reference modifications:

1. Method 2340C - Total Hardness:

a. The procedures listed in SM 2340C and Method 130.2 are modified by using potassium cyanide (KCN) as the inhibitor instead of sodium cyanide (NaCN).

b. SM2340C and EPA 130.2 state to dilute 25 mL of sample to 50 mL with reagent water prior to titration. This procedure uses 50 mL sample.

2. Method 4500_F_C, 340.2 – Fluoride and Distilled Fluoride
SM 4500-F-C states that the electrodes are inserted before stirring the sample. For EPA 340.2 begin stirring the sample before the electrodes are inserted.
3. Method SM4500NH#_D, 350.3 – Ammonia-Nitrogen and Distilled Ammonia-Nitrogen
Instead of using NaOH in order to pH adjust the samples during the ammonia analysis, this procedure uses alkaline reagent. Alkaline reagent is a purchased reagent containing NaOH that is currently recommended by the manufacturer of the ammonia electrode.

Interferences

Sample matrix is likely to be the largest cause of interference for each analysis.

Samples containing oily layers, soaps, suspended solids, or precipitates may impede the electrode response. The electrode must be cleaned according to the manufacturer's instructions.

Total Hardness – excessive amounts of heavy metals can interfere, causing a faded or indistinct endpoint by the stoichiometric consumption of EDTA. If this interference is not resolved after multiple dilutions on the ManTech automated procedure, then the sample must be analyzed using the manual procedure. See SM 2340C for more discussion on interferences and how to treat them.

Ammonia Nitrogen – volatile amines are a positive interference. Mercury and Silver also interfere with this procedure. Electrode responds slowly at levels <1 mg NH3-N/L; use longer electrode immersion times.

Fluoride – several polyvalent cations, notably aluminum, iron and silicon interfere by forming complexes with fluoride. Adding TISABIII provides a uniform ionic strength background, adjusts pH and breaks up complexes so that the fluoride ion activity can be measured. Fluoborates are widely used in industrial processes. At concentrated levels, as in electroplating wastes, fluoborates do not hydrolyze to release fluoride without using the Bellack distillation (Analysis 01448) prior to analyzing the sample distillate by ISE. SM 4500 F C-2011 1.b requires to distill fluoride if the Total Dissolved Solids concentration is greater than 10,000 mg/L.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Proficiency is measured through an Initial Demonstration of Capability (IDOC).

The IDOC consists of four aliquots spiked at 1-4X the RL that are carried through all steps of the procedure. The criteria include the calculation of mean accuracy of 50 - 150% and standard deviation of less than 20%.

The DOC consists of four laboratory control spikes (or alternatively, one blind sample for the DOC) that are carried through all steps of the procedure and meet the LCS acceptance criteria and standard deviation of less than 20%.

Sample Collection, Preservation, and Handling

Samples for pH and Temperature of pH are to be collected in unpreserved glass or plastic containers and analyzed as soon as possible upon receipt at the laboratory. Avoid sample agitation and prolonged exposure to air.

Samples for Total Alkalinity, Total Acidity, and Acidity to pH 3.7 and pH 8.3 are to be collected with minimum aeration and analyzed within 14 days of collection.

Samples for Specific Conductance and Fluoride are to be collected in unpreserved glass or plastic containers and analyzed within 28 days of collection.

Samples for Ammonia must be collected in a glass container, preserved with concentrated sulfuric acid to a pH < 2. Analyze within 28 days of collection.

Samples for Total Hardness must be collected in a glass or plastic container, preserved with nitric acid to a pH < 2. Analyze within 6 months of collection.

All samples must be stored at 0° to 6°C, not frozen. Prior to analysis, samples must be brought to room temperature.

Apparatus and Equipment

1. ManTech Multi-Parameter System instrument:

The instrument is equipped and programmed to analyze for pH, temperature of pH, alkalinity, acidity, conductivity, fluoride, ammonia and total hardness.

Each test can be performed individually or in tandem with others. The analyst will determine the combination of analyses for each run.

   a. pH Electrode

   b. Fluoride ion selective electrode

   c. Interface

   d. Burivar I/2 (25 mL burette)

   e. TitraRinse pump

   f. TitraRinse slow speed reagent addition pump

   g. Reversible Peri-Max pump

   h. ManTech photometric detector with a 620nm filter

   i. Conductivity/TDS Meter, Model 4510

   j Ammonia electrode

   k. Autosampler - MEGA, 197 sample locations

2. Ammonia Distillation LIMS ID SM4500NH3_B

   a. Kjeldahl distillation rack

   b. Refrigerated recirculator (Coolflow) with a recirculating pressure set at 20 psi and the temperature adjustment set at 10°C, or equivalent.

   c. Glass distillation apparatus with connector and 800 mL Kjeldahl flask

   d. pH indicator strips, purchased

   e. Porous boiling chips, purchased

   f. 500 mL class A graduate

   g. 400 mL (approx.) distillation collection cups

   h. 800 mL (approx.) sample collection cups

   i. Kjeldahl flasks

   j. 5 mL class A pipette

3. Total Acidity Preparation LIMS ID SM2310B_Prep

   a. pH meter with pH electrode and automated temperature compensator (ATC) probe that reads to 0.05 pH units

   b. Magnetic stir bar and stir plate

c. Hot plate

d. 150-mL glass beakers and plastic cups

Reagents and Standards

Alternative weights and volumes are acceptable as long as final concentrations remain the same.

A. Reagents and Standards needed for ManTech Analyses

1. Standardized Sulfuric acid, 0.02 N

   a. Dilute 0.6 mL of concentrated sulfuric acid to 1000 mL with reagent water.

   b. Store at room temperature in glass or plastic container and re-evaluate yearly.

   c. Standardize according to *T-WC-WI10362*.

   d. Re-standardize titrant before use if more than 30 days have passed since the last standardization date.

2. Sodium hydroxide, 10 N - Purchased; see container for shelf life information. Or prepare:

   a. Dissolve 400 ± 0.5 g NaOH pellets in 1000 mL volumetric flask containing approximately 800 mL reagent water. Solution becomes very warm.

   b. Cool to room temperature and dilute to 1000 mL with reagent water.

   c. Store at room temperature in plastic or glass container and re-evaluate yearly.

3. Sodium hydroxide, 1.0 N

   a. In a 1-L glass volumetric flask containing approximately 500 mL reagent water, dissolve 40.00 ± 0.05 g NaOH.

   b. Cool and dilute to volume.

   c. Store at room temperature in plastic or glass container and re-evaluate yearly.

4. Standardized Sodium Hydroxide, 0.02 N

   a. In a 1-L glass volumetric flask, add approximately 500 mL reagent water.

   b. Add 20 mL of 1 N NaOH to the flask and dilute to volume with reagent water.

   c. Store at room temperature in glass or plastic container and re-evaluate yearly.

   d. Standardize using instructions as per *T-WC-WI11585*.

   e. Re-standardize titrant before use if more than 30 days have passed since the last standardization date.

5. Total alkalinity standard (9400 mg/L as $CaCO_3$)

   a. Dry sodium carbonate (Na_2CO_3) for at least 4 hours at approximately 250°C.

   b. Desiccate approximately 2 hours.

   c. Dissolve 9.954g ± 0.002g Na_2CO_3 in reagent water and dilute to 1000 mL in a volumetric flask.

   d. Solution expires 3 months from the date of preparation.

   e. Store in a glass container at 0º to 6ºC, not frozen.

   f. Dilute for other concentrations.

6. pH 4, 7, and 10 buffer solutions- purchased; see container for shelf life information.

NOTE: A second source 7.00 pH buffer solution that is from ISO 17025 approved vendor must be purchased; see container for shelf life information. This is to be used for Methods SM4500_H+, 9040C, 9040B Laboratory Control Standard (LCS). It is also to be used for Methods SM4500_H+, 9040C, 9040B, 2320B and 310.1 Continuing Calibration Verification Standards (CCVs)

7. 1413 µhoms/cm cell constant; purchased. See container for shelf life information

8. 0.1 M KCl (12,900 µhoms/cm) [Solution I]

   a. In a 1 L glass volumetric flask, dissolve 7.4555 ± .0001 g predried KCl (2 hours at 105° ± 2°C) in approximately 500 mL reagent water.

   b. Dilute to volume with reagent water.

   c. Solution expires 3 months from the date of preparation.

   d. Store at room temperature in a glass or plastic

9. 0.01 M KCL (1413 µhoms/cm) [Solution II

   a. In a 1-L volumetric flask, dissolve 0.7456 ± 0.0001 g predried KCl (2 hours at 105° ± 2°C) in approximately 500 mL reagent water.

   b. Dilute to volume with reagent water.

   c. Solution expires 3 months from the date of preparation.

   c. Store at room temperature in a glass or plastic container.

10. 5 umhos/cm low-level check standard

    a. In a 1 L glass volumetric flask, containing approximately 500 mL reagent water, dissolve 0.0025 g of NaCl.

    b. Prepare fresh before use.

11. Fluoride standard stock solution (100 mg/L)

    a. Dissolve 0.2210 ± .0005 g of anhydrous sodium fluoride (NaF) in reagent water and dilute to 1000 mL in a volumetric flask.

    b. Stable for 6 months.

    c. Store in a plastic container at room temperature.

    d. Dilute for other concentrations.

NOTE: A separate standard fluoride stock solution must be prepared using a **different source of NaF** when preparing a calibration curve.

12. TISAB III, purchased. See container for storage conditions.

13. Ammonia nitrogen standard (100 m/L NH_3-N)

    a. Dry ammonium chloride (NH4Cl) at 103°C to 105°C for approximately 2 hours.

    b. Desiccate approximately 1 hour.

    c. Dissolve 0.3819 ± 0.0002 g NH_4Cl in approximately 800 mL reagent water.

    d. Once dissolved, preserve the solution with concentrated sulfuric acid to a pH < 2. Dilute to 1000 mL in a volumetric flask.

    e. Stable for 6 months.

    f. Store at 0º - 6º C, not frozen in a glass or plastic container.

    g. Dilute as needed for other concentrations.

    NOTE: The Ammonia nitrogen standard used to prepare the calibration curve must be prepared using a **different source** of NH4Cl.

14. Ammonia electrode storage solution- purchased. See container for shelf life information.

15. Standard EDTA titrant (0.02N) - Purchased; see container for shelf life information.

16. pH 10 hardness buffer solution – purchased; see container for shelf life information. Or prepare:

    a. Dissolve 16.9 g ammonia chloride (NH_4Cl) in 143 mL of concentrated ammonium hydroxide (NH_4OH).

b. Separately, dissolve 1.179 ± 0.0005 g of disodium EDTA and 0.78 ± 0.005 g of ($MgSO_4 \cdot 7\ H2O$) in 50 mL of reagent water (this solution becomes turbid).

c. Combine the above two solutions and dilute to 250 mL with reagent water in a volumetric flask.

d. Solution is stable 30 days.

e. Store at room temperature in plastic container.

17. Calmagite indicator solution (0.1 % w/v) – Purchased; Store at room temperature. See manufacturer's label for expiration date.

18. Calcium reference standard (1000 mg/L Ca = 2497 mg/L $CaCO_3$) – Purchased; store at room temperature. See manufacturer's label for expiration date.

19. 1000 mg/L $CaCO_3$ intermediate calcium standard

a. Pipette 20.0 mL of purchased reference standard into 50 mL volumetric flask and dilute to volume with reagent water.

b. Stable for 6 months.

c. Store at room temperature in glass or plastic container.

20. 15% w/v Sodium Acetate Solution – Add 85 mL of reagent water to a 150 mL beaker. Dissolve 15.0 g ± 0.01 g of sodium acetate anhydrous into the reagent water. Prepare fresh before use.

21. Total acidity standard (5000 mg/L as $CaCO_3$)

a. In a 1-L glass volumetric flask containing approximately 500 mL of reagent water; add 20.4000 ± 0.0005 g potassium hydrogen phthalate, dried at 120 degrees C for 2 hours. Cool in desiccator for approximately 1 hour.

b. Allow to dissolve and dilute solution to volume.

c. Store at 0°to 6°C, not frozen, in a glass container.

d. Solution expires 6 months from the date of preparation.

22. Hydrogen peroxide (H_2O_2, 30% solution) – purchased. Store at room temperature. See label for expiration date.

23. pH 8.00 buffer Solution; purchased. Store at room temperature. See container for shelf life information.

B. **Reagents needed for LIMS ID SM4500NH3_B – Ammonia distillation:**

1. Borate buffer solution – Dissolve 19.0 ± 0.1 g sodium borate, 10-hydrate ($Na_2B_4O_7 \cdot 10\ H_2O$) in approximately 1000 mL of reagent water. Add 176 mL of 0.1N NaOH to the solution and dilute to 2000 mL with reagent water in a volumetric flask. Store at room temperature in a glass container. Solution stable for 6 months.

2. 0.1N H_2SO_4 – Dilute 3.0 mL of concentrated sulfuric acid to 1000 mL with reagent water in a volumetric flask. Store at room temperature in a glass or plastic container and re-evaluate yearly.

3. 4% H_2SO_4 Solution – Dilute 380 mL of 0.1N H_2SO_4 to 1000 mL with reagent water in a volumetric flask. Store at room temperature in a plastic container and re-evaluate yearly.

4. Antifoam B; purchased. Store at room temperature. See manufacturer's label for expiration date.

5. Sodium hydroxide, 5N – Dissolve 200 ± 0.5 g sodium hydroxide (NaOH) pellets in approximately 800 mL of reagent water. Solution becomes very warm. Cool to room temperature and dilute to 1000 mL with reagent water in a volumetric flask. Store at room temperature in plastic container and re-evaluate yearly. (This is used to pH adjust samples.)

6. Sodium hydroxide, 0.1N – Dilute 40 mL of 5N NaOH solution to 2000 mL with reagent water in a volumetric flask. Store at room temperature in a plastic container and re-evaluate yearly. (This is used in borate buffer solution.)

7. Dilute Hydrochloric (HCl) acid – Add 50 mL of concentrated HCl to approximately 3.5 liters of reagent water. Slowly invert. Store at room temperature in a plastic container. (This is used to rinse tubing prior to steam cleaning the distillation apparatus.)

8. Ammonia-nitrogen standard, 500 mg/L NH_3-N – In a 1 L volumetric flask containing approximately 500 mL reagent water, dissolve 1.9095 ± .0002 g NH_4Cl (which has been dried at 105° ± 2°C for at least 2 hours). Dilute to 1 L using

reagent water. Preserve the solution with concentrated sulfuric acid to a pH <2. Store the standard at 0º to 6ºC, not frozen in a glass or plastic container. Standard expires 6 months from the date of preparation.

C. Standards Preparation Needed for Linearity Check for LIMS ID 2510B, 120.1 and 9050A

1. Prepare Solution I (12,900 µhoms/cm) and II (1413 µhoms/cm) as indicated above under the reagents and standards section.

2. Prepare the following 8 standards in 100-mL volumetric flasks using Solutions I or II as indicated in the table below. Bring to volume with reagent water. Prepare fresh before use.

Solution to use	Standard	mL of Solution	umhos/cm
Solution II	0.0001 M	1	14.94
Solution II	0.0005 M	5	73.9
Solution II	0.001 M	10	147
Solution II	0.005 M	50	717.8
Solution II	0.01 M	100	1,413
Solution I	0.02 M	20	2,767
Solution I	0.05 M	50	6,668
Solution I	0.1 M	100	12,900

Calibration

Calibration is performed daily. It is only necessary to calibrate for analyses that will be performed on that day.

Balances must be calibrated each day before use.

NOTE: For all calibrations, 50 mL of standard is poured into a sample tube. For each analysis, a predetermined and programmed sample volume is used (to be taken from the 50 mL in the sample tube).

NOTE: Recalibration is necessary for each analysis if acceptance criteria is not met.

A. LIMS ID 2510B,120.1, 9050A Conductivity Calibration

1. Determine cell constant daily:

   a. Place 1413 µhoms/cm calibration standard into autosampler rack.

   b. The ManTech instrument then rinses the conductivity cell with reagent water, followed by the calibration standard. The instrument reading stabilizes for 25 seconds.

   c. The meter prompts the analyst to press calibration key twice.

   d. The cell constant is displayed. Record cell constant in maintenance logbook.

2. Conductivity Meter Linearity Check:

   a. Linearity check of the conductivity meter must be performed on the instrument at least once per year using the following concentrations below. Refer to Reagents and Standards section A for preparation instructions.
   0 .0001M, 0.0005M, 0.001M, 0.005M, 0.01M, 0.02M, 0.05M, 0.1M

   b. Fill tubes with standards in accending order by concentration and schedule the Mantech instrument to perform conductivity on all the standards.

   c. Print out data from standards and keep in designated calibration folder for Conductivity.

   d. Correlation Coefficient must be = 0.995. If this acceptance criteria is not met, the linearity check must be repeated.

B. pH Calibration - Analyses that require pH calibration: LIMS ID# 305.2, SM2310B, 305.1, SM4500_H+, 9040C, 9040B, 2320B, 310.1

1. Place pH 4, 7, and 10 buffers into autosampler rack and run a schedule to calibrate pH electrode.

2. Sampler moves to rinse station where the sample transfer line and Titrasip vessel are rinsed with reagent water.

3. Sampler moves to pH 4 buffer position and sample transfer line is primed with pH 4 buffer solution.

4. 10 mL of buffer solution is pumped into Titrasip cell and stirrer is turned on.

5. pH of buffer solution is measured and recorded.

6. Steps b. to e. are repeated for pH buffers 7 and 10.

7. Acceptance criteria: Slope of pH calibration must be within the range of -54.0 to -60.0.mV for pH performed on the ManTech.

8. Record pH electrode ID, instrument ID, Employee ID, and date on calibration print out. Export and attach the calibration to the analytical batch in LIMS. Store in designated calibration folder for pH calibration sheets.

9. Immediately after calibration, analyze one of the pH buffers again. The result must be within ±0.1 pH units of the true value of the buffer.

C. LIMS ID 340.2, 4500_F_C Fluoride Calibration:

1. Curve:

a. Using the fluoride concentrations listed below, analyze a new calibration curve daily.

NOTE: When analyzing samples from the state of North Carolina, each analyst performing the analytical procedure must produce a standard curve (Ref 15A NCAC 2H .0805 (a) (7) (l)).

Concentration (mg/L)	mL Stock Standard (100 mg/L)	Final Volume (mL)
0.10	1	1000
0.50	5	1000
1.0	10	1000
1.5	15	1000
2.0	20	1000

NOTE: Before analyzing distillate batches from LIMS ID 4500_F_B or 340.2_dist, add 1 mL of 15% Sodium Acetate to all curve standards.

b. Place calibration standards 0.10, 0.50, 1.0, 1.5, 2.0 mg/L, into autosampler rack in ascending order and run a schedule to calibrate fluoride probe.

1.) Fluoride curves for distillate batches (from LIMS ID 4500_F_B or 340.2_dist), must have 1 mL of 15% of Sodium Acetate added to all curve standards.

c. Sampler moves to rinse station where sample transfer line and Titrasip vessel are rinsed with reagent water.

d. Sampler moves to first standard position.

e. Sample transfer line is primed with standard solution.

f. 30 mL of standard and 3 mL of TISAB is pumped into the Titrasip vessel, and stirrer is turned on.

g. Fluoride concentration is measured and recorded.

h. Steps c. – g. are repeated for remaining standards.

i. Acceptance criteria: The slope of the curve must be between -54.0 to -60.0 mV.

j. Record pH electrode ID, instrument ID, TISAB III lot number, calibration standards documentation, Employee ID and date on calibration print out. Store in designated calibration folder.

k. Export and attach the curve to the analytical batch in LIMS.

D. LIMS ID SM4500NH3_D, 350.3 Ammonia Calibration

1. Curve: Prepare a calibration curve daily using the concentrations listed below.

The curve must be analyst specific.

Conc. (mg/L NH3-N)	mL 100 mg/L ® 100 mL
0.1	0.1
0.5	0.5
2.5	2.5
5.0	5.0

10.0 10.0

a. Ensure electrode is filled to line with appropriate fill solution (NH4Cl).

b. Dilute stock standard to obtain the following concentrations: 0.1, 0.5, 2.5, 5.0, 10.0 mg/L and place calibration standards into the sampler rack in ascending order, and pH 4 buffer into dip rinse (second rinse) position.

c. Sampler moves to flowing rinse station where electrode is rinsed with reagent water.

d. Sampler moves to dip station and electrode remains immersed in pH 4 buffer for 15 seconds.

e. Sampler moves to flowing rinse station where electrode is rinsed again with reagent water.

f. Sampler moves to first calibration standard position and stirrer is turned on.

g. 0.45 mL of ISA (10 N NaOH) is added to sample to adjust pH to 11 or greater, ensuring all NH4 is converted to NH3.

h. Ammonia electrode is allowed to stabilize and reading is recorded.

i. Steps c. - h. are repeated for remaining calibration standards.

j. Acceptance criteria: The slope of the curve must be between -54.0 to -60.0 mV

k. Record pH electrode ID, instrument ID, Employee ID, and date on calibration print out. Store in designated calibration folder.

l. Export and attach the curve to the analytical batch in LIMS.

E. When linear fits are used, the % error is measured between the calculated and expected amounts to determine the calibration function acceptability. The % error must be ≤50% for the low calibration point and ≤30% for the mid-point of the calibration curve. This calculation is kept on file with the raw calibration data.

Procedure

I. Preparation Procedures: Ammonia Distillation

A. LIMS ID SM4500NH3_B - Ammonia Distillation (for use with LIMS ID SM4500NH3_D)

1. Before each distillation, rinse tubes with dilute HCl. Add approximately 500 mL of reagent water to an 800-mL Kjeldahl flask to steam clean the distillation apparatus.

2. Connect Kjeldahl flask to glass adapter and hose. Turn on the Coolflow. Turn on the temperature control and distill until approximately 150 mL of water is collected in the beaker at the bottom of the setup. Remove distillate from delivery tube immediately after turning off heat source to avoid back wash during the cool-down phase.

3. Measure 500 mL of sample (or an aliquot diluted to 500 mL with reagent water) using a Class A graduated cylinder. Pour into a beaker and adjust the pH of the sample to 9.5 with 5N NaOH. Check pH of adjusted sample with purchased pH strips to ensure the pH is 9.5, and then add 25 mL of borate buffer solution.

4. Transfer the solution to an 800-mL Kjeldahl flask. Add a pinch of boiling chips and approximately 5 mL of antifoam B to the solution. Connect flask to glass adapter and hose. Turn on the Coolflow.

5. Measure 50 mL of 4% H2SO4 solution into a 400-mL beaker. Make sure the delivery tube is below the level of the 4% H2SO4 solution (receiving solution).

6. Begin heating. Collect approximately 220 mL of distillate. Distill at a rate of 6 - 10mL/min. Turn off heat and immediately remove the distillate beakers from the delivery tube. Turn off the Coolflow.

7. Pour the distillate into a 500-mL Class A graduated cylinder and dilute to final volume of 500 mL with reagent water. Store distillate at 0°C - 6°C; not frozen, prior to analyzing

8. Analyze distillate for NH3-N according to Method SM4500NH3_D procedure.

B. LIMS ID SM2310B_Prep - Total Acidity Preparation (for use with LIMS ID SM2310B)

1. Calibrate the pH electrode prior to use. Refer to *T-WC-WI11519* for instructions on calibration.
2. Pour 100 mL of the sample into a 150-mL beaker. Read the initial pH of the sample and record the result.

3. If the pH is above 4.0, add standard sulfuric acid in 5 mL increments to lower the pH to 4.0 or less. If the initial pH is less than 4.0, addition of sulfuric acid is not required.

4. Add 5 drops of 30% H_2O_2 .

5. Heat the sample to boiling and boil for 3 minutes.

6. Cool the sample to room temperature. Analyze for Total Acidity, LIMS ID SM2310B.

II. ManTech Procedure:

NOTE: Before operating the analyst must ensure that all required reagents and reagent water containers needed for each test are in adequate supply and are not expired.

A. To operate the instrument, open the PC-titrate software menu from the computer desktop.

Each day before any analysis is performed; the daily calibration associated with each analysis must be completed and evaluated to ensure that the acceptance criteria are met. (See the calibration section for the required concentrations and acceptance criteria for each calibration). Daily calibration schedules are created and saved. If a specific analysis is not being performed that day, the calibration can be removed from the schedule for that day.

B. Performing daily calibration:

Open the daily start up tab and load the standards according to the schedule for each calibration. Click on the start button and the instrument will proceed with the calibration. Once the calibration is complete the calibration data is automatically sent to the assign printer and is printed. Ensure the calibration data meets requirements before proceeding. See the calibration section for the required concentrations and acceptance criteria for each calibration. Store calibration sheets in designated ManTech folders.

C. Analyzing samples:

NOTE: Before analyzing distilled fluoride samples (requiring Method 4500_F_C with 4500_F_B), add 1 mL of 15% of Sodium Acetate to all standards (including the curve), samples, and Blank.

NOTE: For Fluoride, the LCS must be at or below the Maximum Contaminant Level (MCL) when analyzing regulatory drinking waters.

NOTE: When referencing EPA 150.1, perform additional measurements on successive volumes of sample until the values differ by **less than** 0.1 pH units (two or three measurements are usually sufficient).

To analyze samples, select “Run titration” from the PC-titrate menu. A blank schedule will appear.

1. Click on the add row buttons to add the required number of rows for that run.

2. Double click on the blank space under the schedule header. The menu of analyses will appear. Select the analyses to be performed and click ok.

3. When completing the schedule, each analysis must be bracketed by its own Continuing Calibration Verification standard (CCV) of alternating concentrations and a Continuing Calibration Blank (CCB). The CCV’s and CCB’s ID’s are pre–programmed and are to be scanned in from the charts provided at each instrument. Barcodes are provided for each CCV and CCB. See Table I.

4. The Laboratory Control Standard (LCS) for each analysis is pre-programmed and is to be scanned in from the charts provided at each instrument. See Table I.

5. Scan the sample numbers directly from the label of the container. Sample numbers and QC identifiers can be typed. Use a "^" to designate the dilution factor. 410-12345-A-6^10 indicates a 10 times dilution.

6. Fill the sample tubes with Method Blank, LCS, each CCV, CCB and samples. Ensure the sample tubes are loaded according to the order on the schedule.

7. Click on the auto-generate order number to add the order number to the schedule.

8. Once the schedule is completed, click start and the instrument will proceed with the analysis until the entire schedule of samples is complete.

9. Save the data and send to the PC –Titrate export file before importing to the LIMS system.

10. Create PDFs of all calibrations and raw data associated with the batch. Attach the PDFs to the "Docs" tab in the batch in the LIMS.

D. Routine Maintenance of ManTech multi-parameter system

1. Calibration of Titrasip Pumps: Flow Rate Check:

a. Manual Control of Autosampler

(1) From the PC-Titrate main menu, click on Titrator, then on Manual Control (autosampler tab)

(2) Next, click on Load Tray From Folder button and then double click on Automax 197 Tube Sampler file

(3) Then, under Zone select tubes. Under Tubes select tube position and place a tube in that position on the autosampler tray.

(4) Click on Home Sampler

(5) Click on Go To This Location XYZ button. The autosampler will then move to the tube position.

(6) Click OK button in order to get back to the PC-Titrate main menu

b. Flow Rate Check:

(1) From the PC-Titrate menu select the pump to be calibrated (Click on Pump Cal button) and follow the prompts.

(2) Calibration must be performed monthly and documented in the maintenance logbook.

NOTE: When completed, Home sampler (follow instructions under II. ManTech Procedure D1a. steps 1-4)

2. Calibration of Zero and Span for the Hardness detector and monthly buffer volume check for Hardness Detector

NOTE: Turn on Hardness Detector in order for the detector to warm up before calibration.

NOTE: Ensure reagent water is in titration vessel cup containing the photo cell

a. Accessing Zero and Span Check screen and set-up:

(1) From the PC-Titrate main menu, click on Titrator, then on Manual Control

(2) Click on Analog

(3) Click on Scan Analog, making sure the continuous button is checked

(4) The Hardness Detector is on Monitor Electrode # 4

b. Zero Check/Calibration:

(1) Unscrew the Zero (careful not to look directly into the bright light). The Zero must be as close as possible to 0 mV.

(2) If not, adjust the screw for Zero on the hardness detector until reading is as close as possible to 0 mV.

(3) Check/Calibration must be performed monthly and documented in the maintenance logbook.

c. Span Check/Calibration:

(1) The Span reading must be -400 mV ± 25 mV.

(2) If not, adjust the screw for Span on the hardness detector until reading is within range.

(3) Check/Calibration must be performed monthly and documented in the maintenance logbook.

d. Monthly buffer volume check on Hardness Detector:

**Perform two trials:

(1) Place buffer dispenser titrant line into a 10 mL graduated cylinder.

(2) From the PC-titrate main menu, click on run titration.

(3) Following steps outlined in procedure section C above, schedule a vial of reagent water to be analyzed for Hardness and click on START.

(4) Once the buffer has been dispensed into the graduated cylinder, click on STOP on the computer screen.

(5) Record the amount of buffer solution collected in the graduated cylinder in the maintenance logbook for the instrument. Repeat steps 1-5 once more.

(6) Average two trials and record average result in maintenance logbook

(7) Acceptance criteria is 2.0 mL +/- 0.1 mL.

(8) If averaged amount falls outside the acceptance range, then repeat the buffer volume check. If the check fails again then seek guidance from supervisor.

3. Changing and Entering Acid Normalities on ManTech:

a. Changing Titrant –Purging titrant: Titrant must be changed each time a new stock of titrant is prepared.

NOTE: Disconnect acid titrant bottle from dispenser line

(1) Click on PC-Titrate, Titrator, Manual Control, Serial Devices

(2) Click on Burivar II TIS1 tab; Titrasip pump#1/Burette #1

(3) Purge Buret one time (empty cup-use manual button on side of pump #1 at the top of cup)

(4) Fill titrant bottle with new standardized 0.02N H2SO4 titrant and connect dispenser line to bottle

(5) Purge system two more times

(6) Click OK

b. Entering Acid Normalities: Acid Normalities must be updated in ManTech software each time the acid is standardized and the standardization yields a new normality.

(1) Click on PC-Titrate, Set-up, Titration Method, Load

(2) Click Alkalinity

(3) Under Titrant Information-Concentration, change Normality to current value.

(4) Click Save

(5) Click Alkalinity-Low and follow steps (3) and (4) above

E. Maintenance of all other systems:

1. Maintenance of the Ammonia Ion-Selective Electrode – See manufactures instruction manual for maintenance and operation of electrode

2. Maintenance of pH electrodes- refer to *T-WC-WI11519* for maintenance of pH electrodes

3. Perform Maintenance on all other systems as needed.

F. Retrieving Historical Raw Data on ManTech:

1. Find run number of sample in question.

2. Open PC-titrate software menu from computer desktop

3. Click on Titrator, Replay Titration, Load, Sort by order and sample name

4. Click on sample (go by time), Select, Print, Equation Result Report (rplyeqn.srw), Print.

Calculations

A. Fluoride, pH, Temperature of pH, Conductivity, and Ammonia are measured directly and therefore no calculations are needed.

B. Alkalinity: (LIMS ID 2320B, 310.1)

To pH of 8.3:

Alkalinity, mg/L CaCO3 = (mL of titrant pH 8.3) x Normality x 50,000) / mL of sample

To pH of 4.5:

Alkalinity, mg/L CaCO3 = (Total mL of titrant x Normality x 50,000) / mL of sample

C. Low Alkalinity (< 20 mg/L CaCO3):

[(2 X B - C) X N X 50,000] / mL of sample

where:
B = mL titrant to first pH
C = Total mL titrant to pH 0.3 units lower
N = Normality of 0.02 N H2SO4

D. Carbonate, Bicarbonate, and Hydroxide Alkalinity are calculated from the total alkalinity result and the phenolphthalein alkalinity value (LIMS ID 2320B)

Phenolphthalein Alkalinity Value	Bicarbonate Alkalinity Calculation	Carbonate Alkalinity Calculation	Hydroxide Alkalinity Calculation
< MDL	Total Alkalinity	< MDL	< MDL
< 1/2 x Total Alkalinity	Total Alkalinity - (2 x Phenolphthalein Alkalinity)	2 x Phenolphthalein Alkalinity	< MDL
= 1/2 x Total Alkalinity	< MDL	2 x Phenolphthalein Alkalinity	< MDL
> 1/2 x Total Alkalinity	< MDL	2 x (Total Alkalinity - Phenolphthalein Alkalinity)	(2 x Phenolphthalein Alkalinity) - Total Alkalinity
= Total Alkalinity	< MDL	< MDL	Total Alkalinity

E. Free Carbon Dioxide Calculation (LIMS ID SM4500_CO2_D)

The calculation assumes that the total alkalinity of the sample is due almost entirely to hydroxides, carbonates or bicarbonates.

The total dissolved solids of the sample may not be greater than 500 mg/L for this calculation.

mg/L CO2 = 2.0 x B x 10^(6-pH)

Where:
B = bicarbonate alkalinity (from LIMS ID 2320B)

NOTE: Total carbon dioxide can be calculated, if requested, according to the calculations found in SM 4500 CO2 D-2011

F. Total Hardness (LIMS ID 2340C, 130.2):

Hardness (EDTA) as mg $CaCO_{3/L}$ =

A x B x 1000 / mL of sample

where:
A = mL titration for sample
B = mg CaCO3 equivalent to 1.00 ml of 0.01 M EDTA titrant (B = 1.00088)

B is calculated as follows:

$$B = \left(\frac{0.01\ \text{mol}}{\text{L}}\right) \times \left(\frac{0.001\ \text{L}}{1}\right) \times \left(\frac{100.088\ \text{g}}{\text{mol}}\right)\left(\frac{1000\ \text{mg}}{\text{g}}\right)$$

B = (Molarity of titrant) x (1 mL of titrant) x (molecular weight of CaCO3)

G. Un-ionized Ammonia (LIMS ID SM8010F_NH4):

mg un-ionized ammonia/L = (ammonia nitrogen raw result mg/L) x (% un-ionized ammonia at a given pH and temperature)

Refer to table below for % un-ionized ammonia:

Table 8010: VI.
Percentage of Ammonia Un-ionized in Distilled Water*

Temp °C	Percentage Un-ionized at a given pH*								
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
5	0.01	0.04	0.11	0.40	1.1	3.6	10	27	54
10	0.02	0.06	0.18	0.57	1.8	5.4	15	36	64
15	0.03	0.08	0.26	0.83	2.6	7.7	21	45	72
20	0.04	0.12	0.37	1.2	3.7	11.7	28	55	80
25	0.05	0.17	0.51	1.7	5.1	14	35	63	84
30	0.07	0.23	0.70	2.3	7.0	19	43	70	88

*Prepared from data given in Sillen and Martell.

H. Total Acidity (LIMS ID SM2310B, 305.1)

$$\text{Acidity as mg / mL } CaCO_3 \quad \frac{[(A \times B) - (C \times D)] \times 50{,}000}{\text{mL of sample}}$$

Where:
A = Vol. of std. NaOH used in titration
B = Normality of std. NaOH
C = Vol. of std. H2SO4 used to reduce pH to less than 4
D = Normality of std. H2SO4

I. Acidity to pH 3.7 and pH 8.3 (LIMS ID 305.2)

mg/L as CaCO3 = (Normality)(50,000)(mL of titrant) / (mL of sample volume)

Statistical Information/Method Performance

The method detection limit (MDL) is determined annually by following the procedure outlined in *QA-SOP11892*.

The quality control acceptance windows are generated annually by following the procedure outlined in *QA-SOP11896*.

Quality Assurance/Quality Control

The batch size is limited to 20 samples or less. For analyses with more than 10 samples on a batch, two duplicates are needed (excluding ammonia and fluoride – only one duplicate is needed per batch 20 samples –unless a batch contains an NPDES sample(s) from South Carolina and the batch contains more than 10 samples, then two duplicates are needed).
A Laboratory Control Standard (LCS) must be analyzed for each analysis per batch. See Table I for each analysis LCS concentration.

For alkalinity, Total Acidity and total hardness one matrix spike (MS) must be analyzed per batch of 20 samples or less.

For ammonia, fluoride and Acidity to pH 3.7 and 8.3 (total acidity spikes only), a matrix spike (MS) and a matrix spike duplicate (MSD) must be analyzed per batch of 20 samples or less.

When sample volume does not permit the analysis of either a sample matrix duplicate or an MS and MSD, then a LCSD must be analyzed to demonstrate method precision.

For Fluoride, pH, Ammonia by ISE, and specific conductance a Certified Reference Material (CRM) must be analyzed annually. The acceptance range for the CRM is 90% to 110% of the true value.

Total Acidity samples with results > 600 mg/L as CaCO3 must be diluted and reanalyzed.

Samples from West Virginia require a usable precision measurement for each batch.

Analyzing one of the following on a batch containing a West Virginia sample fulfills this requirement: an MS/MSD, a non-program deleted duplicate, or an LCSD.

For Specific Conductance, if the batch contains samples from the state of North Carolina a low-level check standard of 5 umhos/cm NaCl must be analyzed.

For Total Hardness, samples that are designated NPDES require digestion. Confirm whether this analysis is appropriate for samples designated NPDES.

For Fluoride, the LCS must be at or below the MCL when analyzing regulatory drinking waters.

For each analysis, a continuing calibration verification (CCV) standard must be analyzed at the beginning of each batch, after every 10 samples and at the end of each batch. The concentration of the CCV must at or below the mid-point of the calibration. All CCVs must have an acceptance criteria of 90% to 110%. If any CCV's are outside this range, then the samples bracketed by the out of specification CCV must be repeated. Refer to Table I for CCV concentrations for each analysis.

A continuing calibration verification blank (CCB – a reagent water blank) must be analyzed after each CCV standard on the batch. The CCB must be less than the LOQ for the analysis.

See LIMS for current quality control (QC) acceptance windows. Follow guidelines in *T-WC-WI10360* for outlier QC data.

Table I

Analysis Name and Number	CCV Barcodes/Concentrations	Frequency	Acceptance Criteria
(2320B, 310.1) Total Alkalinity Carbonate Bicarbonate	CCVPH2 = 7.00 pH buffer (ISO 17025 approved) LCSAK = 188 mg/L LCSPH = 7.00 pH buffer (ISO 17025 approved) PBW = Method Blank CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
SM2310B, 305.1 Total Acidity	CCVPH8 = 8.00 pH buffer LCSHACD = 250 mg/L PBW = Method Blank CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
305.2 Acidity to pH 3.7 and pH 8.3	CCVPH8 = 8.00 pH buffer LCSACD = 250 mg/L PBW = Method Blank CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
SM4500_H+, 9040C, 9040B, 150.1 pH Temperature of pH SM2550B, 170.1	CCVPH2 = 7.00 pH buffer (ISO 17025 approved) LCSPH = 7.00 pH buffer (ISO 17025 approved) CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
2510B, 120.1, 9050A Specific Conductance	CCVSC2 = 1413 umhos/cm LCSSC = 147 umhos/cm PBW = Method Blank CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
4500_F_C, 340.2 Fluoride	CCVFL2 = 1.0 mg/L LCSFL = 1.0 mg/L PBW = Method Blank CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
SM4500NH3_D 350.3 Ammonia Distilled Ammonia	CCVNH2 = 2.5 mg/L LCSNH = 5 mg/L PBWNH = Method Blank (12679-distilled) PBW = Method Blank (12677) CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows
2340C, 130.2 Total Hardness	CCVTH2 = 40 mg/L LCSTH = 40 mg/L PBWTH = Method Blank CCB = reagent water blank	CCV/CCB - beginning/end of batch, after every 10 samples	CCVs ±10% of true value PBW/CCBs <LOQ LCS - see LIMS for current QC acceptance windows

10348 Fixed Volume Hand-Held Pipettes
10360 Quality Control Data for Wet Chemistry
10362 Standardization of 0.02 and 0.1 Normal Sulfuric Acid
10425 Bellack Distillation for Fluoride in Waters and Solids by SM 4500 F B-2011, EPA 340.1 Procedure 6.1 or SM 4500 F B-1997
11188 Reagents and Standards
11519 pH Probes and Meters
11585 Standardization of 0.02 Normal Sodium Hydroxide
11880 Laboratory Equipment Verifications - Balance, Syringe, Pipette, Weights, and Other Equipment
11892 Determining Method Detection Limits and Limits of Quantitation
11896 Establishing Control Limits
11913 Laboratory Notebooks, Logbooks, and Documentation
9862 Accumet Model AB30 pH/Ion/Conductivity Meter
9897 Adjustable Volume Handheld Pipettes
9898 Calibration of Hach 2100AN Turbidimeter

End of document

Version history

Version	Approval	Revision information	
15	22.APR.2021		
16	04.OCT.2021		
16.1	06.OCT.2021		

eurofins	Always check on-line for validity. **Colorimetric Sulfide in Waters, Sulfide as H2S, Dissolved Sulfide in Waters by 4500-S2 D-2011, 4500-S2 H-2011, or EPA 376.2**	Level: **Work Instruction**
Document number: **T-WC-WI11483**		
Old Reference: **1-P-QM-WI-9011642**		
Version: **20**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **08-OCT-2021**	Document users: **6_EUUSLA_Water Quality_Misc Analysis, 6_EUUSLA_Water Quality_Misc Verification**	Responsible: **5_EUUSLA_Water Quality_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Reagents for Standardization of Sulfide Standard Intermediate Solution
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision:	20	**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout Document	Not in use Not required - manual process		Removed all references to Thermo Fisher Gallery Discrete Analyzer Removed references to ICB/CCBs
Definitions	Not required		Removed 3. ICV
Personnel Training and Qualifications	Clarification		Added specific criteria
Apparatus and Equipment 4.	Common equipment not required to be listed		Removed 4. Analytical balance

Revision:	20	**Effective Date:**	This version
Reagents and Standards 12 and 13	not in use		Removed reagents 12 and 13. Used for Gallery Discrete Analyzer
Calibration	Enhancement		Added percent error requirement
Calibration E.7.	Correction		Changed = to ≥
Calibration E.8-9.	Not in use		Deleted steps
Procedure B.1.d.(3).	Not required		Removed 1.5mg/l CCV
Procedure B.1.e	Not required - manual process		Removed step e. ICB/CCBs
Procedure B.9.	Not in use		Deleted step
Calculation B.2.c	Reflect current process		Added procedure for samples with conductivity greater than 50,000 umhos/cm
Quality Assurance/ Quality Control	Clarification		Clarified CCV requirement is at or below midpoint of the calibration curve Removed obsolete NC requirement for RLV standard.

Revision:	19	**Effective Date:**	23-FEB-2021
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout Document	Current version		Updated with LIMS method codes
Interferences	Method reference		moved Procedure A.1. to Interferences, added statement that this is not acceptable for SC compliance samples.
Procedure	Data is entered into LIMS		Removed first sentence requiring recording raw data in logbook

Reference

1. *Standard Methods for the Examination of Water and Wastewater*, Method 4500 S2 D-2011.

2. *Standard Methods for the Examination of Water and Wastewater*, Method 4500-S2 H-2011.

3. *Standard Methods for the Examination of Water and Wastewater*, Method 4500-S2 B-2011. (flocculation for dissolved sulfide analysis)

4. *Standard Methods for the Examination of Water and Wastewater*, Method 4500-S2 F-2011. (iodometric method for standardization of sulfide)

5. Method 376.2, *Methods for the Chemical Analysis of Water and Wastes*, USEPA 600.

6. Method 376.1, *Methods for the Chemical Analysis of Water and Wastes*, USEPA, 600.

7. *Standard Methods for the Examination of Water and Wastewater*, Method 4500 S2 D-2000.

8. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-WC-WI10352	Spectronic Genesys 2 and Genesys 10 Vis Spectrophotometers
T-WC-WI10348	Fixed Volume Hand-Held Pipettes
T-WC-WI9897	Adjustable Volume Handheld Pipettes
T-WC-WI10360	Quality Control Data for Wet Chemistry

Scope

The colorimetric sulfide method is applicable to the measurement of total and dissolved sulfides in drinking, surface, and saline waters and domestic and industrial wastes. The procedure is applicable at sulfide concentrations between 0.1 and 20 mg/L.

Method SM4500_S2_H is used to determine the amount of sulfide as H2S in fresh or salt waters.

Basic Principles

Sulfide reacts with dimethyl-*p*-phenylene diamine in the presence of ferric chloride to produce methylene blue. Diammonium hydrogen phosphate is added after color development to remove the ferric chloride color. The methylene blue dye is read either on a manual spectrophotometer at a wavelength of 625 nm or on an automated analyzer. The concentration of sulfide is calculated by comparison to a standard curve.

Reference Modifications

SM 4500-S2 D-2011 recommends a 664 nm wavelength. The analyses in this SOP using the 625 nm wavelength meet the method QC requirements. The 625 nm wavelength is recommended by EPA Method 376.2.

Definitions

1. Calibration Blank – reagent water to which all reagents, **except the color indicator reagent**, are added in the same proportions as samples.

2. Method Blank (May also be called a reagent blank) – reagent water that is carried through the same analytical procedure as samples, and to which **all reagents** are added in the same proportions as samples.

Interferences

Oxygen inadvertently added to the sample may volatilize the sulfide so samples for sulfide analysis must be collected with a minimum of aeration.
Interfering substances such as sulfite, thiosulfate, iodide, and other soluble substances are removed with the addition of zinc acetate to form the precipitate, zinc sulfide.

Sample color and turbidity also may interfere. Correct this by running sample blanks.

Sample Preparation Before Analysis to remove interferences (**Note - this is not acceptable for South Carolina compliance samples**):

1. If the sample bottle contains headspace, mark the volume of the sample with a line.

2. After the precipitate settles out and a clear liquid phase is **visible**, siphon down to the precipitated area (being careful not to pull any of the zinc sulfide precipitate out). The sample may be settled, decanted and refilled a second time if the interferences are high.

3. Refill to the original sample volume mark with reagent water. Resuspend the precipitate before withdrawing a portion for analysis.

4. Sample is no longer considered preserved and must be analyzed as soon as possible.

5. Samples without a visible precipitate layer are analyzed without this pretreatment step.

6. Proceed to Procedure A.

NOTE: Removing the supernatant and replacing the sample volume with reagent water in this manner eliminates many interferences.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Use caution when handling any chemicals, solvents, or reagents. Avoid inhalation and skin contact. Standard safe laboratory procedure must be followed as outlined in the Chemical Hygiene Plan.

NOTE: Adding acid to samples that may contain high concentrations of sulfide must be done in a well-ventilated area to protect laboratory staff from accidental exposure to hydrogen sulfide gas.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Proficiency is measured through an Initial Demonstration of Capability (IDOC).

The IDOC consists of four aliquots spiked at 1-4X the RL that are carried through all steps of the procedure. The criteria include the calculation of mean accuracy of 50 - 150% and standard deviation of less than 20%.

The DOC consists of four laboratory control spikes (or alternatively, one blind sample for the DOC) that are carried through all steps of the procedure and meet the LCS acceptance criteria and standard deviation of less than 20%.

Sample Collection, Preservation, and Handling

Samples for total sulfide must be collected in a glass container with minimum aeration.
Preserve with 0.2 ml of 2N zinc acetate per 100 ml of sample. Preserve with sodium hydroxide (NaOH) to a pH of at least 9. Fill bottle completely and stopper. Refrigerate at 0° to 6°C, not frozen, and analyze within 7 days of collection.

Apparatus and Equipment

1. Spectrophotometer for use at 625 nm with 1-cm cell or equivalent. Refer to *T-WC-WI10352*.
2. Test tubes with screw type lids or equivalent
3. Automatic pipettes. Refer to *T-WC-WI9897*.
4. Class A burette with burette stand (50 ml capacity with 0.1 ml graduations)

Reagents and Standards

Alternate weights and volumes are acceptable as long as final concentrations remain the same.

1. 1+1 sulfuric acid

   a. In a glass beaker, slowly and carefully add 250 mL of concentrated sulfuric acid (H2SO4) to slowly stirring 250 mL of reagent water.

   b. Solution becomes very hot. Allow time to cool.

   c. Store in a glass bottle at room temperature and re-evaluate yearly.

2. Amine-Sulfuric Acid Stock Solution, for Sulfide Determination (Methylene Blue method) (27% w/v N,N-dimethyl-*p*-phenylene diamine oxalate)

NOTE: Currently this reagent is not used. The Amine-Sulfuric Acid working reagent is purchased instead, making the stock solution unnecessary.

If needed, stock solution may be purchased and stored per manufacturer's instructions, or prepared as follows:

a. Add 50 mL of concentrated H_2SO_4 slowly and carefully to 20 mL of reagent water.

b. After solution has completely cooled, dissolve 27.0 ± 0.5 g N,N-dimethyl-*p*-phenylene diamine oxalate in this solution.

c. Cool and dilute to 100 mL with reagent water in a volumetric flask.

d. Store in amber glass bottle at room temperature.

e. Stable 1 year. (When this stock solution is diluted and used in the procedure, the reagent blank will first be pink and then turn colorless within 3 minutes. If this doesn't happen, discard reagent and remake with fresh oxalate.)

3. Amine-sulfuric acid working reagent (0.68% w/v N,N-dimethyl-*p*-phenylene diamine oxalate)

a. Purchased, see manufacturer's label for expiration date.

b. Or to prepare:

(1.) Dilute 2.5 mL amine-sulfuric acid stock solution to 100 mL with cooled 1+1 H_2SO_4 in a volumetric flask.

(2.) Store in an amber glass bottle at room temperature.

(3.) Stable 6 months.

4. Ferric chloride solution

a. Dissolve 100.0 ± 0.5 g $FeCl_3 \cdot 6H_2O$ in approximately 40 mL of reagent water.

b. Store in an amber glass bottle at room temperature.

c. Stable 6 months.

5. Diammonium hydrogen phosphate solution

a. Dissolve 250.0 ± 0.5 g $(NH_4)_2HPO_4$ in approximately 500 mL of reagent water.

b. Store in glass bottle at room temperature.

c. Stable 6 months.

6. Sulfide standard stock solution

a. Dissolve 3.75 ± 0.01 g $Na_2S \cdot 9H_2O$ in reagent water and dilute to 500 mL in a volumetric flask.

b. Crystals may have excess water on the surface or a layer of contamination from oxidation products. They may be rinsed and blotted dry before weighing.

c. Concentration of solution is approximately 1000 mg/L.

d. Avoid excess agitation to limit introducing oxygen to the standard

e. Store in glass at 0° to 6°C, not frozen

f. Stable 7 days.

NOTE: A separate source of Na2S·9H2O must be used when preparing the sulfide standard stock solution used for the calibration curve.

7. 2N zinc acetate solution – Purchased. Store at room temperature. See manufacturer's label for expiration date. Used to prepare intermediate sulfide solution.

8. 5N sodium hydroxide solution (NaOH)

a. Dissolve 200 ± 1 g of NaOH in approximately 800 mL of reagent water.

b. Stir well with stir bar. (Solution will get very warm.)

c. Dilute to 1000 mL in a volumetric flask.

d. Store at room temperature and re-evaluate yearly. Used to prepare sulfide standard intermediate solution.

9. Sulfide standard **intermediate** solution

a. Pipette 20.0 mL of sulfide stock solution into approximately 800 mL of reagent water in a 1000-mL volumetric flask.

b. Preserve with NaOH to a pH >9 and add approximately 3 mL of purchased 2N zinc acetate solution.

c. Dilute with reagent water to 1000 mL.

d. Prepare fresh and standardize daily. (Concentration of solution is approximately 20 mg/L). Used as spiking solution.

10. 5-mg/L Sulfide working standard:

Where:

X = mL of standardized intermediate sulfide solution (diluted to **200 mL** with reagent water in a volumetric flask) needed to obtain a sulfide working standard solution equal to 5 mg/L concentration.

$$X = \frac{1000}{mg/L\ actual\ concentration\ of\ intermediate\ sulfide\ solution}$$

NOTE: 5 mg/L sulfide working standard must be prepared fresh daily.

11. 6N aluminum chloride solution – Purchased, or equivalent. Store at room temperature. See manufacturer's label for expiration date. Used for dissolved sulfide sample preparation.

Reagents for Standardization of Sulfide Standard Intermediate Solution

1. Hydrochloric acid (1+1)

a. Mix equal portions of concentrated hydrochloric acid (HCI) and reagent water.

b. Store at room temperature and re-evaluate yearly.

2. Starch indicator – Purchased. Store at room temperature. See manufacturer's label for expiration date.

3. Potassium iodide (KI) crystals – Purchased. Store at room temperature and re-evaluate yearly.

4. 0.025N potassium bi-iodate

   a. Dry KH(IO3)2 for at least 2 hours at 104° ± 1°C and cool approximately one hour in a desiccator.

   b. Dissolve 0.8124 ± 0.0002 g KH(IO3)2 in reagent water and dilute to 1000 mL in a volumetric flask.

   c. Store in amber glass bottle at room temperature.

   d. Stable 1 year.

5. 0.1N sodium thiosulfate – Purchased. Store at room temperature. See manufacturer's label for expiration date.

6. 0.025N sodium thiosulfate (Na2S2O3)

   a. Dilute 250 mL of 0.1N Na2S2O3 (purchased) to 1000 mL with reagent water.

   b. Hold time is determined by manufacturer's expiration date for 0.1N Na2S2O3.

   c. Store at room temperature.

   d. Standardize weekly against 0.025N potassium bi-iodate.

7. 0.025N iodine solution

   a. Dissolve 20 to 25 g KI in approximately 800 mL of reagent water and add 3.20 ± 0.05 g iodine.

   b. Allow plenty of time to dissolve and then dilute to 1000 mL with reagent water in a volumetric flask.

   c. Stable 1 year.

   d. Store in amber glass bottle at room temperature.

   e. Standardize weekly against 0.025N sodium thiosulfate.

Calibration

A. Balances must be calibrated each day before use.

B. Pipettes must be checked for accuracy daily.

C. Spectrophotometer must be calibrated as per *T-WC-WI10352*.

D. Standardization:

Record all standardization in the solution standardization logbook.

1. 0.025N Sodium thiosulfate

   a. Dissolve approximately 2.0 g KI in an Erlenmeyer flask with approximately 150 mL reagent water. Add a few drops of concentrated H2SO4. Swirl.

   b. Add by pipette 20 mL of 0.025N potassium bi-iodate.

c. Dilute to approximately 200 mL with reagent water. Immediately titrate the liberated iodine with 0.025N Na2S2O3 titrant to a pale yellow color.

d. Add a few drops of starch solution and titrate to the first colorless endpoint.

e. Perform duplicate trials and average the results.

$$Na_2S_2O_3N = \frac{(20mL KH(IO_3)_2) \times (0.025N\, KH(IO_3)_2)}{mL\ of\ sodium\ thiosulfate\ titrated}$$

2. 0.025N Iodine

a. Pipette 10 mL of 0.025N iodine solution into an Erlenmeyer flask.

b. Add approximately 90 mL of reagent water.

c. Titrate immediately with the Na2S2O3 (previously standardized) to a pale yellow color.

d. Add a few drops of starch solution and titrate to the first colorless endpoint.

e. Perform duplicate trials and average the results.

$$IodineN = \frac{(mL\ of\ Na_2S_2O_3\ titrated)\ (standardized\ normality\ of\ Na_2S_2O_3)}{10.0\ mL\ iodine\ solution}$$

3. 20-mg/L intermediate sulfide solution

Add reagents to the Erlenmeyer flask in this order to ensure no sulfide gas is liberated before the titration is performed.

a. Pipette 10 mL of iodine solution (previously standardized) into an Erlenmeyer flask.

b. Add approximately 10 mL of reagent water and approximately 2 mL of 1+1 HCI.

c. Pipette 100 mL of well-mixed, precipitated 20-mg/L intermediate solution into the flask, discharging it under solution surface. Swirl.

d. Titrate immediately with Na2S2O3 (previously standardized) to a pale yellow color.

e. Add a few drops of starch solution and titrate to the first colorless endpoint.

f. Perform duplicate trials and average the results.

Standardization Calculation:

mg/L sulfide = [(A x B) - (C x D)] x 16000 **/** 100 ml of standard

Where:

A = mL of iodine solution
B = Normality of iodine solution

C = mL of $Na_2S_2O_3$ solution
D = Normality of $Na_2S_2O_3$ solution

E. Curve (zero spectrophotometer with calibration blank)

The % error is measured between the calculated and expected amounts to determine the calibration function acceptability. The % error must be ≤50% for the low calibration point and ≤30% for the mid-point of the calibration curve. This calculation is kept on file with the raw calibration data.

1. Prepare a calibration curve every 3 months or when a new reagent is prepared using the sulfide concentrations listed below. Include a reagent blank as part of the curve. Alternate volumes are acceptable as long as the final concentrations remain the same.

Concentration (mg/L)	mL of 5-mg/L standard (diluted to a final volume of 100 mL)
0.00	0 (reagent blank)
0.10	2
0.50	10
1.00	20
1.50	30
2.00	40

2. Zeroing the spectrophotometer with a calibration blank:

a. Prepare a calibration blank by pipetting 7.5 mL of reagent water into a 10 mL test tube.

b. Add by pipette, 0.5 mL of 1+1 H_2SO_4 and 0.15 mL (3 drops) ferric chloride solution. **Mix immediately by inverting slowing only one time**. Wait 3 to 5 minutes for color development.

c. Add by pipette 1.6 mL diammonium hydrogen phosphate solution to test tube. Slowly invert test tube 3 times. Wait 10 minutes for color development.

d. Zero the spectrophotometer with the calibration blank **at 625 nm using a 1 cm cell.**

3. Pipette 7.5 mL of each standard curve point into a 10 mL test tube.

4. To test tubes, add by pipette, 0.5 mL of amine-sulfuric acid working reagent and 0.15 mL (3 drops) ferric chloride solution. **Mix immediately by inverting slowing only one time**. Mixing too vigorously causes low results by releasing hydrogen sulfide gas before it has had time to react. Presence of sulfide will be indicated by the development of blue color. Wait 3 to 5 minutes for complete color development.

5. Add by pipette 1.6 mL diammonium hydrogen phosphate solution to each test tube. Slowly invert test tube 3 times. Wait 10 minutes.

6. Read absorbance on spectrophotometer **at 625 nm using a 1-cm cell**.

7. Plot calibration curve of mg/L sulfide concentration vs. absorbance using least squares fit. The correlation coefficient of the curve must be ≥ .995.

Procedure

A. Sample Preparation:

1. Prepare samples with method SM4500S2_B for **soluble (dissolved) sulfide** in the following manner:

NOTE: If sample is entirely free from visible suspended solids, dissolved sulfide equals total sulfide. This means the sample is analyzed without the following pretreatment step.

a. Fill the bottle with sample (pH adjusted to >9 with NaOH) and add approximately 4 drops(0.2mL) of 6N aluminum chloride solution.

b. Rotate back and forth about a transverse axis vigorously for 1 minute or longer to flocculate contents.

c. Vary the amounts of aluminum chloride and NaOH, if needed, to get good clarification without using excessively large amounts and to adjust the pH to between 6 and 9.

d. Let settle until a reasonably clear supernatant is visible.

e. Analyze supernatant as soon as possible.

B. Sample Analysis

1. QC Preparation Instructions

a. Method blank - analyze 7.5 ml of reagent water.

b. Analyze 7.5 ml of the 1 mg/l sulfide LCS/CCV standard for the LCS(D).

c. Prepare the MS and MSD by spiking 7.5 ml of sample with 0.2ml of the intermediate sulfide standard.

d. CCV preparation
(1). 0.5 mg/l sulfide CCV
(a). pipette 10 ml of the 5 mg/l sulfide working standard into a 100-ml volumetric flask
(b). Bring up to volume with reagent water
(c). Prepare fresh daily. Use as prepared for CCV

(2). 1 mg/l sulfide LCS/CCV
(a). Pipette 20 ml of the 5 mg/l sulfide working standard into a 100-ml volumetric flask
(b). Bring up to volume with reagent water
(c). Prepare fresh daily. Use as prepared for LCS/CCV

e. For North Carolina samples, analyze an LOQ check standard at the level of the LOQ (0.3 mg/l), each day samples are analyzed.
Pipette 4 ml of the 20 mg/l sulfide standard to 250 ml reagent water.

2. Zeroing the spectrophotometer with a calibration blank:

a. Prepare a calibration blank by pipetting 7.5 mL of reagent water into a 10 mL test tube.

b. Add by pipette, 0.5 mL of 1+1 H2SO4 and 0.15 mL (3 drops) ferric chloride solution. **Mix immediately by inverting slowing only one time**. Wait 3 to 5 minutes for color development.

c. Add by pipette 1.6 mL diammonium hydrogen phosphate solution to test tube. Slowly invert test tube 3 times. Wait 10 minutes.

d. Zero the spectrophotometer with the calibration blank, **at 625 nm using a 1-cm cell.**

3. Using a wide-tipped pipette, place 7.5 mL of sample or 7.5 mL of a suitable dilution of sample each into two 10-mL test tubes, one for the sample and the other for a sample blank.

4. Sample:

a. Add by pipette, 0.5 mL of amine-sulfuric acid working reagent and 0.15 mL (3 drops) ferric chloride solution.

b. **Mix immediately by inverting slowing only one time**. Mixing too vigorously causes low results by releasing hydrogen sulfide gas before it has had time to react. Presence of sulfide will be indicated

by the development of blue color.

c. Wait 3 to 5 minutes for complete color development.

5. Sample blank:

a. Each sample requires a sample blank to subtract interferences.

b. Add by pipette, 0.5 mL of 1+1 H2SO4 and 0.15 mL (3 drops) ferric chloride solution.

c. **Mix immediately by inverting slowing only one time.**

d. Wait 3 to 5 minutes for complete color development.

6. Add by pipette 1.6 mL diammonium hydrogen phosphate solution to test tube (samples and sample blanks). Slowly invert test tube 3 times. Wait 10 minutes.

7. Read absorbance on spectrophotometer **at 625 nm using a 1-cm cell**.

8. If the concentration result of the absorbance is greater than the highest concentration on the curve, then the sample must be diluted and reanalyzed to produce an absorbance contained on the curve.

a. Diluent is reagent water.

Calculations

A. Colorimetric Sulfide and Dissolved Sulfide

Subtract the sample blank absorbance from the sample absorbance and obtain concentration of sulfide in mg/L from calibration curve. Multiply this value by sample dilution factor to calculate mg/L sulfide concentration in sample.

mg/L sulfide = A x DF

Where:
A = concentration from the sulfide curve

DF = Dilution factor

B. Sulfide as H_2S

1. pH and specific conductance are needed to determine sulfide as H_2S.

2. The specific conductance is used to determine if a sample is freshwater or saltwater.

a. The definition of saltwater for this analysis is a specific conductance > 50,000 umhos/cm.

b. If the specific conductance is less than 50,000 umhos/cm, the sample is considered freshwater.

(1). Estimate the sulfide as H_2S for freshwater using Figure 4500-S^2:III SM 4500-S^2 H-2011.

c. If the specific conductance is greater than 50,000 umhos/cm, the sample is considered saltwater. Due to the sample conductivity exceeding the range given in the table for logarithmic practical ionization constants for hydrogen sulfide, the H2S value reported is based on the highest conductivity listed of 50,000 umhos/cm.

d. Multiply the percentage of sulfide as H_2S by the result from the dissolved sulfide analysis.

(1). Sulfide as H_2S Saltwater Calculation

salinity = $1.6 \times 10^{-5} C$
Where: C = conductivity (umhos/cm) from Table 2330:I SM 4500-S^{2-} H-2011

$a_{H_2S} = [H_2S]/S_T = 1/(10^{pH-pK'sw} + 1)$

Sulfide as H_2S (mg/L) = $a_{H_2S} \times S_T$

Where:

S_T = total dissolved sulfide concentration

pK'_{SW} is determined from Table 4500-S^{2-} :III using temperature and salinity.

Statistical Information/Method Performance

The method detection limit (MDL) is determined annually by following the procedure outlined in *QA-SOP11892*. For this analysis, the MDL study must be analyzed over a minimum of 3 days.

The quality control acceptance windows are generated annually by following the procedure outlined in *QA-SOP11896*.

Quality Assurance/Quality Control

Manual colorimetric analysis

Batch size is limited to 20 samples or less.

A method blank and a 1.0-mg/L laboratory control standard (LCS) must be analyzed on each batch.

The method blank must be less than half the LOQ for this analysis.

A continuing calibration verification (CCV) standard must be analyzed at the beginning of each batch, after every ten samples, and at the end of each batch. The concentration of the CCV must be no greater than the midpoint of the calibration curve. The acceptance range for all CCVs is 90-110%.

If the CCV does not meet requirements, the cause for the unacceptable result must be determined, if possible. Corrective action must be taken -- samples bracketed by the unacceptable CCV must be repeated and bracketed by acceptable CCVs. If acceptable results cannot be obtained, the data must be qualified.

A matrix spike (MS), a matrix spike duplicate (MSD), and a sample matrix duplicate must be analyzed with each batch. For the manual colorimetric analysis, prepare the MS and MSD by spiking 7.5 ml of sample with 0.2 ml of the intermediate sulfide standard.

When sample volume does not permit the analysis of either a sample matrix duplicate or an MS and an MSD, then a 1.0 mg/L LCSD must be analyzed to demonstrate method precision.

A second sample matrix duplicate is not required unless a batch contains an NPDES sample(s) from South Carolina and the batch contains more than 10 samples.

Samples from West Virginia require a usable precision measurement for each batch. Analyzing one of the following on a batch containing a West Virginia sample fulfills this requirement: an MS/MSD, a non-program deleted duplicate, or an LCSD.

Refer to *T-WC-WI10360* for requirements that fall under Chapter 4 of Standard Methods for the Examination of Waters and Wastewaters, 22nd Edition.

If any of the QC samples do not meet required specifications, refer to *T-WC-WI10360*. Follow guidelines in *T-WC-WI10360* for outlier QC data and for corrective action. See LIMS for current quality control acceptance windows.

Attachment:
SM 4500-S2 2011 Figure 3 (.pdf)
Sulfide.docx (.docx)

10348 Fixed Volume Hand-Held Pipettes
10352 Genesys 30 Spectrophotometer
10360 Quality Control Data for Wet Chemistry
9897 Adjustable Volume Handheld Pipettes

End of document

Version history

Version	Approval	Revision information	
18	12.MAR.2020		
19	23.FEB.2021		
20	06.OCT.2021		

eurofins	Always check on-line for validity.	Level:
Document number: **T-WC-WI11512**	**Oxidation-Reduction Potential for Wastewaters and Soils by ASTM D1498, SM 2580 B-2011**	**Work Instruction**
Old Reference: **1-P-QM-WI-9013403**		
Version: **15**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **31-DEC-2021**	Document users: **6_EUUSLA_Water Quality_24/48 Hour Analyst, 6_EUUSLA_Water Quality_24/48 Hour Verification**	Responsible: **5_EUUSLA_Water Quality_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 15	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reference	Clarification	Removed references to SM 2580
Reference Modification	Clarification	Removed reference to SM2580
Reagents and Standards	Clarification	Removed CaCl2 solution
Procedure	Clarification	waters and soils are run separately. Data is recorded into LIMS, not logbook Removed reference to CaCl2 solution Potential is read while sample is stirring

Revision 14		**Effective Date:**	01.MAY.2018
Section	**Justification**	**Changes**	

Revision 14	**Effective Date:**	01.MAY.2018
Title	Formatting requirement	Added methods and matrices
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reference 3	Reflect current editorial revision	Updated SM to Method 2580 B-2011
Reference Modifications	Reflect current procedure	included solid matrix modifications Added justification for not recording temperature of sample
Procedure	Clarification	Added NOTE explaining that waters and solids can be analyzed on the same batch Divided into two sections: A=waters, B=Soils
Calculations	clarification	removed reference to table 1 for E(ref) and added E(ref) = +199 when Ag/AgCl is used
Quality Assurance/Quality Control	Clarification	clarified when two duplicates are needed per batch

Reference

1. Annual Book of ASTM Standards, Method D 1498

2. *Test Method for Evaluating Solid Waste*, SW-846, USEPA, Vol. IC, p. 9045C (modified).

3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-WC-WI10360	Quality Control Data for Wet Chemistry
QA-SOP11188	Reagents and Standards

Scope

This method covers the procedure for the electrometric measurement of oxidation-reduction potential in potable waters and wastewaters. This method is also modified to perform Oxidation-Reduction Potential on solid waste and soil samples. The electrodes are reliable in nearly all aqueous solutions and are not subject to interference from color, turbidity, colloidal matter, or suspended matter. Applicable concentration ranges and reporting limits are found in the LIMS.

Basic Principles

Oxidation-reduction potential is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution, referred to the standard hydrogen electrode. The oxidation-reduction potential electrodes are inert and measure the ratio of the activities of the oxidized to the reduced species in the process reactions.

Reference Modifications

This method can be modified for soils by preparing a 1:1 slurry using equal amounts of sample and reagent water.

Interferences

Particulate matter present in a sample has the possibility of causing interference to the electrode.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See the *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and a documented Demonstration of Capability.

Analysts are considered proficient when they have successfully completed a Demonstration of Capability. This consists of four laboratory control samples that are carried through all steps of the analysis and that meet the defined acceptance criteria. Demonstration of Capability is performed annually and documentation is maintained in each individual's training records.

Sample Collection, Preservation, and Handling

Samples for this analysis must be in an unpreserved container. Water samples are collected in unpreserved plastic or glass containers. Solid samples are collected in unpreserved glass containers. The samples are stored at 0° - 6°C; not frozen. The samples are analyzed as soon as possible after collection and must be analyzed at room temperature. There is no defined holding time for this analysis.

Apparatus and Equipment

1. pH meter – A pH meter capable of storing and calibrating on a Redox standard solution must be used.

2. Oxidation-reduction combination electrode – Platinum, with appropriate filling solution.

Reagents and Standards

Alternative weights and volumes are used as long as final concentrations remain unchanged. Refer to *QA-SOP11188* for appropriate labeling and documentation.

1. ORP Standard - Purchased; The expiration date must be the manufacturer's suggested expiration date. See container for storage information.

2. Ag/AgCl – Reference Electrode filling solution. Store at room temperature. Re-evaluate yearly.

Calibration

Not applicable to this procedure

Procedure

NOTE: Electrode Preparation - Remove traces of foreign matter and oily residues, and change filling solution if necessary. Soils and waters must be analyzed separately.

A. Analyzing Waters

1. All standards and samples must be brought to room temperature prior to analysis.

2. Assemble pH meter and connect oxidation-reduction potential electrode. Set the meter to RmV.

3. Place the oxidation-reduction potential electrode into approximately 50 mL of ORP Standard.

4. Repeat this procedure until two successive readings of sample differ by no more then 10 mV. Record the two readings in the raw data logbook.

5. For the result, take the average of the two successive trials. Record this reading as the LCS/CCV.

6. Proceed with analyzing waters by using approximately 50 mL of sample and repeating steps 3-5.

B. Analyzing Soils

1. When analyzing soils, make a 1:1 slurry by adding equal amount of sample and reagent water to a beaker.

NOTE: It is possible to make a 1:1 slurry by using equal amounts of 0.5 N CaCl2 and sample to a beaker at the client's request.

2. Use a stirring rod and mix the sample gently.

3. Add magnetic stir bar and stir for five minutes.

4. While the sample is still stirring and when the reading is stabilized, read the millivolt potential of the solution.

5. Repeat this procedure until two successive readings of sample differ by no more then 10 mV. Record the two readings in the raw data logbook. For the result, take the average of the two successive trials. Record the final average result in the LIMS.

Calculations

The oxidation-reduction potential is related to the reference electrode used in the measurement. Calculate the oxidation-reduction potential of the sample in millivolts, referred to the hydrogen scale:

$$E_{(h)} = E_{(obs)} + E_{(ref)}$$

Where:

$E_{(h)}$ = oxidation-reduction potential referred to the hydrogen scale, mV
$E_{(obs)}$ = observed oxidation-reduction potential of the platinum electrode, mV
$E_{(ref)}$ = oxidation-reduction potential of the reference electrode as related to the hydrogen standards, mV (NOTE: The mV of $E_{(ref)}$ is +199 if saturated Ag/AgCl is the only option)

Statistical Information/Method Performance

See LIMS for MDL/QC windows.

Quality Assurance/Quality Control

ORP standard is analyzed at the beginning of each batch as a laboratory control standard (LCS) and is repeated after every 10 samples as a CCV. The ORP standard is also analyzed at the end of each batch. The acceptance range for this solution is the certified value ± 30 mV or the manufactures suggested range, whichever is less.

Two duplicates must be analyzed for each batch of 20 samples. When batch contains 10 or less samples, only one duplicate is needed. When a batch contains 11 to 20 samples, then two duplicates are needed.

See LIMS for current quality control acceptance windows. Refer to *T-WC-WI10360* if any of the QC samples do not meet required specifications.

10360 Quality Control Data for Wet Chemistry
11188 Reagents and Standards

End of document

Version history

Version	Approval	Revision information	
13	13.APR.2015		
14	01.MAY.2018		
15	29.DEC.2021		

eurofins	Always check on-line for validity. **Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D422-63 (reapproved 2007) - Modified**	Level: **Work Instruction**
Document number: **T-WC-WI46354**		
Old Reference: **NA**		
Version: **1**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **25-NOV-2021**	Document users: **6_EUUSLA_Water Quality_Misc Analysis, 6_EUUSLA_Water Quality_Misc Verification**	Responsible: **5_EUUSLA_Water Quality_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
A. % Solids Test
B. Hydrometer Analysis
C. Sieve Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table 1 - Hydrometer Reading Table (For up to 12 Sedimentation Cylinders)
Table 2 - Percent Solids Table for Weight Determination for D422

Revision Log

Revision	1	**Effective Date:**	This version
Section	**Justification**		**Changes**
			New Procedure

Reference

1. ASTM Standard D422-63 (Re-approved 2007) "Standard Test Method for Particle-Size Analysis of Soils", ASTM International, West Conshohocken, PA 2003, DOI: 10.1520/C0033-03, www.astm.org

2. ASTM Standard D2217-8585 (Re-approved 1998) "Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants", ASTM International, West

Conshohocken, PA 2003, DOI: 10.1520/C0033-03, www.astm.org

4. ASTM Standard D6913-17 "Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using SieveAnalysis"

5. STM Standard D7928-17 "Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained SoilsUsing the Sedimentation (Hydrometer) Analysis"

6. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
S-SS-WI10697	% Moisture Calculation and % Solids Calculation (Gravimetric)
T-WC-FRM46355	D422-Mod Particle Size Distribution / Grain Size Classification
T-WC-WI9901	Equipment Muffle Furnaces and Ovens

Scope
This procedure is applicable to the determination of the distribution of particle sizes in soils and solids. Particle sizes in the range 75 to 0.075 mm are determined by sieving. Distribution of particle sizes smaller than 0.075 mm is determined by a sedimentation process using a hydrometer.

Basic Principles
A portion of sample is soaked in a dispersing agent then partitioned into separate portions: material retained on a #10 sieve and material passing the #10 sieve. The material retained on the #10 sieve is dried to constant weight then passed through a large size sieve stack; the material retained on each sieve is measured and recorded. Material passing the #10 sieve is subject to hydrometer analysis then passed through a small size sieve stack; the material retained on each sieve is measured and recorded. All measurements: large and small sieves and hydrometer readings, and the hygroscopic moisture are used to establish the particle size distribution of the sample.

This SOP is based on the following reference methods: ASTM Standard D2217-8585 (Re-approved 1998), ASTM Standard D422-63 (Re-approved 2007), ASTM Standard D6913-17, and ASTM Standard D7928-17.

NOTE: ASTM D2217 was withdrawn without replacement by ASTM in 2007. A withdrawn standard is an ASTM standard that has been discontinued by the ASTM Sponsoring Committee responsible for the standard.

NOTE: ASTM D422-63 was withdrawn by ASTM in January 2016. Individual methods for gradation by sieve analysis (ASTM D6913-17) and gradation by sedimentation/hydrometer analysis (ASTM D7928-17) were promulgated as replacement approaches. At the time of this writing, ASTM has not yet developed a combined sieve/hydrometer approach. The laboratory's procedure will utilize elements of these two new methods into a combined approach.

Interferences
Not Applicable.

Safety Precautions and Waste Handling
All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Analysts are considered proficient when they have successfully demonstrated competency under supervision of a supervisor or other trained analyst, with a documented OJT form.

Sample Collection, Preservation, and Handling

Sample are collected in a glass jar or plastic bag. A minimum of 500g of sample is recommended. There is no holding time for this analysis. Samples are stored at 0 to 6 degrees C; not frozen.

Apparatus and Equipment

1. Top-Loading Balance, capable of weight measurement to 0.01 g
2. Mechanical Stirring Device and Dispersion Cup
3. Thermometer: Accurate to 0.5°C
4. Mortar and Rubber Tipped Pestle
5. Sedimentation Cylinder(s) 1000 mL
6. Hydrometer: ASTM 151H in specification E 100.
7. Sieves, of the following size(s): Gilson Company, Inc. or equivalent
    1. 3.0" (75.00 mm)
    2. 2.0" (50.00 mm)
    3. 1.5" (37.50 mm)
    4. 1.0" (25.00 mm)
    5. 3/4" (19.00 mm)
    6. 3/8" (9.50 mm)
    7. # 4 (4.75 mm)
    8. #10 (2.00 mm)
    9. #20 (850.0 um)
    10. #40 (425 um)
    11. #60 (250.0 um)

12. #80 (180.0 um)
13. #100 (150.0 um)
14. #200 (75.0 um)

8. Drying Oven with temperature range of 60-110°C
9. Stainless Steel Spatulas & Spoons
10. Metal & Bristle Brushes
11. Sieve Shaker
12. Timer

Reagents and Standards

Alternate weights may be used as long as the final concentrations remain the same.

1. Sodium hexametaphosphate solution
    a. Using a 1000-mL volumetric flask, dissolve 40 g of sodium hexametaphosphate in reagent water.
    b. Dilute to final volume once dissolved.
    c. Store at room temperature in a glass or plastic container.
    d. Solution expires one month from date of preparation.

Calibration

Balance calibration must be checked each day before use.

Procedure

A. % Solids Test

Check to be sure that the balance has been calibrated each day before use.

1. Label an aluminum pan with the Lab ID for each sample.

2. Tare the balance. Weigh the aluminum pan and record in spreadsheet *T-WC-FRM46355*.

3. Mix the sample with a stainless steel spatula. Measure at least 10-15 g of each sample into the labeled aluminum pan and record the weight of sample in the spreadsheet.

4. Place the pan and sample in an oven maintained at a temperature of 110°C +/- 5°C and dry the sample for at least 16 hours. Reweigh each pan and record the weight measurement in the spreadsheet.

B. Hydrometer Analysis

Check to be sure that the balance has been calibrated each day before use.

1. Use calculated % Solids from Procedure A. and Table 2 to determine the amount needed for analysis. Add an NCM and contact the PM if there is insufficient sample to perform the test.

2. Using the sample in the 250-mL beaker add 125 mL of sodium hexametaphosphate solution. Stir the soil-water slurry until it is thoroughly moistened. Cover and label beaker with sample number. Allow this slurry to soak for at least 16 hours.

3. At the end of the soaking period, transfer the soil-water slurry into a dispersion cup using room temperature reagent water. Be sure to rinse all residue from the beaker into the dispersion cup.

NOTE: Extra care needs to be taken when rinsing the sample into another container or when using any apparatus. **All particles need to be rinsed into the new container or a loss in sample weight is possible to occur.**

4. Stir for one minute using the stirring apparatus. **Rinse stirring apparatus well into dispersion cup to prevent loss of sample.**

5. Place the #10 sieve in a funnel above a 1000-mL glass sedimentation cylinder. Transfer the soil-water slurry into the cylinder, rinsing well. Add room temperature reagent water until the total volume is 1000 mL.

a. Label an aluminum pan with the sample ID. Transfer the sample retained on the #10 sieve to the aluminum pan. Place the pan in the oven set to 110°C +/- 5°C and dry the sample for at least 16 hours. Inspect materials in Procedure C.1 and perform Sieve Analysis in procedure C.2.

6. Cover the open end of the cylinder with parafilm, then placing the palm of the hand over the end, invert the cylinder and agitate for a period of one minute. Place the cylinder in a location where it will not be disturbed or moved during the sedimentation readings (for 24 hours). Start a timer.

7. Remove the parafilm and immediately begin the hydrometer readings, recording the temperature reading after each suspension. Record the readings at the following intervals (measured from the beginning of sedimentation): 2, 5,15, 30, 60, 250, and 1440 minutes. Insert the hydrometer about 20 to 25 seconds before the reading is due to the approximate depth. Read the hydrometer from the top of the meniscus to the nearest 0.0005 and enter the reading on the worksheet *T-WC-FRM46355*. Clean the hydrometer before the first reading, and between readings, by placing it into reagent water and twisting with a spinning motion.

NOTE: The hydrometer used in the process will be calibrated on an annually basis by a certified vendor.

8. After hydrometer reading, insert a calibrated thermometer into the cylinder to the same depth as the hydrometer reading. Read the temperature to the nearest 0.5°C and enter the temperature measurement on the worksheet. Rinse the temperature probe in the hydrometer rinse bath.

9. After hydrometer analysis, proceed to Small Sieve Analysis in Procedure C.3.

C. Sieve Procedure

1. Inspect the sample material in the aluminum pan and record a description of the non-soil material (e.g.- sticks, grass, wood, plastic), hardness of material, and shape of material in the worksheet. Hardness qualifiers include hard, soft, and brittle. Shape qualifiers include well-rounded, rounded, subrounded, subangular, and angular.

2. Sieve Analysis

a. Weigh the 3/4”, 3/8”, #4 and #10 sieves and enter the weight measurements in the worksheet as the tare weight.

b. Stack the sieves and then transfer the sample material from the aluminum dish to the sieve stack. If the sample material is less than 30 g, manually shake the sieve stack for 2 minutes. If the sample material is greater than 30 g, place the sieve stack into the Ro-tap machine and shake the sieve stack for 10 minutes.

c. Weigh each sieve and record these measurements in the worksheet.

3. Small Sieve Analysis

a. Quantitatively transfer the sample from the graduated cylinder to a #200 wet wash sieve. Ensure the entire sample has been transferred to the #200 wet wash sieve by rinsing the graduated cylinder several time with reagent water. Using reagent water, wash the sample through the #200 sieve until the water runs clear, then transfer the material retained on the sieve into a 250-mL glass beaker labeled with the sample ID.

b. Place the beaker in the drying oven and dry at a temperature of 110ºC for at least 16 hours. After 16 hours, remove the beaker from the oven and allow it to cool.

c. Gently mix the dried contents of the beaker with a rubber-tipped pestle to break up any soil aggregates that may have formed during the drying stage.

d. Tare the balance and weigh the sieve stack sized between #20 and #200 and record the tare weights.

e. Transfer the sample to the sieve stack and ensure complete transfer. Use hair or wire brushes to clean the beaker. Place the sieve stack on the RoTap machine and shake for ten minutes.

f. Weigh each sieve and record these measurements in the worksheet.

Calculations

A. Sample Used (SU): Dry Preparation

SU = (pan+ dry sample - pan) - (pan + non- soil material - pan) x HMCF

Where:
HMCF = Hygroscopic moisture correction factor.

B. Sieve Analysis (Percent Finer = PF)

Large Sieves:

3 inch: PF = 100-100* (Sieve and Sample (3 inch) - Sieve (3 inch))/SU

2 inch: PF = PF (3 inch) - 100*(Sieve and Sample (2 inch) - Sieve (2 inch))/SU

and so on through the #10 Sieve.

Small Sieves:

#20: PF = PF(#10) - 100*(mass passing #10/sample mass (Hyd))*(sieve and sample (#20) - sieve(#20))/sample used

#40: PF = PF (#20) - 100*(mass passing #10/sample mass (Hyd))*(sieve and sample (#40) - sieve (#40))/sample used and so on up through #10 sieve.

B. Hydrometer Analysis

Particle size, Micron

1000*sqrt [930*viscosity/980*(SG-1))*(effective depth/time)]

Viscosity at sample temperature, poises

Effective Depth, cm = 16.29-264.5*(actual Hydrometer reading - 1) above equation for effective depth based on equation found with table 2 in method, in which 16.29 = 0.5*(14.0-67.0/27.8)+10.5 and 264.5 = (10.5-2.3)/0.031

Time, minutes = Time of hydrometer reading from beginning of sedimentation

Sqrt - square root

SG - Specific Gravity of soil

Viscosity - is the resistance of a liquid to flow

C. Percent Finer (PF):

PF = Constant*(actual hydrometer reading - hydrometer correction factor - 1)

Where:

Constant = (100,000/W)*SG/(SG-1)

W = (Total sample used *sample used for hydrometer analysis*HMCF)/Amount of total sample passing #10 sieve

Hydrometer Correction = slope*sample temperature + Intercept

Slope = ((low temp. reading -1)-(high temp. reading -1)/(low temp. - high temp.))

Intercept = (low temp. reading -1) - (low temp. * slope)

Statistical Information/Method Performance

Not applicable to this procedure

Quality Assurance/Quality Control

When possible, perform duplicate analyses for particle size on a routine basis.

Batch size is limited to 20 samples or less.

Table 1 - Hydrometer Reading Table (For up to 12 Sedimentation Cylinders)

Table 1: Hydrometer Reading Table (For up to 12 Sedimentation Cylinders)

Elapsed Time (hr:min)	Task	Cyl. No.	Actual Time (min)	Elapsed Time (hr:min)	Task	Cyl. No.	Actual Time (min)
0:00	Shake	1		1:01	Read	10	5
0:01	Place	1		1:02	Shake	11	
0:01	Shake	2		1:03	Place	11	
0:02	Place	2		1:04	Read	9	15
0:03	Read	1	2	1:05	Read	11	2
0:04	Read	2	2	1:06	Read	7	31
0:06	Read	1	5	1:07	Read	3	58
0:07	Read	2	5	1:08	Read	11	5
0:08	Shake	3		1:09	Shake	12	
0:09	Place	3		1:10	Place	12	
0:09	Shake	4		1:11	Read	10	15
0:10	Place	4		1:12	Read	12	2
0:11	Read	3	2	1:13	Read	4	63
0:12	Read	4	2	1:14	Read	8	32
0:14	Read	3	5	1:15	Read	12	5
0:15	Read	4	5	1:18	Read	11	15
0:16	Read	1	15	1:19	Read	9	30
0:17	Read	2	15	1:21	Read	5	60
0:20	Shake	5		1:25	Read	12	15
0:21	Place	5		1:26	Read	10	30
0:23	Read	5	2	1:27	Read	6	59
0:24	Read	3	15	1:33	Read	11	30
0:25	Read	4	15	1:34	Read	7	59
0:26	Read	5	5	1:41	Read	12	31
0:27	Shake	6		1:42	Read	8	60
0:28	Place	6		1:52	Read	9	63
0:30	Read	6	2	1:53	Read	10	57
0:31	Read	1	30	2:06	Read	11	63
0:32	Read	2	30	2:07	Read	12	57
0:33	Read	6	5	4:17	Read	1	256
0:34	Shake	7		4:18	Read	2	256
0:35	Place	7		4:19	Read	3	250
0:36	Read	5	15	4:20	Read	4	250
0:37	Read	7	2	4:21	Read	5	240
0:38	Read	3	29	4:22	Read	6	234
0:39	Read	4	29	5:00	Read	7	265
0:40	Read	7	5	5:01	Read	8	259
0:41	Shake	8		5:02	Read	9	253
0:42	Place	8		5:03	Read	10	247
0:43	Read	6	15	5:04	Read	11	241
0:44	Read	8	2	5:05	Read	12	235
0:47	Read	8	5	24:01	Read	1	1440
0:48	Shake	9		24:02	Read	2	1440
0:49	Place	9		24:03	Read	3	1434
0:50	Read	7	15	24:04	Read	4	1434
0:51	Read	9	2	24:05	Read	5	1424
0:52	Read	5	31	24:06	Read	6	1418
0:54	Read	9	5	24:07	Read	7	1412
0:55	Shake	10		24:08	Read	8	1406
0:56	Place	10		24:09	Read	9	1400
0:57	Read	8	15	24:10	Read	10	1394
0:58	Read	10	2	24:11	Read	11	1388
0:59	Read	6	31	24:12	Read	12	1382
1:00	Read	1	59				
1:00	Read	2	58				

Table 2 - Percent Solids Table for Weight Determination for D422

% solids	Specific Gravity	Silt/Clay	Silt/Sand	Sand	Sand/Gravel
1	2500	5000	7500	10000	20000
2	1250	2500	3750	5000	10000
3	833	1667	2500	3333	6667
4	625	1250	1875	2500	5000
5	500	1000	1500	2000	4000
6	417	833	1250	1667	3333
7	357	714	1071	1429	2857
8	313	625	938	1250	2500
9	278	556	833	1111	2222
10	250	500	750	1000	2000
11	227	455	682	909	1818
12	208	417	625	833	1667
13	192	385	577	769	1538
14	179	357	536	714	1429
15	167	333	500	667	1333
16	156	313	469	625	1250
17	147	294	441	588	1176
18	139	278	417	556	1111
19	132	263	395	526	1053
20	125	250	375	500	1000
21	119	238	357	476	952
22	114	227	341	455	909
23	109	217	326	435	870
24	104	208	313	417	833
25	100	200	300	400	800
26	96	192	288	385	769
27	93	185	278	370	741
28	89	179	268	357	714
29	86	172	259	345	690
30	83	167	250	333	667
31	81	161	242	323	645
32	78	156	234	313	625
33	76	152	227	303	606
34	74	147	221	294	588
35	71	143	214	286	571
36	69	139	208	278	556
37	68	135	203	270	541
38	66	132	197	263	526
39	64	128	192	256	513
40	63	135	188	250	500
41	61	122	183	244	488
42	60	119	179	238	476
43	58	116	174	233	465
44	57	114	170	227	466
45	56	111	167	222	444
46	54	109	163	217	435

47	53	106	160	213	426
48	52	104	156	208	417
49	51	102	153	204	408
50	50	100	150	200	400
51	49	98	147	196	392
52	48	96	144	192	385
53	47	94	142	189	377
54	46	93	139	185	370
55	45	91	136	182	364
56	45	89	134	179	357
57	44	88	132	175	351
58	43	86	129	172	345
59	42	85	127	169	339
60	42	83	125	167	333
61	41	82	123	164	328
62	40	81	121	161	323
63	40	79	119	159	317
64	39	78	117	156	313
65	38	77	115	154	308
66	38	76	114	152	303
67	37	75	112	149	299
68	37	74	110	147	294
69	36	72	109	145	290
70	36	71	107	143	286
71	35	70	106	141	282
72	35	69	104	139	278
73	34	68	103	137	274
74	34	68	101	135	270
75	33	67	100	133	267
76	33	66	99	132	263
77	32	65	97	130	260
78	32	64	96	128	256
79	32	63	95	127	253
80	31	63	94	125	250
81	31	62	93	123	247
82	30	61	91	122	244
83	30	60	90	120	241
84	30	60	89	119	238
85	29	59	88	118	235
86	29	58	87	116	233
87	29	57	86	115	230
88	28	57	85	114	227
89	28	56	84	112	225
90	28	56	83	111	222
91	27	55	82	110	220
92	27	54	82	109	217
93	27	54	81	108	215
94	27	53	80	106	213
95	26	53	79	105	211

96	26	52	78	104	208
97	26	52	77	103	206
98	26	51	77	102	204
99	25	51	76	101	202
100	25	50	75	100	200

Use the attachment of Table 2 to determine the amount of sample to use in Procedure B.1.

Attachment:
Table 2 - Percent Solids Table for Weight Determination for D422 (.xls)

10697 % Moisture Calculation and % Solids Calculation (Gravimetric)
11188 Reagents and Standards
11880 Laboratory Equipment Verifications - Balance, Syringe, Pipette, Weights, and Other Equipment
46355 D422-Mod Particle Size Distribution / Grain Size Classification
9901 Equipment Muffle Furnaces and Ovens

End of document

Version history

Version	Approval	Revision information	
1	11.NOV.2021		

eurofins	Always check on-line for validity. **pH by EPA 9045C, 9045D and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometic Methods**	Level: **Work Instruction**
Document number: **T-WC-WI11518**		
Old Reference: **1-P-QM-WI-9011685**		
Version: **14**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **30-APR-2021**	Document users: **6_EUUSLA_Water Quality_24/48 Hour Analyst, 6_EUUSLA_Water Quality_24/48 Hour Verification**	Responsible: **5_EUUSLA_Water Quality_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision	14	**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout Document	Current process		Update to new LIMS
Cross Reference	Higher level documents are not required to be referenced		Removed *QA-SOP11880*
Procedure 10.	Current process		Added step 10 - to read the 2 and 12 standards when analyzing samples for corrosivity
Procedure	Current Process		Removed previous step 11. Units are reported as S.U.
Quality Assurance/ Quality Control	Clarification Current process		Added acceptance range for CCVs. Removed requirement to analyze the 2 and 12 standards before any samples Removed step to read pH 3 times for corrosivity

Revision	13	**Effective Date:**	08-JUL-2019
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Procedure 11	Clarification		Added how solid pH is reported (soil pH measured in water at recorded temp at time of analysis)

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 9045C, January 1995.
2. Test Methods for Evaluating Solid Wastes, SW-846 Method 9045D, November 2004.
3. Test Methods for Evaluating Solid Wastes, SW-846 Chapter 7.
4. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-WC-WI11519	pH Probes and Meters
T-WC-WI10360	Quality Control Data for Wet Chemistry

Scope

This SOP provides the guidelines for analysts performing pH on solid, soil, and solvent samples. This procedure is applicable to solid/soil/solvent samples.

The sensitivity limit for this technique is 0.01 pH units.

Basic Principles

A 1:1 slurry is prepared and the activity of hydrogen ions in the supernatant is measured using a combination pH electrode.

Determination of corrosivity is based on the pH value of the sample.

Reference Modifications

Method 9045C/D has been modified for the analysis of solid, soil, and solvent samples in the following ways:

1. An Automatic Temperature Compensator is used for all samples instead of manually performing calculations to correct measured pH values if the sample and buffer solution temperatures differ by more than 2°C.

2. 25 g of soil to 25 g reagent water is used instead of the 20 g: 20 mL ratio.

3. The samples are tumbled for approximately 30 minutes instead of being stirred with a stir bar for 5 minutes.

These modifications are performed in order to allow for adequate agitation and to provide sufficient supernatant to immerse the pH electrode during analysis.

Interferences

Interferences occur when oily or particulate matter adheres to the electrodes and reduces the response. Gentle wiping or rinsing with reagent water usually corrects this problem. Temperature effects are compensated for by calibrating the pH meter at the temperature of the sample or using a pH meter equipped with temperature compensators. There are no means of controlling temperature effects caused by shifts in ionic equilibria of the sample.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention. Standard safe laboratory procedure must be followed as outlined in the Chemical Hygiene Plan.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Proficiency is measured through an Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four pH readings of the 7.00 pH buffer (which is used as the laboratory control standard) that are carried through all steps of the procedure and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Sample must be collected in an unpreserved container and stored at 0° to 6°C; not frozen, until the time of analysis. There is no published holding time for pH analysis on soil; analysis is performed as soon as possible after sample is received in the laboratory.

Apparatus and Equipment

1. Analytical balance capable of weighing 0.0001 g

2. pH meter equipped with an ATC probe (Automatic Temperature Compensator)

3. Combination electrode or equivalent

4. Stir bar and stir plate

Reagents and Standards

1. 7.00 pH Buffer (ISO 17025 approved vendor) – purchased; see container for shelf life information.

2. Appropriate pH electrode filling solution for electrode, purchased. Store at room temperature. See label for expiration date.

Calibration

Balances must be calibrated each day before use.

Calibrate pH meter as described in *T-WC-WI11519*.

Procedure

1. Make sure the pH meter has been calibrated within the last 24 hours.

2. Weigh 25 ± 0.5 g of sample into a clean specimen cup and add 25 ± 0.5 mL of reagent water (makes a 1:1 slurry).

If the sample absorbs the water, add an additional 25 ± 0.5 mL of reagent water (makes a 1:2 slurry). If a 1:2 slurry does not provide sufficient supernatant to immerse the pH electrode, use less sample and add reagent water in proportion to the weight selected. Enter a comment in LIMS indicating the dilution.

3. Tightly place the screw-cap lid on the sample and mix the slurry in the tumbler for approximately 30 minutes.

4. Remove the sample from the tumbler and allow the sample to settle for about 1 hour.

5. Rinse and shake off any water on the electrodes.

6. Dip the electrodes into the supernatant (aqueous layer) of the sample and allow to equilibrate. If necessary, decant or pipette this layer into another container.

7. Using the calibrated, pH meter note the pH value of the sample after the meter equilibrates, and enter the value in the LIMS.

NOTE: If pH reading is < 4.00 or >10.00, then the pH result will be reported with a qualifying flag.

8. Note the temperature of the sample and record the value in LIMS.

9. Rinse and clean the electrodes before proceeding to the next sample.

10. If corrosivity is to be reported, read the pH 2 and 12 standards and record the pH value.

11. Corrosivity is determined from the sample's pH reading. A "Yes" or "No" response is entered for the corrosivity result, depending on the pH value. A sample is considered corrosive if the pH is <2 or >12, warranting a "Yes" result. A sample with a pH value from 2 to 12 has a corrosivity result of "No".

Calculations

Not applicable.

Statistical Information/Method Performance

Not applicable to this procedure

Quality Assurance/Quality Control

One batch consists of no more than 20 samples.

A Laboratory Control Standard (LCS; 7.00 pH Solution) must be analyzed at the beginning of each batch.

A CCV (7.00 pH Solution) must be analyzed after every ten samples and at the end of the batch. The acceptance range for the CCV is 90 - 110%.

Two matrix duplicates must be analyzed per batch of 20 samples. If 10 or less samples are on a batch then only one matrix duplicate is needed.

When analyzing for Corrosivity, a pH check using buffers 2 and 12 must be analyzed.

If the meter must be re-calibrated during the analysis, a LCS must be analyzed after the calibration is performed.

See LIMS for current quality control acceptance windows.

Refer to *T-WC-WI10360* if any of the QC samples do not meet required specifications.

QA-SOP11880 Balance, Syringe, Pipette, Weights and Labware Verification
T-WC-WI10360 Quality Control Data for Wet Chemistry
T-WC-WI11519 pH Probes and Meters

End of document

Version history

Version	Approval	Revision information
12	27.JUL.2018	
13	27.JUN.2019	
14	22.APR.2021	

eurofins	Always check on-line for validity. **pH Probes and Meters**	Level: **Work Instruction**
Document number: **T-WC-WI11519**		
Old Reference: **1-P-QM-PRO-9015421; DOD - MC-WQ-007**		
Version: **15**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **31-MAR-2022**	Document users: **5_EUUSLA_Water Quality_All**	Responsible: **5_EUUSLA_Water Quality_Manager**

Revision Log
Reference
Cross Reference
Purpose
Scope
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure

Revision Log

Revision 15	**Effective Date:** This version	
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure	Correction	Re-lettered previous I through M to C through G

Revision 14	**Effective Date:** 28-DEC-2020	
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reference	Addition	Added current pH meter instruction manuals
Personnel Training and Qualifications	Required wording	Added proficiency statement
Apparatus and Equipment	Addition	Added current pH meters
Reagents and Standards	method requirement	pH buffers must be ISO Guide 34 (ISO 17034) certified

Reference

1. pH meter Instruction/User Manuals

a. Thermo Scientific Orion Star A111 Benchtop and Star A121 Portable pH Meters Reference Guide. 2011.

See https://assets.thermofisher.com/TFS-Assets/LED/Product-Guides/Orion-Star-A111-and-A121-Meter-User-Guide-EN.pdf

b. Denver Instruments UltraBasic Benchtop pH Meter Operation Manual. 902388.1 Rev A.

See www.denverinstrument.com/denverusa/media/pdf/Op-Man-UB-Long-RevA.pdf

2. Chemical Hygiene Plan, current version.

Cross Reference
Not applicable.

Purpose
The following procedure explains how to calibrate pH meters in the department. They must be calibrated each day before use. Also included are instructions on the maintenance and reconditioning of pH probes.

Scope
The pH meter is sloped using a 3-point calibration curve. The buffers must be at least three pH units apart. Certified pH 4, 7, and 10 buffers are used.

Safety Precautions and Waste Handling
All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Personnel Training and Qualifications
All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP.

Analysts are considered proficient when they have successfully demonstrated competency under supervision of a group leader or other trained analyst. Documentation of this training is in each individual's training records.

Apparatus and Equipment
1. pH meter with probes and Automatic Temperature Compensator (ATC)

    a. Thermo Scientific Orion Star A111 Benchtop pH meter

    b. Denver Instruments UB-10 pH/mV meter

2. 50-mL plastic beakers

3. Stir plate and stir bars

4. Calibration/maintenance logbooks for each pH meter

Reagents and Standards

NOTE: Alternative volumes are acceptable as long as final concentrations remain the same.

1. pH 4, 7, and 10 buffers – ISO 17034 certified, purchased. For expiration information see container.

2. KCl Solution – Purchased, for expiration information see container.

3. Methanol – Purchased, for expiration information see container.

4. Acetone – Purchased, for expiration information see container.

5. Isopropyl Alcohol – Purchased, for expiration information see container.

6. 0.1 N HCl

   a. In a 1-L volumetric flask containing approximately 500 mL reagent water, add 8.3 mL concentrated HCl.

   b. Dilute to volume using reagent water.

   c. Store at room temperature in a glass or plastic container.

   d. Solution expires 1 year from date of preparation.

7. 1.0 N HCl

   a. In a 1-L volumetric flask containing approximately 800 mL reagent water, add 83 mL concentrated HCl.

   b. Dilute to volume using reagent water.

   c. Store at room temperature in a glass or plastic container.

   d. Solution expires 1 year from date of preparation.

8. 1.0 N NaOH

   a. In a 1-L volumetric flask, dissolve 40.0 ± 0.5 g NaOH pellets in approximately 500 mL reagent water.

   b. Cool and dilute to 1 L.

c. Store at room temperature in a glass or plastic container.

d. Solution expires 1 year from date of preparation.

9. Filling and Storage solutions for pH electrodes – purchased; see containers for shelf life information.

Calibration
See Procedure section.

Procedure
NOTE: Prior to calibration, check the pH meter to assure the Automatic Temperature Compensator (ATC) probe is attached and the meter is in the correct mode for ATC correction.

NOTE: Documentation must be recorded in the appropriate logbook for all calibration and/or maintenance performed on meters and/or pH electrodes.

A. Calibration

1. Follow the pH meter's instruction manual for calibration steps using certified 4, 7, and 10 pH buffers. Follow the on screen prompts for each meter. Record each calibrated value at time of calibration as the "Cal as" reading in the corresponding calibration/maintenance logbook.

2. Once all 3 buffers have been read for calibration, the % slope will be displayed. Record the percent slope in the corresponding calibration/maintenance logbook.

3. Re-read the 4, 7, and 10 buffers and record each reading in the corresponding calibration/maintenance logbook as the "pH re-read" value.

B. Acceptance criteria: pH ranges and percent slope

NOTE: These ranges are for pH re-reads and not for calibration pH values

1. The acceptance ranges for pH buffers 4, 7, and 10 are established as follows:

a. "True pH value" of buffer recorded at calibration ± 0.05

For example: If the true value of pH 4 buffer at time of calibration was 4.01, then the acceptable pH range for buffer 4 must be 3.96 pH units to 4.06 pH units.

2. The percent slope must be within the acceptance range of 92% and 102%.

3. If any of the acceptance criteria are not met, the meter must be re-sloped. If any problems remain, rejuvenation of the bulb is necessary. If acceptance criteria is still not met, then seek the guidance of your supervisor.

C. Monthly calibration

Rinse the inside of the electrode with warm reagent water followed by KCl to remove excess KCl crystals. Fill the electrode with new filling solution.

D. Filling solution for pH electrodes

Refer to pH electrode user manual for appropriate filling solution to use for each brand of pH electrode.

E. Rejuvenation of bulb for Orion electrodes

It is possible that a low response or mV reading out of range is due to the bulb being dirty or contaminated.

Either of these steps is taken to clean and rejuvenate the bulb.

1. Soak in 0.1N HCl for 1 hour minimum, followed by soaking in filling solution for at least 1 hour.
2. Rinse with methanol.

F. Rejuvenation of bulb for Beckman electrodes

It is possible that a slow response or mV reading out of range is due to the bulb being contaminated. One or more of the following steps, in order of preference, is taken to rejuvenate the bulb.

1. Soak in 1N HCl for 1 hour. Rinse bulb thoroughly in reagent water.
2. Cycle or alternately immerse bulb between 1N HCl and 1N NaOH for 1 minute in each solution. Soak in pH 4 buffer for 10 minutes.
3. Clean bulb with a 50/50 mixture of acetone and isopropyl alcohol. Soak in pH 4 buffer for 1 hour.

G. Rejuvenation of clogged junction for Beckman electrodes

It is possible that drifting or fluctuating of the pH reading is due to a clogged reference junction. The junction is cleared by soaking the electrode in a saturated KCl solution. Warm this solution to 40° to 50°C and allow it to cool to room temperature with electrode immersed. For refillable combination electrodes, soak junction in electrode filling solution overnight, rinse thoroughly with water and soak for 15 minutes in pH 4 buffer.

End of document

Version history

Version	Approval	Revision information	
13	13.OCT.2016		
14	14.DEC.2020		
15	17.MAR.2022		

eurofins	Always check on-line for validity. **Anions by Ion Chromatography in Waters and Soil by EPA 300.0, SW 846 9056, and SW 846 9056A**	Level: **Work Instruction**
Document number: **T-WC-WI11626**		
Old Reference: **1-P-QM-WI-9011637**		
Version: **23**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **30-APR-2021**	Document users: **6_EUUSLA_Instrumental Water Quality _IC Analyst, 6_EUUSLA_Instrumental Water Quality _IC Verifier**	Responsible: **5_EUUSLA_Instrumental Water Quality_Manager**

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Revision Log
References
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handing
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Quality Control Standards
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Table I
Table II

Revision Log

Revision:	23	**Effective Date:**	This version
Section	**Justification**		**Changes**
Throughout document	Current process		Updated to current LIMS IDs Added TALS reagent IDs Removed low level reagents
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout Document	Current Instrumentation Process		Removed unnecessary sample information that was used for old instrumentation.
Title	Enhancement		Removed 'Determination of'
Procedure 7	Current process		Samples and Standards are diluted with eluent, not DI
Quality Assurance, Quality Control A5	Enhancement		changed "must" to "should"

Revision:	22	**Effective Date:**	This version

Revision:	22	**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Throughout Document	Analysis Clarification		Removed unused analysis and added the DOD analysis to document
Throughout Document	Update Reference SOPs		Updated to current D4 numbers
Calibration and QC standards	Enhancement and traceability		Rewrote sections and updated standard names
Quality Assurance/ Quality Control	Method Change		Updated the frequency of calibration
Quality Assurance/ Quality Control	Analysis update		Added the source and procedure for preforming the matrix Spike

References

1. Method 300.0, Methods for Chemical Analysis of Water and Wastes USEPA 600, Revision 2.1, 1993

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 9056, September 1994.

3. Test Methods for Evaluating Solid Wastes, SW-846 Method 9056A, February 2007

4. ICS-1000, *Chromatography System Operator's Manuel*, Dionex Corporation, Document No.031879, Revision 02, September 2005.

5. Method 4110, *Standard Methods for the Examination of Water and Wastewater*, 21st Edition, 2005, pp. 4-3 to 4-7.

6. Chromeleon®, *Chromatography Management System*, Tutorial and User Manual 6.70, April 2005, or 6.80, March 2007, Dionex Corporation.

7. *Installation Instructions and Troubleshooting Guide for the Ionpac AG14 Guard Column and AS14 Analytical Column*, Dionex Corporation, Document No. 031199, Revision 04, December 10, 1998.

8. *Installation Instructions and Troubleshooting Guide for the Anion Self-Regenerating Suppressor (ASRS-ULTRA)*, Dionex Corporation, Revision 04, Document No. 031367, April 8, 1999.

9. *Chemical Hygiene Plan*, current version.

10. ICS-1100, *Chromatography System Operator's Manual*, Dionex Corporation, Document No. 065289, Revision 01, March 2009.

11. Department of Defense Quality Systems Manual (DOD QSM) revision 5.3, 2019

Cross Reference

Document	Document Title
T-WC-WI10083	Reagent Water Extraction (as Preparation for Analysis on the Ion Chromatograph or Autoanalyzer)
T-WC-WI11652	Quality Control for Analyses Preformed in Insturmental Water Quality
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits
QA-SOP11886	Processing Regulatory Compliance (i.e. SDWA, NPDES) Samples
QA-SOP11188	Reagents and Standards

Scope

This method covers the determination of the following inorganic anions in reagent water, drinking water, surface water, wastewater, and groundwater using an ion chromatography system: bromide, chloride,

fluoride, nitrate-N, nitrite-N, and sulfate. The limits of quantitation and method detection limits are found in the analysis information file.

This method is used on solids after a reagent water extraction. See analysis 1352. The limits of quantitation for anion analysis of a solid are also found in the analysis information file.

For EW samples: MCL violations must be reported within regulatory guidelines. Refer to QA-SOP11886 for MCLs and reporting requirements.

Basic Principles

A small volume of sample is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, separator column, suppressor, and conductivity detector. Separations are due to differences in the equilibrium distribution of sample components between the mobile phase (eluent) and stationary phase (column exchange resin). Retention times for various anions depend on several factors such as ionic charge, ionic size, pH, resin type, eluent concentration, and flow rate.

Interferences

Interferences occur when substances with retention times that are similar to and overlap those of the anion of interest are present. Often, large amounts of an anion interfere with the peak resolution of an adjacent anion. Use sample dilution to solve most interference problems.

Potential sources of interference which lead to false readings or elevated baselines are contaminated reagents, glassware, or other sample-processing apparatus. Samples containing particulate matter >0.45 microns require filtration to prevent damage to instrument columns and flow systems. If any samples on a batch are filtered, the corresponding PBW and LCSW must also be filtered.

Known coelution is caused by carbonate and other small organic anions such as acetate and formate. At certain fluoride concentrations or in certain sample matrices, this interference is not significant. It is the analyst's responsibility to perform a spike in any sample matrix that has interferences potentially affecting the fluoride determination. If repeatability and accuracy are not obtained in the sample matrix, it is recommended that this method not be used for fluoride.

Safety Precautions and Waste Handing

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

There are no special safety precautions for this method. Follow routine laboratory safety steps. Discard all acid waste in the acid waste containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst’s training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Proficiency is measured through an Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control spikes (or alternatively, one blind sample for the DOC) that are carried through all steps of the procedure and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Samples must be collected in unpreserved, clean glass or polyethylene containers. Samples for fluoride must be collected in plastic. Samples must be stored at 0° to 6°C, not frozen. The holding time for samples is 28 days except for samples requiring nitrate nitrogen and/or nitrite nitrogen analysis. Samples requiring one or more of these analyses must be run within 48 hours of collection.

Waters – Samples with particulate matter >0.45 microns must be filtered before analysis. The corresponding LCSW and PBW of filtered samples on a batch must also be filtered.

Blanks (rinse blanks – RB, equipment blanks – EB, field blanks – FB) and GLP samples must initially be run at a dilution factor of one. Most other samples are initially analyzed at a dilution factor of five, which increases the reporting limits by a factor of five. The analyst must increase this dilution factor further (if necessary) to obtain raw results that are less than the most concentrated calibration curve standard for the anion(s) of interest.

NOTE: Refer to Project Notes in Parallax for client/project specific requirements for each sample.

Highly alkaline or highly acidic samples must be neutralized before injection. Often, sample dilution is used in lieu of neutralization.

If appropriate, samples are prescreened for chloride and sulfate. For sulfate, add approximately 0.2 to 0.3 g of $BaCl_2$ using a measuring spoon (1 scoop) to one culture tube of sample. The amount of sulfate in the sample is estimated based upon the resulting turbidity. For chloride, add a few drops of 0.1 N $AgNO_3$ to one culture tube of sample. The chloride is estimated based upon the resulting turbidity. For nitrate nitrogen and nitrite nitrogen, estimate the concentration of the sample using nitrite/nitrate test strips.

Apparatus and Equipment

1. Dionex system ICS-1000, or ICS-1100 Ion Chromatograph
2. PC, with Windows XP (or equivalent)
3. Hard disk, monitor, keyboard, mouse, and printer
4. Chromeleon® software, Version 6.70 (or newer), Dionex Corporation, 2005
5. Lancaster Laboratories' LIMS system with IDAT
6. Automatic sampler
7. Anion guard column, 4 × 50 mm, Dionex AG14, or equivalent
8. Anion analytical column, 4 × 250 mm, Dionex AS14, or equivalent
9. Anion suppressor, Dionex anion self-regenerating suppressor, ASRS-Ultra, or equivalent
10. Conductivity cell detector
11. Analytical balance, capable of accurately weighing to 0.0001 g

Reagents and Standards

NOTE: All chemicals used must be ACS reagent grade unless otherwise noted. See QA-SOP11188 for the appropriate labeling and documentation of reagents and standards. It is acceptable to use different volumes or weights in the preparation of reagents or standards as long as the ratios remain equivalent.

1. Concentrated eluent solutions, 0.5 M $NaHCO_3$ (WC_IC_BCrbSTK) and 0.5 M Na_2CO_3 (WC_IC_CrbSTK)

Sodium bicarbonate ($NaHCO_3$)	42.00 ± 0.05 g

Sodium carbonate (Na2CO3)	53.00 ± 0.05 g

a. Prepare separate stocks for each component by dissolving each reagent listed above in reagent water and diluting to 1 L in a volumetric flask.

b. Store stock solutions in amber glass at 0° to 6°C not frozen.

c. Stable for 30 days.

2. Working eluent for AS14 column, 1.0 mM NaHCO3/3.5 mM Na2CO3

a. Combine 32 mL of sodium bicarbonate concentrated eluent and 112 mL of sodium carbonate concentrated eluent.

b. Dilute the solution to 16 L with reagent water.

c. Store in plastic carboy. Stable for 7 days at room temperature.

3. BaCl2 (anhydrous) – Purchased. Store at room temperature. See label for expiration date.

4. 0.1 N AgNO3 – Purchased. Store at room temperature. See label for expiration date.

5. Nitrate/Nitrite test strips – Purchased. Store at rom temperature. See label for expiration date.

Calibration

Calibration

A. Stock standards for calibration - These anion standards are purchased with a concentration of 1000 mg/L each. Store purchased standards at room temperature. See label for expiration date. As an option, below is the procedure for preparing stock standards:

Cal Standard 1

Sodium fluoride (NaF)	2.2100 g
Potassium nitrate(KNO_3)	7.2179 g
Sodium nitrite($NaNO_2$)	4.9257 g

Cal Standard 2

Sodium chloride (NaCl)	1.6485 g

Cal Standard 3

Potassium bromide (KBr)	1.4893 g

Cal Standard 4

Sodium sulfate(Na_2SO_4)	1.4787 g

a. Dry each of the above compounds at 105°C ± 5°C for 30 minutes (± 5 minutes). Weigh each compound to ± 0.0003 g.

b. Weigh out and quantitatively transfer into a 1000-mL volumetric flask.

c. Dilute to volume with reagent water. The concentration of each of the standard solutions is 1000 mg/L. Store at 0° to 6°C not frozen. The solutions are stable for 30 days.

NOTE: Salt standards that are stored in a dessicator must be covered with parafilm, not ground glass stoppers.

B. Waters and Soils Calibration Standards

1. Detection limit standard (WC_IC_C_Det)

Anion (1000 mg/L stock)	Initial Volume (mL)	Final concentration (mg/L)
Fluoride (WC_IC_C_F)	0.5	10
Nitrite (WC_IC_C_NO2)	0.5	10
Nitrate (WC_IC_C_NO3)	0.5	10
Chloride(WC_IC_C_Cl)	2.0	40
Bromide (WC_IC_C_Br)	2.5	50
Sulfate (WC_IC_C_SO4)	5.0	100

a. Using a volumetric pipette, add the above volumes to a 50-mL volumetric.

b. Dilute to volume with reagent water.

c. Prepared fresh each time the instrument is recalibrated and store at room temperature.

2. Intermediate calibration standard (WC_IC_C_Int)

Anion (1000 mg/L stock)	Initial Volume (mL)	Final concentration (mg/L)
Fluoride (WC_IC_C_F)	0.5	10
Nitrite (WC_IC_C_NO2)	0.5	10
Nitrate (WC_IC_C_NO3)	0.5	10
Chloride (WC_IC_C_Cl)	1.0	20
Bromide (WC_IC_C_Br)	2.5	50
Sulfate (WC_IC_C_SO4)	2.5	50

a. Using a volumetric pipette, add the above volumes to a 50-mL volumetric.

b. Dilute to volume with reagent water.

c. These standards are stable for 24 hours at room temperature.

3. Working calibration standards and continuing calibration verification (CCV)

Pipette the specified volume of the appropriate calibration standard into a volumetric flask. Dilute to volume with reagent water. Prepare fresh daily according to the table below:

Regular Anion				Mg/L - Anions			
	Std	Std Volume (mL)	Final Volume (mL)	F/ NO_2, NO_3	Cl	Br,	SO_4
Cal 1	Det. Limit Std	0.5	50	0.1	0.4	0.5	1.0
Cal 2	Int. Cal Standard	2.0	50	0.4	0.8	2.0	2.0
Cal 3	Int. Cal Standard	5.0	50	1.0	2.0	5.0	5.0
Cal 4	Int. Cal Standard	10.0	50	2.0	4.0	10.0	10.0
Cal 5	Int. Cal Standard	15.0	50	3.0	6.0	15.0	15.0
CCV/LCS	Int. QC Standard	15.0	50	0.75	3.0	7.5	7.5

NOTE: A reagent water blank is analyzed prior to the calibration and must contain no anions of interest. Therefore all anions must be< the MDL or re-calibration must occur.

Quality Control Standards

A. QC Standards – pipet the below standards in 50-ml volumetrics and bring to volume with reagent water. Stable for 24 hours at room temperature.

1. Soil QC Standard (WC_IC_DISPIKE)

Anion (1000 mg/L stock)	Initial Volume (mL)	Final concentration (mg/L)
Fluoride (WC_IC_Q_F)	0.5	10
Nitrite (WC_IC_Q_NO2)	0.5	10
Nitrate (WC_IC_Q_NO3)	0.5	10
Chloride (WC_IC_Q_Cl)	1.0	20
Bromide (WC_IC_Q_Br)	2.5	50
Sulfate (WC_IC_Q_SO4)	2.5	50

2. Intermediate QC standard (WC_IC_QC2)

Anion (1000 mg/L stock)	Initial Volume (mL)	Final concentration (mg/L)
Fluoride (WC_IC_Q_F)	0.25	5
Nitrite (WC_IC_Q_NO2)	0.25	5
Nitrate (WC_IC_Q_NO3)	0.25	5
Chloride (WC_IC_Q_Cl)	1.0	10
Bromide (WC_IC_Q_Br)	2.5	50
Sulfate (WC_IC_Q_SO4)	2.5	50

B. Working control standards

1. ICV/CCV2 and LCSW:

a. Pipette 7.5 mL of the intermediate QC standard into a 50-mL volumetric flask, which contains about 80-mL reagent water.

b. Dilute to volume with reagent water.

c. This standard must be prepared daily. True values of this standard are:

NO2, NO3, F	0.75 mg/L
Cl	3.0mg/L
Br, SO4	7.5 mg/L

2. The LCSS is spiked before digestion of samples using the Soil QC Standard. See the preparation SOP T-WC-WI10083.

Procedure

1. Check chromatography setup for proper installation according to the following flow diagram:

Anion Self-Regenerating Suppression

injection valve ® guard column ® anion column ® ASRS suppressor ® conductivity cell ® ASRS suppressor ®waste

2. Check working eluent reservoirs. If levels are getting low, replenish as needed.

3. Start up the ion chromatograph using Table I as a guide.

NOTE: Prime the analytical pump before turning on if the system has not been used for a few days or if the working eluent has been changed.

4. Do not begin any injections until the pressure of the system has equilibrated and the conductivity reading has stabilized.

5. Using Chromeleon®, set up the ion chromatograph with the method, program file, and sequence files to be used. Refer to the *Chromeleon® User's Guides* for more detailed instructions on the use of the software.

a. A new sequence table is started with each daily batch of samples. The daily sequence table is identified with a six-digit number containing the following information:

```
        03    360     X
RUN#
        |     |       |
        yr    |       |
        Julian day    |
                Where x is the system #
```

b. A program file is identified as the template as this information does not change from the sequence under which the system was calibrated. Calibrations last for up to one month.

c. All data files are saved in the sequence with which they are run.

6. Inject aliquots of reagent water until a stable baseline results.

7. Prepare standards and sample dilutions. Use eluent for the diluent.

8. The dilution factor must be entered for each sequence file. For solids, the sample weight is entered into the volume column. The dilution factor for solids is calculated by multiplying the final volume of the extract (typically 50-mL) by the dilution performed.

9. When calibrating the system, use a blank and the working calibration standards. After the calibration standards, analyze the following: batch QC, ICV, ICB, independent QC standard.

10. Samples are injected. A CCV and CCB are required after every 10 injections.

11. All injections must be documented with the following:

a. Sample name

b. Dilution factor

c. Auto-sampler Position

Calculations

This analytical method has been validated using peak areas for quantitation. The calibration fit is linear, equally weights all calibration points, and ignores zero. The equation of the line is y = K0 + K1x, where y = the area, K1 = the slope, x = the concentration, and K0 = the y intercept. Chromeleon® software performs the above determinations each time the calibration is updated. After the calibration is completed, Chromeleon® determines x (concentration) using the above equation. For the waters report format, Chromeleon® automatically multiplies this result by the dilution factor that has been entered by the analyst. For the solids report format, Chromeleon® performs the calculation using the analyst's inputted values for sample weight in grams and dilution factor. (The value entered in the dilution factor column is the volume extracted [normally 50 milliliters] × any dilution made by the analyst).

Statistical Information/Method Performance

1. The method detection limit (MDL) must be determined every 6 months by following the procedure outlined in QA-SOP11892

2. The quality control acceptance windows must be generated by following the procedure outlined in QA-SOP11896.

Quality Assurance/Quality Control

Check standards are used to establish retention times at the beginning of each calibration. The retention window assigned to each analyte is set with each calibration. Refer to the Initial Calibration for each analyte's specific window. The windows are set from 0.200AG to 1.00 AG. The window is +/- a set time from the greatest peak within the window around each established retention time. The time input is in minutes. For example, 1.00 AG corresponds to 60s, therefore 0.200 AG corresponds to 12 seconds.

A. For waters and solids:

1. Calibration

a. The ion chromatography system should be recalibrated every 30 days. Instruments must be re-calibrated,whenever the calibration verification requirements of ±10% are not met or if the retention time windows are exceeded.

b. For each analyte of interest, a blank and calibration standards at 5-concentration levels must be used to calibrate the instrument.

(1) The concentrations for cal 1 must recover within 50% of the true value. The concentrations for this cal are equal to the reporting limit for each anion.

(2) The calibration curves for the anion(s) of interest must have a correlation coefficient (r) of greater than or equal to 0.995 for the curve to be valid. The r^2 value must be greater than or equal to 0.99.

NOTE: Chromeleon® returns an r^2 value for the correlation coefficient. The square root of this value is the "r" value, which is used to evaluate the curve.

c. The linearity of the calibration range must be verified every 6 months or whenever a significant change in instrument response is observed or expected. A minimum of 3 calibration standards must be analyzed. The results of these standards must not deviate from the true values by >10%. If this criterion is not met, linearity must be re-established. The values of the three standards are taken from the calculated values of the standards used for the calibration curve.

2. An ICV standard must be analyzed after every calibration. An acceptable result is a result which does not deviate from the true value by >±10%. If this criterion is not met for any anion(s) of interest, the cause for the out-of-spec condition must be determined if possible. Corrective action must be taken and the ICV

reanalyzed. Upon reanalysis, if the acceptance criterion still is not met for the anion(s) of interest, the instrument must be recalibrated. If the acceptance criterion is met, the analysis is in control. Any samples affected by the original out-of-spec ICV must be repeated. All corrective action taken must be documented. Refer to T-WC-WI11652.

NOTE: If referencing Method 9056, results for the anions must not deviate from the true value by >±5%.

3. An ICB must be analyzed after every calibration. An acceptable result is a result < the MDL for the anion(s) of interest. If this criterion is not met for the anion(s) of interest, the cause for the out-of-spec condition must be determined if possible. Corrective action must be taken and the ICB reanalyzed. Upon reanalysis, if the acceptance criterion still is not met for the anion(s) of interest, the instrument must be recalibrated. If the acceptance criterion is met, the analysis is in control. Any samples affected by the original out-of-spec ICB must be repeated. All corrective action taken must be documented. T-WC-WI11652.

4. Samples must be analyzed in batches not exceeding 20 samples per batch.

5. Sample results must not exceed the concentration of the highest standard. If a sample result falls above this value, the sample is diluted and run again. The sample result for any diluted sample should be >10% of the concentration of the highest standard for it to be considered acceptable data.

6. A batch blank (PBS, or PBW) must be analyzed for the anion(s) of interest in every batch. An acceptable result is a result < the MDL for the anion(s) of interest. If this criterion is not met, the cause for the out-of-spec condition must be determined and corrective action taken, if possible. The batch blank is reanalyzed once. Upon reanalysis, if the acceptance criterion still is not met for the anion(s) of interest, all samples associated with the batch blank must be re-prepared and reanalyzed. If the acceptance criterion has been met for a reanalyzed blank, all sample results associated with the batch blank are valid. All corrective action taken must be documented. Refer to T-WC-WI11652.

7. A LCSS or LCSW must be prepared and analyzed for the anions of interest in every batch. The current acceptance window of the LCSW is 90% to 110%. See Lims for the acceptance windows for DOD analyses - 10697, 10698, 10699, 10700, 10701, and 10702. If this criterion is not met, the cause for the out-of-spec condition must be determined if possible. Corrective action must be taken and the LCS reanalyzed. Upon reanalysis, if the acceptance criterion is still not met, all samples associated with that LCS must be re-prepared and reanalyzed.

If the acceptance criterion is met, the sample results are valid. All corrective action that was taken must be documented. Refer to T-WC-WI11652.

8. Based upon client requirements (when appropriate) a LCSDS or LCSDW is also prepared and analyzed under the same conditions as the LCS. The acceptable range is the same as that of the LCS. If this criterion is not met, the cause for the out-of-spec condition must be determined, if possible. Corrective action must be taken and the LCS and LCSD reanalyzed. Upon reanalysis, if the acceptance criterion is still not met, all samples associated with the LCS and LCSD must be re-prepared and reanalyzed. If the acceptance criterion is met, the sample results are valid. All corrective action that was taken must be documented. For the acceptable RPD between the LCS and LCSD, refer to the current statistical windows in the LIMS. If the RPD is outside these criteria, consult your group leader to determine if reanalysis is necessary.

9. A CCV and CCB must be analyzed after every 10 injections. An acceptable result for the CCV is a result which does not deviate from the true value by> ±10%. An acceptable result for the CCB is a result < the MDL. If the CCV and/or CCB do not meet this acceptance criterion, all samples since the last compliant CCV/CCB and before the next compliant CCV/CCB must be reanalyzed for the out-of-spec analyses. The cause of the out-of-spec condition must be determined and corrective action, if taken, must be documented. Refer to T-WC-WI11652.

NOTE: If referencing Method 9056, results for the anions must not deviate from the true value by >±5%.

10. A duplicate must be prepared and analyzed for every 10 samples in the batch (not to exceed 20 samples). For the acceptable RPD, refer to the LIMS. The cause of the out-of-spec condition must be determined if possible and corrective action, if taken, must be documented.

11. A MS must be analyzed for every 10 samples in the batch (not to exceed 20 samples). The MS is prepared by adding 0.5 mL of the intermediate QC STD to a 5 mL volumetric and bringing to volume with the appropriate sample. (The MS can be prepared into any volume volumetric as long as the amount of intermediate QC added is adjusted to keep the ratio of 1:10 the same.) See LIMS for current windows.

Table I

Ion Chromatographic Operating Conditions

		ICS-1100	ICS-1000
System Power		On	On
Service Air Valve (In-house air)		N/A	N/A
Helium Pressure Valve		N/A	N/A
High Limit Switch		3000 psi	3000 psi
Analytical Pump Flow Rate		1.2 mL/min	1.2 mL/min
Low Limit Switch		0 psi	0 psi
ASRS current		24 mA	39 mA
Detector Range (Full Scale)		10 µS	10 uS
Operating Pressure		1200-2200 psi	1200-2200 psi
Temperature Compensation		1.7 %/ºC	1.7 %/°C
Sample Loop		Approx. 50 µL	Approx. 50 µL
Analytical Pump		On	on

Table II

Ion Chromatography Shutdown Conditions

	ICS-1000/ICS-1100
Analytical Pump	Off
Service Air Valve (In-house air)	Closed
Helium Pressure Valve	N/A
ASRS Suppressor Current	N/A
System Power	Off
Analytical Pump	Off

End of document

Version history

Version	Approval	Revision information
21	26.MAY.2015	
22	10.DEC.2018	
23	22.APR.2021	

eurofins	Always check on-line for validity. **TOC and TC in Solids and Sludges by Combustion by SM 5310B, EPA 415.1, SW-846 9060/9060A, Lloyd Kahn**	Level: **Work Instruction**
Document number: **T-WC-WI11627**		
Old Reference: **1-P-QM-WI-9013418**		
Version: **17.1**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **06-JUL-2021**	Document users: **6_EUUSLA_ Instrumental Water Quality _TOC Analyst, 6_EUUSLA_ Instrumental Water Quality _TOC Verifier**	Responsible: **5_EUUSLA_Instrumental Water Quality_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Sample Cup Preparation
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision:	18	**Effective Date:**	This version
Section		**Justification**	**Changes**
Revision Log		Formatting requirement	Removed revision logs up to the previous version
Reference		MUR	Added method reference to comply with MUR
Throughout Document		LIMs update	Corrected IDs to match current LIMs

Revision:	17	**Effective Date:**	July 09, 2019
Section		**Justification**	**Changes**
Revision Log		Formatting requirement	Removed revision logs up to the previous version.
Scope		Current Process	Removed LIMS analyses 6623 and 11763

Revision:	17	**Effective Date:**	July 09, 2019
Reference Modifications	Method Requirement		Removed 10% dup instead of a quadruplicate per batch
Procedure 8.	Current Process		Removed the process of analyzing three blanks prior to calibration.
Procedure 10.	Current Process		Removed the concentration of the CCV, this changes dependent on the CRM provided by the manufacturer
QA/QC	Method Requirement		One quadruplicate per batch for Lloyd Kahn

Reference

1. Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005, Method 5310B-2011,

2. Standard Methods for the Examination of Water and Wastewater, Method 5310B-2014.

3. *Method 415.1, Methods for Chemical Analysis of Water and Wastes USEPA 600.*

4. Test Methods for Evaluating Solid Wastes, SW-846 Method 9060, September 1986.

5. Test Methods for Evaluating Solid Wastes, SW-846 Method 9060A, November 2004

6. *The Primacs SNC-100 Analyzer Manual*, Skalar..

7. *Determination of Total Organic Carbon in Sediment, U. S. EPA, Region II, July 27, 1988. ("Lloyd Kahn Method.").*

8. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits
QA-SOP11188	Reagents and Standards

Scope

This method is applicable for the determination of total organic carbon (TOC) in soils and other samples not easily analyzed by the TOC waters method. The limit of quantitation (LOQ) for this method can be found in the analysis information file. Quantitative TOC results up to 1,000,000 mg/kg may be obtained by this method.

Basic Principles

TOC is determined by acidifying a sample and heating it to remove the TIC. An aliquot of sample (1 mg to 1 g) is weighed into a sample cup. The sample is then heated to 900°C for combustion of the remaining TOC. The resulting carbon dioxide from the TOC is detected by a nondispersive infrared (NDIR) detector that has been calibrated to directly display the mass of carbon dioxide detected. The mass is proportional to the mass of TOC in the sample. Samples analyzed by this method include solids such as soils or sediments, slurries, sludges, brines, and corrosives.

The TC measurement is identical to the TOC measurement, with the exception that there is not an acidification and heating step to remove the TIC.

TIC is the calculation subtracting the TOC soil result from the result obtained when analyzing the TC.

Reference Modifications

There is no referenced method for the determination of Total Carbon in solids the analysis references a modified TOC method. The calibration standards, QC standards, and LCS employed for this analysis are composed of only organic sources of carbon (Sucrose for the calibration and QC standards, and a purchased standard for the LCS solid). Therefore, the Total Organic Carbon content is equal to the Total Carbon content in these standards.

Interferences

Carbon is ubiquitous in nature. Therefore, extra care must be taken to avoid contamination of reagents, glassware, and any other materials that come in contact with the sample. Samples which are light in weight may need to be analyzed at smaller aliquots to fit within a sample cup. These samples are reported with an elevated LOQ.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

1. Normal laboratory practices for safety must be followed.

2. Extreme caution must be used when handling sample cups after they have been analyzed.

3. Discard acid waste in acid waste containers.

4. See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and a documented Demonstration of Capability.
Analysts are considered proficient when they have successfully completed a Demonstration of Capability for the analysis. A Demonstration of Capability consists of four laboratory control standards that are carried through all steps of the analysis and that meet the acceptance criteria for the LCS and LCSD. Documentation for these studies are in each individual’s training records.

Demonstration of Capability is performed annually and is maintained in the analyst's training records.

Sample Collection, Preservation, and Handling

Samples must be collected and stored in glass containers unpreserved. Samples must be stored under refrigeration at 0° to 6°C, not frozen.

Because very small amounts (1 mg to 1 g) of sample are used for the analysis, the sample must be as homogeneous as possible.

The holding time for analysis by SM 5310 B, EPA 415.1 and SW-846 9060/9060A is 28 days. The holding time for analysis by the Lloyd Kahn method is 14 days.

Apparatus and Equipment

1. Skalar-Primacs SC100

2. PC and SNAccess software

3. 2-stage gas regulator (two required)

4. Sample cups

5. Fiber quartz wool

6. Analytical balance, capable of accurately weighing to 1. mg

7. Glassware – General laboratory glassware as needed for preparing reagents and standards

8. Microliter syringe, various volumes

Reagents and Standards

NOTE: All chemical used must be ACS reagent grade unless otherwise noted.
Different volumes or weights may be used provided the ratios remain equivalent.
See *QA-SOP11188*, for the appropriate labeling and documentation of reagent and standard preparation.

1. Ultra pure nitrogen gas (60 psi)

2. Ultra pure oxygen gas (60 psi)

3. Hydrochloric acid, concentrated (HCI) – Purchased. Store at room temperature.

4. 1+1 Phosphoric acid (WC_TOC_1:1PA)

Phosphoric acid (H3PO4)	50 mL
Reagent water	50 mL

Take 50 mL of H3PO4 and add slowly while swirling to a 100-mL volumetric flask containing 50 mL reagent water. Store at room temperature. Prepare fresh every 6 months.

5. TOC stock calibration standard (sucrose containing 30% carbon) (WC_TOC_30%SUC), purchased. See label for expiration date. Store at room temperature.

6. TOC LCS standard, purchased (WC_TOC_SLCSCC). See label for expiration date, and the certified concentration. Store at room temperature.

Sample Cup Preparation

Sample cups must be conditioned prior to analysis. This is achieved by heating the cups to 750°C for a period of 2 to 5 minutes.

Calibration

1. Working standards for calibration

Pipette a volume of the TOC stock calibration standard into the sample cups as follows:

Working Std. (mg C)	Vol. Stock TOC (µL)
0.30	1.0
0.90	3.0
3.0	10.0
6.0	20.0

Prepare fresh daily. Store at room temperature.

2. Continuing calibration verification standard (CCV)

This is a purchased standard, and the acceptable range is specified by the manufacturer.

Procedure

1. Turn on nitrogen to 60 psig.

2. Turn on oxygen to 60 psig.

3. Add water and a drop of HCI to the scrubber.

4. Measure the carrier gas (oxygen) flow rate and adjust to 200 mL/min.

5. Measure the dryer gas (nitrogen) flow rate and adjust to 160 to 300 mL/min.

6. Power up instrument.

7. Program in a sequence file.

8. Run the calibration sequence as follows: 0.30, 0.90, 3.0, and 6.0 mg C (Performed monthly).

9. The instrument automatically calculates the R and list the calibration data.

10. Samples are analyzed along with the appropriate laboratory control standard and preparation blank. A check standard (CCV) and a continuing calibration blank (CCB) must be run at the beginning of each run and after every ten samples.

11. Add sufficient glass wool to each cup to cover the bottom surface.

12. Weigh samples into sample cups (up to 1000 mg). Add 1+1 H3PO4 drop wise until effervescence stops. Heat at 75°C for 15 minutes. Record the oven ID, time and temperature of this step in the log book.

NOTE: This procedure will convert inorganic carbonates and bicarbonates to carbon dioxide and eliminate it from the sample. The addition of H3PO4 and the heating to 75°C is not performed for analysis 10065.

13. Analyze the residue according to the instrument manufacturer's instructions for the remaining TOC result.

Calculations

1. To determine mg/kg TOC or TC

   mg/kg = (Raw result in mg C) x (1000/weight in mg) x (1000)

2. To determine LOQ/MDL factors

$$Factor = \frac{Maximum\ sample\ aliquot\ weight\ (1000.mg)}{weight\ of\ sample\ (mg)}$$

3. To determine Total Inorganic Carbon (TIC)

   TIC = Total Carbon (TC) - Total Organic Carbon (TOC)

Statistical Information/Method Performance

1. The method detection limit (MDL) is determined annually by following the procedure outlined in *QA-SOP11892*.

2. The quality control acceptance windows are generated annually by following the procedure outlined in *QA-SOP11896*.

Quality Assurance/Quality Control

1. A calibration must be performed every 30 days. The acceptable range for the calibration is R = 0.995 or greater. If this criteria is not met, the instrument must be recalibrated.

2. A batch must contain no more than 20 field samples.

3. A batch blank (MB) must be analyzed every batch or each day samples are prepared (not to exceed 20 samples). An acceptable result is < the limit of quantitation. If the PBS does not meet this criterion, it must be rerun twice. If either of the two additional trials do not meet the acceptance criterion, all samples in the batch must be repeated.

4. A laboratory control standard (LCSS) must be analyzed every batch or each day samples are analyzed (not to exceed 20 field samples). For TOC this is a purchased standard and the acceptable range is specified by the manufacturer. The LCSS should undergo the same steps as the samples. If the LCSS does not meet the acceptable criterion, it must be repeated twice. If either of the two additional trials do not meet the acceptance criterion, all samples in the batch must be reanalyzed.

5. Based upon client requirements, a laboratory control standard duplicate (LCSD) may need prepared and analyzed under the same conditions as the LCS. The acceptance criterion for the LCSD is the same as that of the LCS. The relative percent difference between the LCS and the LCSD is calculated statistically.

6. 9060 - a duplicate is analyzed every 10 samples. Lloyd Kahn - one sample is analyzed in quadruplicate every batch. The acceptable relative percent difference is statistically determined. The duplicate relative percent differences must be tracked to continually monitor method performance.

7. 9060, 5310B - A spike must be analyzed for every 10 samples. The sample is spiked with 3 ul of the purchased TOC stock calibration standard. The acceptance range is determined statistically. The spike recoveries must be tracked to continually monitor method performance.

8. Based upon client requirements, a matrix spike duplicate (MSD) may need prepared and analyzed under the same conditions as the MS. The acceptance criterion for the MSD is the same as that of the MS. The relative percent difference between the MS and the MSD is calculated statistically.

9. A check standard (CCV) and blank (CCB) must be run after every ten injections (including blanks and standards). The acceptable range for the CCV determined by the manufacturer. An acceptable CCB result is < the limit of quantitation. If either, or both, of these injections do not meet the acceptance criterion, the unacceptable original must be repeated twice. If either of the two additional trials do not meet the acceptance criterion, all samples since the last compliant CCV/CCB must be reanalyzed.

10. A CCV and CCB shall be analyzed at the beginning and the end of each run. At any time when the instrument has been idle for a period of 4 hours or more, a CCV and CCB must be analyzed. If either of these parameters cannot meet specifications, the instrument must be recalibrated.

11188 Reagents and Standards
11892 Determining Method Detection Limits and Limits of Quantitation
11896 Establishing Control Limits

End of document

Version history

Version	Approval	Revision information	
16	17.OCT.2018		
17	03.JUL.2019		
17.1	22.JUN.2021		

eurofins	Always check on-line for validity. **Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), and Total Inorganic Carbon (TIC) by SM 5310C or EPA 415.1 in Waters**	Level: **Work Instruction**
Document number: **T-WC-WI11637**		
Old Reference: **1-P-QM-WI-9011651**		
Version: **18.1**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **12-NOV-2021**	Document users: **6_EUUSLA_ Instrumental Water Quality _TOC Analyst, 6_EUUSLA_ Instrumental Water Quality _TOC Verifier**	Responsible: **5_EUUSLA_Instrumental Water Quality_Manager**

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Revision Log
Reference
Cross Reference:
Scope:
Basic Principles:
Reference Modifications:
Interferences:
Safety Precautions and Waste Handling:
Personnel Training and Qualifications:
Sample Collection, Preservation, and Handling:
Apparatus and Equipment
Reagents and Standards
Calibration:
Procedure:
Calculations:
Statistical Information/ Method Performance:
Quality Assurance/Quality Control:

Revision Log

Revision:	18.1	**Effective Date:**	This version
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Procedure	Correction		Syringe filters are not rinsed prior to use.
QAQC 2.	Clarification		CCVs alternate concentration.

Revision:	18	**Effective Date:**	11/12/2021
Section	**Justification**		**Changes**
Revision Log	Formatting requirement		Removed revision logs up to the previous version
Reference Modifications	Lab Practice		Syringe filters are not rinsed prior to use.
Throughout Document	SM5310A-2014		All blanks are evaluated to <RL
Personnel Training and Qualifications	SM5310A-2014		IDOC performed with 4LCS

Revision:	18	**Effective Date:**	11/12/2021
Sample Collection, Preservation, and Handling	SM5310A-2014		DOC Samples filtered in the lab must be filtered within 48 hours.
Apparatus and Equipment	DOC procedure		Added syringe filters

Reference

1. Standard Methods for the Examination of Water and Wastewater, 22nd Edition, Method 5310 C - 2000

2. . Standard Methods for the Examination of Water and Wastewater, Method 5310 C- 2011

3. Standard Methods for the Examination of Water and Wastewater, Method 5310 C -2014.

4. Method 415.1, Revision 1 (1974), Methods for Chemical Analysis of Water and Wastes USEPA 600.

5. *Model 1030 Total Organic Carbon Analyzer Operating Procedures and Service Manual,* O.I. Corporation, 2005.

6. *Chemical Hygiene Plan*, current version.

7. QC Laboratories Inc.SOP QC0590.

Cross Reference:

Document	Document Title
T-WC-WI11644	Maintenance of the OI Analytical Model 1030 Total Organic Carbon Analyzer
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits

Scope:

This procedure is applicable for the determination of total organic carbon, Dissolved Organic Carbon, or Total Inorganic Carbon in water and wastewaters by SM 5310 C or EPA 415.1.

Swabs can be accepted and analyzed for TOC as a special request by the client.

The current limit of quantitation (LOQ) and method detection limit (MDL) for this analysis can be found in the laboratory information management system (LIMS).

Basic Principles:

The procedure outlined in this method pertains to the O.I. Model 1030 analyzer. This model uses the persulfate oxidation technique.

A sample aliquot of water or wastewater is injected into a reaction vessel at 100°C where metered amounts of phosphoric acid are added. The sample is purged with ultrapure nitrogen gas to remove inorganic carbon as carbon dioxide and any purgeable organic carbon (POC). Following the purging of the inorganic fraction, a metered amount of sodium persulfate is added to the reaction vessel, and the sample is heated. The persulfate oxidizes any organic carbon to carbon dioxide. Following the completion of the persulfate digestion, the carbon dioxide is carried to the IR detector by the nitrogen stream.

Samples for DOC are passed through a 0.45-µ membrane filter prior to analysis. TIC can be determined by calculating the difference between total carbon and TOC.

Clients can send swabs for the determination of TOC. These samples are reported as mg/swab. Multiply the concentration of TOC found in the extract by the swab extract volume.

Reference Modifications:

There are no procedural differences between EPA 415.1 and SM 5310 C.

Syringe filters are not rinsed prior to sample filtration. All Method Blanks and LCS samples are filtered in the laboratory to show that there is no interference (positive or negative) that impacts DOC analysis. MB are evaluated to <1/2RL and LCS are evaluated to method criteria, showing acceptability of filters used in the laboratory.

Interferences:

This method is generally free of interferences when normal wastewater and water samples are analyzed. However, high concentrations of chloride can interfere and several other problems can arise from certain sample matrices. These are listed below.

1. Chloride can react with the persulfate, which can cause erroneously low TOC results. Samples high in chloride may require that extra persulfate be added and the reaction time extended. The chlorine gas that is produced is also damaging to the molecular sieve. For these reasons, samples must not be preserved with hydrochloric acid.

2. Samples with high levels of inorganic carbon may require extra acid and longer purge time to ensure all the carbonates and bicarbonates are removed from the sample. A smaller sample volume may also be used.

3. Samples with high levels of organic carbon may require that extra sodium persulfate be added and that the reaction time is extended to ensure that all the organic carbon is oxidized by the persulfate. A smaller sample volume may also be used. Spiking the sample with a known amount of carbon and calculating recovery can be used to verify the oxidation efficiency.

4. When sequentially analyzing samples, carryover may occur when a sample high in carbon is followed by a sample low in carbon. This will produce erroneously high results for low-level TOC samples. This is caused by adsorption of organic carbon on the Teflon™ tubes and overloading of the molecular sieve. If an excessively high-level sample is accidentally introduced into the system, it may be necessary to clean the digestion vessel with reagent water before analyzing any more samples. This is accomplished by cycling reagent water and the reagents through the system until TOC values drop to less than 1/2 the RL.

Safety Precautions and Waste Handling:

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Normal laboratory safety practices must be followed when performing this method. Extra care must be taken when handling the persulfate reagent (which is a strong oxidant) and unknown samples that could contain toxic or carcinogenic chemicals. Inspect all glassware before use. Discard or send for repair any glassware that is chipped, flawed, or broken.

Personnel Training and Qualifications:

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst’s training records.

Initially, each technician performing these techniques must work with an experienced technician for a period of time until they can independently perform the procedure. Proficiency is measured through an Initial Demonstration of Capability (IDOC).

The IDOC consists of four replicates of the LCS. The mean of the replicates must fall within ± 15% of the true value and have a RSD <10%.

Various options are available for a DOC and can include four LCS's that meet the method acceptance criteria, or analysis of one blind sample.

Sample Collection, Preservation, and Handling:

All samples must be collected in glass containers and stored at 0°to 6°C not frozen.

TOC samples must be acidified with concentrated phosphoric acid or sulfuric acid to a pH <2. The holding time for these samples is 28 days.

DOC samples are field or lab filtered within 48 hours, and then acidified with concentrated phosphoric acid or sulfuric acid to a pH <2. The holding time for these samples is 28 days after preservation.

Apparatus and Equipment

1. O.I. Corporation Model 1030 TOC analyzer

2. O.I. Corporation Model 1088 Rotary Autosampler

3. 2-stage gas regulator

4. Analytical balance capable of accurately weighing to 0.0001 g

5. Automatic pipettes

6. Syringe filters - 0.45 µm pore size

Reagents and Standards

A. All chemicals used must be ACS reagent grade unless otherwise noted.
B. Different volumes or weights may be used provided the ratios remain equivalent.

C. Reagents and Standards
1. Ultra-pure nitrogen gas (30 psi)

2. (WC_TOC_SodPer) Oxidizing reagent - Sodium persulfate (Na2S2O8)
   a. Dissolve 100 ± 1 g of sodium persulfate in approximately 500 mL of reagent water in a 1000-mL volumetric flask.

   b. Dilute to volume with reagent water.

   c. Purge with nitrogen gas for 1 hour to release inorganic carbon present in reagent.

   d. This solution is stable for 6 months and is stored at room temperature in a plastic container.

3. (WC_TOC_5%Phos) Phosphoric acid (5% w/w)

a. Add 59 mL of 85% H3PO4 to about 500 mL of reagent water in a 1000-mL volumetric flask.

b. Mix thoroughly and dilute to volume with reagent water.

c. This solution is stable for 6 months and is stored at room temperature in a plastic container.

4. (WC_TIC_QC) Total Inorganic Standard (500 mg/L)

Sodium bicarbonate (NaHCO3) 0.1750 g ±0.0005 g

Sodium carbonate (Na2CO3) 0.2209 g ±0.0005 g

a. Dissolve above reagents in a 100-mL volumetric flask containing about 50 mL of reagent water.

b. Dilute to volume with reagent water.

c. Prepare monthly. Do not acidify. Store in the flask at 0°to 6°C not frozen.

5. ISO 17034 Certified Reference Material (CRM): Purchased. See certificate of analysis for true value supplied by the vendor.

Calibration:

1. (WC_TOC_CALSTD) TOC stock calibration standard (500 mg C/L)

Potassium hydrogen phthalate (KHP) 1.063 ± 0.005 g
Phosphoric acid, concentrated (H3PO4) 20 drops

a. Dissolve 1.063 ± 0.005 g of KHP a 1000-mL volumetric flask containing about 500 mL of reagent water.

b. Add concentrated phosphoric acid (H3PO4) to the 1000-mL volumetric flask until the pH is <2.

c. Bring to volume with reagent water

d. Prepare every 30 days. Store in an amber glass bottle at 0º to 6º C, not frozen.

2. (WC_TOC_QC_STD) TOC stock QC standard (500 mg C/L)

Prepare identically to TOC stock calibration standard using KHP from a different source.

3. Working standards for calibration and QC

Pipette a volume of TOC stock standard into the appropriate volumetric flask that contains reagent water and three drops of concentrated phosphoric acid. Dilute to volume with reagent water. Prepare daily, as needed, according to the following table:

Volume Stock CAL Standard (mL)	Standard Concentration (mg/L)	Final Volume (mL)
20	100	100
10	50	100
10	25	200
2.0	10	100
3.0	7.5	200
0.2	1.0	100

Volume Stock CAL Standard (mL)	Standard Concentration (mg/L)	Final Volume (mL)
Volume Stock QC Standard (mL)	Standard Concentration (mg/L)	Final Volume (mL)
0.4	1.0 - CCVL	200
10.0	25 - LCSW / ICV / CCV (Mid)	200
10.0	50 - CCV (High)	100

4. Instrument Calibration

a. The instrument must be calibrated at least every 30 days, or whenever acceptable check standards can no longer be obtained. Prepare a calibration sequence as follows:

Clean Up
Rinse
QC Blank
STD - 0mg/L
1.0 mg/L CAL
2.0 mg/L CAL
15 mg/L CAL
20 mg/L CAL
50 mg/L CAL
100 mg/L CAL
ICB
ICV

b. A calibration of 6 standards and a reagent water blank must be run monthly as the instrument calibration. The correlation coefficient of the curve must be ≥0.995.

c. Calibration is linear. The % Relative Error for the 1.0 mg/L and the 25 mg/L standard must be less than 15%.

d. Immediately after a calibration run, analyze the ICB. The ICB is reagent water brought to pH of <2 with phosphoric acid. The ICB must be <1/2 the RL. If the result is higher, a new calibration must be prepared with lower concentrations.

e. After the ICB, analyze the ICV. The ICV must be within 15% of the true value.

Procedure:

1. General (more detailed instructions for each step can be found in the instrument manual)

2. Start up the instrument in the following manner:

a. Turn on the power switch located at the back of the instrument. The system loads the startup screen and User Login dialog box. Turn on the nitrogen gas flow.

b. Prime the syringe and all reagents by following the manufacturer’s instructions located in the instrument manual.

3. Load the active sequence. The daily sequence must include:

100 mg/L CAL standard
CCB
CCV (High) - 50 mg/L
[bracket of 10 samples]
CCB
CCV (Mid) - 25 mg/L
[bracket of 10 samples]
CCB
CCVL - 1.0 mg/L

4. Each sample is injected in duplicate. The RPD of the duplicate injections must be< 10% when the concentrations are greater than five times the LOQ.

5. For DOC, the samples and all quality control samples are filtered through a 0.45 micron filter. There is no subtraction of the filter blank in the calculation for DOC.

6. For swab samples, add 20 to 50 mL of reagent water to the container holding the swab. Record the amount of reagent water added. Shake the sample for 5 minutes. Filter the extract through a 0.45 micron filter as described abouve in #5.

7. Load samples onto the autosampler trays.

8. Press Start.

Calculations:

The TOC result (in mg/L) is performed as below using the average of the two injections:

raw result (mg/L from instrument) x dilution factor = final TOC (mg/L)

For swab samples report the TOC as mg per swab by the following:
TOC, mg per swab = T x L

Where:
T = the concentration of TOC found in the extract in mg/L.
L = swab extract volume (L) = (mL used for the extract/1000).

Statistical Information/ Method Performance:

1. The method detection limit (MDL) is determined annually by following the procedure outlined in *QA-SOP11892*. The 7 replicates must be analyzed over a period of at least 3 days.

2. The quality control acceptance windows are generated annually by following the procedure outlined in *QA-SOP11896*.

Quality Assurance/Quality Control:

1. A calibration of 6 standards and a reagent water blank must be run monthly as the instrument calibration. The instrument must be calibrated at least every 30 days, or whenever acceptable check standards can no longer be obtained. At any point where the instrument has been idle for a period of 4 hours or more, a CCB and CCV must be analyzed. If either of these parameters is not within specifications, the instrument must be recalibrated and a new run started. See the Calibration section for acceptance criteria and corrective actions.

2. A CCV and CCB must be analyzed after every 10 injections, alternating between high, mid, and low CCVs. The acceptable range for the CCV (Mid and High) is ±15% of the true value. The acceptable range for the CCVL is ±50% of the true value. An acceptable CCB result is less than half the reporting limit. The CCB is reagent water brought to a pH of <2 with phosphoric acid.

3. A batch contains no more than 20 samples.

4. A batch blank (MB) is analyzed every batch. An acceptable result is less than half the reporting limit. The Batch blank is reagent water brought to a pH of <2 with phosphoric acid.

5. A laboratory control standard (LCS) must be analyzed every batch. The LCS is the 50-mg/L QC standard (CCV2). The acceptable range for this standard is statistical, and no wider than ±15% of the true value.

6. Based upon client requirements, when appropriate, a laboratory control standard duplicate (LCSD) must also be prepared and analyzed under the same conditions as the LCS. The relative percent deviation between the LCS and LCSD can be found in the LIMS, no wider than 15%. The acceptable range of the LCSD is the same as the LCS. If the LCSD does not meet this acceptance criterion, see T-WC-WI11652 for handling outliers and the appropriate corrective action must be taken. If the RPD between the LCS and LCSD is not within specifications, see your manager or group leader to determine if reanalysis is needed.

7. If any of the QC does not meet acceptance criterion, see T-WC-WI11652 for handling outliers and the appropriate corrective action that must be taken.

8. Sample results may not exceed the concentration of the highest standard. If a sample result falls above this value, the sample must be diluted with reagent water and run again.

9. A duplicate must be analyzed every batch at a frequency of 1 duplicate per 10 samples. The acceptance criterion is <15%. If the relative percent difference falls outside of the acceptance criteria, see your group leader to determine if reanalysis is needed.

10. A matrix spike (MS) must be analyzed at a frequency of 1 spike per 10 samples. This spike must be prepared at a concentration 50 to 200% of the expected concentration of the background sample. The recovery should be <15% of the true value. If the recovery is outside of the acceptance criteria, consult your group leader to determine if reanalysis is necessary.

11. Based upon client requirements, a MSD is prepared and analyzed under the same conditions as the MS. The acceptance criteria and corrective action are the same as the MS. The relative percent difference between the MS and MSD is statistical and can be found in the LIMS. If the RPD is outside of these criteria, consult your group leader to determine if reanalysis is necessary.

12. A Total Inorganic Carbon (TIC) check standard must be prepared daily to determine the efficiency of inorganic carbon removal when performing the total organic carbon analysis. This standard is prepared by adding 1.25 ml of the TOC QC stock and 1.25 ml of the TIC QC stock to a 25 ml volumetric and bringing to volume with reagent water. The acceptable recovery range for this standard is 80% to 120%.

13. Daily a TOC carryover check must be analyzed. This is preformed by analyzing the highest calibration point and immediately following with a blank. the result of the blank must be less than half the reporting limit.

14. Annually, an ISO 17034 certified reference material (CRM) must be analyzed as a check standard. The CRM must recover within the supplier's acceptance criteria, or within 10% of the known value, whichever is tighter.

11644 Maintenance of the OI Analytical Total Organic Carbon Solids Analyzer
11892 Determining Method Detection Limits and Limits of Quantitation
11896 Establishing Control Limits

End of document

Version history

Version	Approval	Revision information	
17	22.JUN.2021		
18	11.NOV.2021		
18.1	12.NOV.2021		

eurofins	Always check on-line for validity. **Digestion of Aqueous Samples by SW-846 Method 7470A**	Level: **Work Instruction**
Document number: **T-MET-WI11924**		
Old Reference: **1-P-QM-WI-9015082**		
Version: **23**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **20-MAY-2022**	Document users: **6_EUUSLA_Metals_Hg Prep, 6_EUUSLA_Metals_Hg Prep Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
11924) Procedure

Revision Log

Revision: 23	**Effective Date:**	This Version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Header	Name Change	Changed to current company name
Cross Reference	Current SOP	Updated to reflect current Prep Solution and Standards SOP

	Revision: 22	**Effective date:** Nov 5, 2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	Updated to reflect current practice	Added TALS methods

	Revision: 22	**Effective date:** Nov 5, 2020
Section	**Justification**	**Changes**
Basic Principles	Updated to reflect current practice	Removed DEENAs
Apparatus and Equipment	Updated to reflect current practice	Removed LLENS
Procedure	Updated to reflect current practice	Updated to current LIMS
Quality Assurance/Quality Control	Updated to reflect current practice	Updated to reflect current terminology

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 7470A, September 1994
2. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI9082	Working Instructions for Prep Solutions and Standards
T-MET-WI7965	Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA

Scope

This procedure is used for automated and manual digestion of samples and standards for Mercury analysis in aqueous samples by SW-846 Method 7470A.

Basic Principles

The samples are digested with nitric acid, sulfuric acid, potassium permanganate, and potassium persulfate to oxidize mercury compounds to mercuric ions. Mercuric ions are reduced to mercury metal using stannous chloride. Mercury measurement is performed using the mercury cold vapor technique.

Interferences

Not applicable to this procedure.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO3) – This acid can cause skin burns. Add nitric acid to samples in a hood to avoid exposure to toxic fumes, or use the designated dispensing equipment.

Sulfuric acid (H2SO4) – This acid is a strong oxidizing agent and can cause severe burns. Sulfuric acid spills are extremely slippery, adding to the danger. Always use in a fume hood, or use the desinated dispensing equipment. Never mix with concentrated HCl or concentrated KMNO4 to avoid a violent reaction (explosive splattering and extreme heat).

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCI with concentrated H2SO4 to avoid a violent reaction. Always use in a fume hood, or use the designated dispensing equipment.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds.

When a hazardous flag is added indicating possible cyanide, special precautions are required to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each employee performing the digestion must work with an experienced employee for a period of time until they can independently perform digestions. Proficiency is measured through documented audits of the tasks listed as well as an Initial Demonstration of Capability (IDOC).

The IDOC and the DOC consists of four laboratory control samples (LCS's) that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Aqueous samples are collected in plastic or glass containers (drinking water sample volume is 1-L). Samples are preserved to a pH of <2 with nitric acid at collection and the pH is checked upon receipt and adjusted as necessary by Sample Support; samples that are pH adjusted at the laboratory must not be digested for a minimum of 24 hours. If samples fail to maintain a pH of <2 the Client Representative is notified for further direction. Samples are stored at 0 to 6°C, not frozen, prior to digestion. Samples must be analyzed within 28 days of collection.

Dissolved Mercury: Samples are to be filtered within 15 minutes of collection by the client. Clients may submit unpreserved bottles to the lab for dissolved mercury analysis. The sample is run through a 0.45 micron filter within 5 days of receipt and then preserved to a pH of <2 with HNO3.

Digested samples are stored in plastic bottles at room temperature. Store samples, standards, and digested samples separately.

Apparatus and Equipment

1. 50-mL polypropylene containers and covers (digestion vessels for block digestion) – certified clean and Class A equivalent

2. Environmental Express HotBlock (block digester) – adjustable and capable of maintaining a sample temperature of 95°C.

Reagents and Standards

1. For standards preparation, shelf life, and storage conditions, see T-MET-WI9082. This form also has instructions for the initial preparation of Method Blanks, LCSs, Matrix Spikes and General Solutions.
2. Store all standards and reagents at room temperature. Label the container with the solution name, lot number, date prepared, the expiration date, the initials of the person preparing the solution, and the storage conditions.
3. Standard/spiking concentration and reagent vendors are subject to change without notification.
4. Nitric acid, 70.0% to 71.0% HNO_3, J.T Baker ACS Grade, or equivalent. Follow manufacturer's expiration date.
5. Sulfuric acid, 95.0% to 98.0%, H_2SO_4, 36 N, J.T Baker, ACS Grade, or equivalent. Follow manufacturer's expiration date.
6. Potassium permanganate, $KMnO_4$, Baker Analyzed reagent, ACS, or equivalent. Follow manufacturer's expiration date.
7. Potassium persulfate, $K_2S_2O_8$ Baker Analyzed reagent, ACS, or equivalent. Follow manufacturer's expiration date.
8. Sodium chloride, NaCl, J.T. Baker, Certified ACS, or equivalent. Follow manufacturer's expiration date.
9. Hydroxylamine hydrochloride, $NH_2OH{\cdot}HCl$, J.T. Baker, Certified ACS, or equivalent. Follow manufacturer's expiration date.
10. Stannous chloride, $SnCl_2$, Baker Analyzed reagent, ACS, or equivalent. Follow manufacturer's expiration date.
11. Hydrochloric acid, HCl, 36.5% to 38.0%, J.T Baker ACS Grade, or equivalent. Follow manufacturer's expiration date.

Calibration

Not applicable to this procedure.

Calculations

Not applicable

Statistical Information/Method Performance

Not applicable

Quality Assurance/Quality Control

1. Each digestion batch is up to 20 samples.

2. Each digestion batch must contain a MB, LCS, BKG, DUP, MS and/or MSD when applicable. If insufficient sample for a duplicate or per client requirement, an LCSD/MSD is added to the batch.

a. MB – Method Blank also equivalent to a Preparation Blank.

b. LCS/LCSD – Laboratory Control Sample/Laboratory Control Sample Duplicate

c. BKG – unspiked background sample

d. DUP – duplicate

e. MS – Matrix Spike

f. MSD – Matrix spike duplicate

11924) Procedure

A. Manual hot block digestion

1. Turn block digester on and allow block to reach the Control Point setting that provides 95° ± 1°C sample temperature.
2. Before digestion, check the temperature with a calibrated thermometer and record in the logbook.
3. If the sample to be digested is not in split bin location:
   a. Scan parent bottle into LIMS prep batch.
   b. Shake sample well.
   c. Transfer 20 mL of well-mixed sample (or an aliquot diluted to 20 mL) into the polypropylene container. If a different final volume is necessary, adjust reagent volumes accordingly.
4. Scan split samples from bin into the LIMS prep batch.
5. Prepare batch QC and calibration standards. See T-MET-WI9082 for preparation instructions and concentrations. See the Quality Assurance/Quality Control section for the required batch QC.

   NOTE: Exception - For leachate batches containing leachate spiked QA samples, use one of the leachate spiked QA samples as the batch QC matrix spike and matrix spike duplicate, and proceed with the spiking procedures for the LCS according to T-MET-WI9082.
6. Add 1 mL of H_2SO_4 and mix.
7. Add 0.5 mL of HNO_3 and mix.
8. Add 3 mL of 5% $KMnO_4$ solution and mix.
9. Allow the sample to stand for 15 minutes and then check sample for purple color.
   a. purple color does not persist for at least 15 minutes, perform a dilution on the sample beginning with a DF5.
   b. Continue diluting in increments of 5 or 10 until the purple color persists for at least 15 minutes.
10. Add 1.6 mL of 5% $K_2S_2O_8$ solution and mix.
11. Place containers in block digester.
12. Place a calibrated thermometer in a container with reagent water.
13. Put a polypropylene cover on each container. Remove after the samples reach 95° ± 1°C.
14. Heat for 2 hours in the block digester at 95° ± 1°C. The temperature is checked with a calibrated thermometer and recorded in the logbook.
15. Remove samples from block digester and cool.
16. Add 1.2 mL of 12% sodium chloride/hydroxylamine hydrochloride solution to reduce excess permanganate (color change is from purple to colorless). If the solution is not colorless, add reductant in 1-mL increments until

$KMnO_4$ is completely reduced.

17. Screw on cap and shake sample

18. Adjust the volume to 20 mL with reagent water and mix. Reserve for analysis.

NOTE: The block temperature is different than the temperature of the liquid being digested.

B. Block Digester Instructions:

1. Turn block digester on by pressing rocker switch located on the cord.
2. Wait about 8 seconds until controller display indicates current block temperature.
3. Press and hold STAR (*) key.
4. The display shows the Set Point Temperature.
5. The digits can be changed to the desired value by pressing the up and down arrow keys while holding the (*) key.
6. Confirm Control Point temperature is set to the block temperature that provides 95°C.

NOTE: See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used for digestion. If necessary, adjust Control Point temperature to the proper setting.

NOTE: Polypropylene containers must not be heated above 130°C.

7965 Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA
9082 Working Instructions for Prep Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
21	29.JUL.2019		
22	05.NOV.2020		
23	26.APR.2022		

eurofins	Always check on-line for validity.	Level:
Document number: **T-MET-WI11931**	**Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)**	**Work Instruction**
Old Reference: **1-P-QM-WI-9018442**		
Version: **15**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **09-MAY-2022**	Document users: **6_EUUSLA_Metals_ICP Analysis, 6_EUUSLA_Metals_ICP Analysis Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Scope
Routine Methods
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Instrument Operations
Routine Maintenance for the ICAP™ 6000 Duo Analyzer
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Appendix I

Revision Log

Revision: 15	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout	Update to current LIMS terms	Updated to reflect current LIMS limits
Reference	Total Hardness reference	Added 2340B reference
Safety Precautions and Waste Handling	Clarification	Reference to contact ERT in case of spills
Reagents and Standards	Clarification	Changes to reflect current standard names
Procedure	Reflects current practice	Changes throughout to reflect current procedure

Revision: 14	**Effective Date:**	30-Nov-2020

Revision: 14	**Effective Date:** 30-Nov-2020
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Quality Assurance/Quality Control	Current Practice	Updated EPA batch size to 20 samples
Reference	Current Practice	Added new verification SOP
Routine Methods	Current Practice	Removed Analysis numbers from previous system
Apparatus and Equipment	Current Practice	Removed products not being used anymore
Reagents and Standards	Current Practice	Updated to current Definitions
Throughout Document	Current Practice	Updated SOPs to D4 document numbers
Procedure	Current Practice	Updated procedure to new LIMs operation
Instrument Operations	Current Practice	Updated to new LIMs operation
Routine Maintenance for ICAP	Current Practice	Updated to better practice and more detail
Calculations	Clarification	added units to Water sample and added LIMs ID to calculations

Reference

1. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 6010B, December 1996.

2. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 6010C, February 2007.

3. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 6010D, Rev.4, July 2014.

4. Method 200.7 (rev. 4.4), Determination of Metals and Trace Metals in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry, USEPA 600/R-94/111 May 1994.

5. ICAP™ 6000 Series ICP-OES Spectrometer Operator Manual, 2005/2006.

6. *Hardness Calculation SM 2340 B-1997, 20th edition.*

7. *Hardness Calculation SM 2340 B-2011.*

8. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
S-SS-WI10695.	Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8
T-MET-WI12063	ICP Solutions and Standards Preparations
T-MET-WI9082	Working Instructions for Prep Solutions and Standards
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
QA-SOP11896	Establishing Control Limits
T-MET-WI35797	Metals Data Verification Process

Scope

This procedure applies to analyses performed in the Metals department using Inductively Coupled Plasma (ICP) Atomic Emissions Spectroscopy for identification and quantitation of metallic constituents by Methods 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous).

The Reporting Limits (RLs) are based on annual statistical evaluation of laboratory data and are subject to change without notification. The current method detection limits (MDLs) and RLs are maintained in the laboratory

information management system (LIMS).

This SOP also outlines the proper operation and maintenance of the ICP instrumentation and provides consistent guidelines for the evaluation of ICP data.

Routine Methods

Elements routinely analyzed on the Thermo Scientific iCAP 6000 and 7000 Series Analyzers:

Element	Wavelength (nm)
Ag	328.06
Al	308.21
As	189.04
B	249.67
Ba	455.4
Be	313.04
Ca	317.93
Cd	226.5
Co	228.62
Cr	267.72
Cu	327.4
Fe	261.19
K	766.49
Li	670.78
Mg	285.21
Mn	257.61
Mo	202.03
Na	589.59
Ni	231.6
P	177.49
Pb	220.35
S	182.03
Sb	206.83
Se	196.09
Si	251.6
Sn	189.99
Sr	421.55
Th	401.913
Ti	334.94
Tl	190.86
V	292.4
W	207.911
Zn	213.86
Zr	339.19

Basic Principles

If required, samples are digested with acids and heated to solubilize metals. Samples are received from the prep area in digestion vials.
After the analytical batch is prepared it is loaded onto the autosampler for trace metals analysis.

Samples are transported to a nebulizer via an autosampler and peristaltic pump. The nebulizer introduces an aerosol into a spray chamber; the resulting mist is then transported to an argon plasma torch where excitation of atoms occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency (R.F.) inductively coupled plasma. The spectra are dispersed by a diffraction grating and the intensities of the light at each wavelength are

monitored by a photosensitive device. The signals from the photosensitive device are processed by a computer. A background correction technique is required to compensate for variable background contribution to the spectra of trace elements.

Interferences

Spectral interferences are caused by background emission, stray light from high concentration elements or overlap from a spectral line from another element. Spectral interferences are compensated for by the use of background points, alternate wavelengths and interelement corrections.

Physical interferences caused by the change in sample matrix affecting sample transport and/or nebulization must be compensated for by using internal standardization.

Memory interference, or carryover, is the contribution of analyte signal from a previous sample onto the next sample analysis. Adequate rinse time of the autosampler tubing overcomes any memory interference.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO3) – This acid can cause skin burns. Add nitric acid to samples in a hood to avoid exposure to toxic fumes.

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCI with concentrated H2SO4 to avoid a violent reaction. Always use in a fume hood.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Fill reagent bottles in an operating fume hood using caution to avoid spills.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

In case of spills contact the Emergency Response Team.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing the instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the sequence editor to set up the run, perform calculations, interpret raw data, and enter data into the LIMS. Proficiency is measured through documented audits of the tasks listed and over checking of data as well as an IDOC (Initial Demonstration of Capability).

The IDOC consists of aliquots spiked at 1-4X the RL that are carried through all steps of the prep and analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy of 50 - 150% and standard deviation of </= 20%.

Various options are available for a DOC and can include four laboratory control samples (LCS) or one blind sample. The mean recovery of four LCSs must meet the accuracy criteria of an LCS, and the standard deviation must be </= 20%.

Sample Collection, Preservation, and Handling

A. Preservation and Holding time

1. All samples are typically shipped and stored at 0°to 6°C, not frozen, but room temperature is acceptable. Samples are analyzed within 6 months of collection.

2. Aqueous samples are collected in plastic or glass containers and are preserved to pH <2 with nitric acid. If samples are received > pH 2, they are preserved at the lab and held at least 24 hours until digestion. See *S-SS-WI10695*.

3. Drinking water samples are digested if the turbidity is > 1 NTU. See *S-SS-WI10695*.

4. Dissolved metals must be filtered within 15 minutes of sampling. If this is not done, the lab filters the samples of unpreserved bottles within 5 days of submission to the laboratory. Lab-filtered samples are preserved to pH <2 with nitric acid after filtration.

5. Solid samples are collected in glass containers with no chemical preservation.

6. Sample digestates are stored in plastic bottles at room temperature.

B. Sample Discard - The general practice in the metals group is to discard the digestions after all the required metals from a batch of samples have been analyzed and verified in the LIMS. Samples which require the digestate to be held for long term storage are periodically evaluated for discard.

Apparatus and Equipment

The following is a list of the hardware and apparatus necessary for ICP analysis. More detailed hardware information is located in the *Operator's Manuals*.

1. 15-mL graduated polypropylene test tubes with caps (certified ±1%)

2. 10-mL sterile disposable syringes

3. syringe filters, PTFE, 0.45-µm

4. 30-mL polypropylene medicine cups

5. Calibrated hand-held pipettes and tips (10 – 5000 µL) - FisherBrand or equivalent.

6. Spectrometer - The Thermo Scientific iCAP™ 6000, 6500, and 7000 series Trace Analyzer utilizes a high performance solid state Charge Injection Device (CID) camera system to deliver high contrast/low noise imaging and quantification of all wavelengths in the analytical range. With the entire spectrometer and foreoptics purged with either Argon or Nitrogen, it features a 52.91 grooves/mm grating and dual-view detector.

7. Auto-sampler – The ESI SC-14 auto-sampler and integrated "FAST" system offer increased capacity and reduce sample introduction times. The parameters for each automated run are entered into the auto-sampler table in the iTEVA™ software as described in Instrument Operation, Section A of this SOP.

8. Coolflow –The ThermoFlex™ 900 cooling device for the iCAP™ 6000 series Trace Analyzer operates at 17°C.

9. Personal computer – The iCAP™ 6000 series Trace Analyzer is controlled by PCs.

Reagents and Standards

Reagent and standard information and the preparation of the following standard and solutions are located in *T-MET-WI12063*:

Initial Calibration (ICAL)
Blank (ICIS) and Calibration Standard (STD1)
Initial Calibration Verification (ICV) standard
Continuing Calibration Verification (CCV) standard
Rinse/Carrier and Profile Solutions
Interference Check Solutions (ICSA and ICSAB)
Low Level Check (CRI) standards
Post Digestion Spike (PDS)

Serial Dilution (SD)
Linear Range Standards (LRC)
Initial Calibration Blank (ICB)
Continuing Calibration Blank (CCB)
Internal Standard Solution
Instrument Detection Limit (IDL) and MDL Solutions

Calibration

See T-MET-WI35797 for the frequency, acceptance criteria and corrective action of the ICAL, ICV, ICB, CRI, ICSA/ICSAB.

Procedure

A. Setting up an ICP run sequence file

1. Determine the batches to be analyzed and determine any special requirements by viewing Batch notes and/or Comments that are with the batch paperwork delivered from the metals prep area.

2. Complete necessary pouring for the prep batch following Section B

a. Batches with only field blanks or equipment blanks do not need a post-digest spike or a serial dilution.

b. "As Received" samples must be run with a blank and LCS, LCSD (prepared and documented in the LIMs system by the analyst).

3. Open run template following Instrument Operations Section 2

4. Scan samples by digestate bottle into program

5. When setting up a run, Batch QC must be placed in the same block of ten or fewer samples. If there are two LCSs, they must be placed one after the other. [The order of the batch QC is typically MB, LCS, (LCSD), BKG, PDS, DUP, MS, (MSD) and SD.]

a. ICV/ICB must be analyzed immediately after the calibration curve.

b. CRI, ICSA, ICSAB, CCV, CCB must immediately follow the ICV/ICB.

c. 6010D requires analysis of LRCs prior to beginning the analytical run

c. CCV/CCB must be analyzed after every ten analytical samples.

d. Additional QC are added per client requirements at the end of the run: CRI, ICSA, ICSAB.

e. Any deviations from protocol must be noted in the LIMs system

6. Edit dilution factors (DF) and auto-sampler locations as needed.

7. Remove all unnecessary QC standards by selecting individual lines and clicking on the remove samples icon at the top of the screen.

8. Save the sequence file

B. Pouring ICP samples and QC samples

It is important to minimize any chance of contamination, both of yourself and the samples. Keep your hands and the work area clean at all times. Do not re-use any pipette tips.

Run QC standards are prepared separately, and kept in separate auto-sampler racks to be obtained at the time of analysis.

1. Use the prep paperwork to document the following information when pouring samples: initials, employee number, PDS lot number, test tube lot number, filter lot number(if applicable) and the date.

2. Carefully examine the batch to ensure there are no discrepancies between the Batch Preparation Sheet and the physical placement of samples in the batch.

3. Obtain and label all required test tubes, and place them in test tube racks.

4. Prepare and label the PDS required for each new batch (sample volume permitting).

a. A PDS is prepared using 0.2 mL of a custom-ordered PDS solution into 9.8 mL of background sample.

i. If sample volume is limited, reduce volumes but keep ratios equivalent (i.e. 0.1 mL PDS solution into 4.9 mL background sample.)

ii. If the background sample must be diluted, add a reduced volume of background sample and bring to volume with the appropriate matrix.

5. Prepare a DF5 serial dilution(SD) of the background sample by pipetting 2 mL of background sample into 8 mL of the matrix solution.

a. If the background sample chosen for serial dilution has been diluted due to matrix interference or to bring the concentration into the linear range of the instrument, the serial dilution must also be diluted by 5 times the dilution factor of the background (i.e., if Bkg = DF5, S.D. must = DF25).

6. If samples need to be filtered due to cloudiness or contain particulate, then the corresponding method blank (MB) and laboratory control sample (LCS) must be filtered.

a. Filter using a 10-mL sterile disposable syringe fitted with a 0.45 µm PTFE syringe filter.

b. Document lot of filters on the preparation batch sheet and mark each sample lid with an "F" to indicate that it was filtered.

7. Perform any additional spiking or dilutions and document on the preparation batch sheet

8. Cover the samples with lids or with plastic wrap to prevent contamination.

9. Place the poured batch on the bench top to await analysis, or return samples to their ICP sample storage location.

10. Take **NOTE** of the following:

a. A PDS and a serial dilution (SD) must be performed on one sample in each digestion batch unless the batch contains only field blanks or equipment blanks.

b. Analysis information, including standard lot numbers, run number, method, analyst and date of analysis, are captured in the LIMs system

c. Documentation is of utmost importance. Double check all entries.

d. Dilute samples when necessary to yield a response that falls within the calibration range. When there are multiple analytes over range, only run a maximum of three tubes, the DF 1 if needed, the highest dilution required for the highest analyte, and a dilution in between.
Exception: If analytes are over range at a DF1, and the next dilution they are ND, take the data

e. If a batch requires re-analysis, it is acceptable to re-use dilutions and/or spiked samples that were prepared for the previous analysis. A "P" on the preparation batch sheet is used to indicate that a previously poured test tube is being re-used.

Instrument Operations

A. iTEVA™ software: The Thermo Scientific iCAP instrument is operated through iTEVA™ software. From the Start menu, select "iTEVA™ Control Center" to start the software.

1. Plasma ignition

    a. Open the plasma status window by clicking on the icon at the bottom of the screen.

    b. Verify that all parameters are within acceptable range for ignition as indicated by a green light.

    c. Ensure that the drain tubing for the spray chamber is properly connected to the peristaltic pump and positioned to drain into a waste carboy.

    d. Select "Ignite plasma". After the plasma has ignited, the instrument automatically performs optimization of the nebulizer gas pressure, and then starts the on-board peristaltic pump.

    e. If the plasma does not light, repeat steps b-d.

    f. Once the plasma operating parameters have engaged, exit the Plasma status window by clicking on Close.

    g. If the plasma has been off for more than 15 minutes let the instrument warm up for 30 minutes. If the plasma has been off less than 15 minutes, let the instrument warm up 5 to 10 minutes.

2. Automated analysis using the iTEVA™ software

    a. Open the Analyst window from the Control Center by clicking on the Analyst icon. When prompted, select the appropriate method.

    b. In the Analyst window, click on the Sequence tab at the bottom of the screen.

    c. From the Auto-session menu, select New Autosampler.

    d. The "New automation-session" window opens.

    e. Click on "New" to add a sequence and the "New sequence" window appears.

    f. Click on the "Import from delimited text file" option and choose an appropriate template or previously prepared run sequence from the drop-down menu for the run to be entered.

    g. Change the sequence name to reflect the run number, but do not change the method revision number in the parentheses.

    h.Click OK at the bottom of the New Automation session window to continue.

    i. The sequence template is loaded. When prompted in the import warning window, click OK to choose the populate the auto-sampler.

    j. Right-click on the most recent auto-sampler session and select "Auto-locate All" to have autosampler positions automatically assigned.

    k. Click on the "list view" icon and scan calibration information into the table using barcodes provided.

    l. Scan client samples into table from digestate bottle to include sample number and hand enter the dilution factor if greater than a DF1.

    m. Additional samples and QC are added using the "Add sample" and "Add QC" icons, respectively, at the top of the screen. Unused rows are removed by selecting the entire row(s) and using the "remove sample" icon at the top of the screen.

    n. Click on the printer icon and choose to print page 1 only. This printout is staples to the batch paperwork. Document on the print out the prep batch and analytical batch number.

    o. Verify that the sample list begins and ends at the correct tube numbers, and check all entries for errors.

p. Carefully examine the batch to ensure there are no discrepancies between the preparation batch sheet, auto-sampler sequence table and the physical placement of samples in the batch. Sign off on the sequence table sheet to indicate these items have been checked.

q. Click on the "Run auto-session" icon to start the run sequence. If a run sequence is to be started at a sample or standard other than the initial calibration, open auto session run using the plus sign. Open the run and use the plus sign to open the required sample or standards. Right-click on the appropriate sample or standard and choose "Start Auto-Session Run at this Sample". Deselect the reslope (or Calibration option if running Multi Point Method) and QC, then click OK.

3. Running an AutoPeak in iTEVA™

a. In an open autosampler session (autosampler must be initialized), right-click on the location of the AutoPeak solution, and choose "Go to..."

b. Click on the Analysis tab to open the Analysis window.

c. From the Instrument menu, select Perform AutoPeak.

d. Click on All elements, then OK.

e. When prompted to aspirate the high standard (STD1,ICV or CCV), click OK. The AutoPeak is now performed.

f. When the AutoPeak has finished, click on Done.

4. Manual analysis in iTEVA™

a. In an open autosampler session (autosampler must be initialized), add sample(s) to be analyzed to a new or existing sequence as detailed in section A.2 of this section.

b. To start analysis, right-click on the appropriate sample and choose "Start Auto-Session Run at this Sample" and elect not to run the "start actions."

c. When analysis is complete, results can be printed from the Analysis tab by right-clicking on the sample name and selecting "Print Sample…"

5. Performing an interelement correction (IEC) in iTEVA™

a. Prepare a solution of the interfering element at the linear range of the instrument. Perform manual analysis according to section A.4 of this section.

b. Note results of elements with a known interference that are greater than the limit of quantitation.

c. Divide the result of each interfered element by that of the interfering element. These values represent the amount the current IECs need to be adjusted.

d. In the Method window, click on Elements to expand the list of elements in the method.

e. Click on the targeted element to view the settings for that element.

f. Click on the IECs tab to view the current IECs for that element.

g. Add each calculated result to the correction factors currently in the first column corresponding to each pair of elements.

h. Enter the new correction factors in the table.

i. Repeat steps d-f as needed.

j. Click on the Save method icon to save the method.

k. For routine IECs that are completed every six months, an experienced analyst updates the LIMs database with the information provided by a calculated analytical run. For non-routine IECs the analyst must document changes in the instrument log book with updated information.

B. Import Analytical and Raw data into LIMs System

1. Right click on Run Number and select Export All Samples

2. Enter the run number, copy the run number, and hit OK.

NOTE: You will need to export the calibration file with each run number for each analytical batch

3. Go into the IDAT-Sequence folder and copy file to TALs Import folder

4. Go into TALs and find the analytical batch and obtain the designated analytical run number determined by the LIMs system

5. Go into the IDAT-Sequence folder and print text file as PDF and name PDF the same as the analytical batch

6. Sign into ShareFile

7. Go to the Personal Folders and hit the + button to add file and choose UPLOAD

8. Browse files

9. Find the analytical batch file in the IDAT Sequence folder and select Open

10. Upload file. This will now be in analyst personal Share File

11. Open TALs and open the analytical batch that is currently being processed

12. Select DOCs button on the top of the analytical batch

13. Right click in the box that pops up and choose Add New Document

14. Find your Citrix Files on the left hand side to access the Personal Folder

15. Double click on the Personal Folder to open it up to access the raw data file and choose Open

16. Click on the file and hit Select and then hit OK

17. Raw data is now attached

NOTE: For DOD samples these steps must be taken

a. Right click on run number and select edit report options.

b. Select output mode to intensity ratio for unknowns as well as QC standards.

c. Right click on run number after and post process samples.

d. Export with same name used in step 2 with "RAW" at the end of the file

e. Do this for both the Calibration file and the Sample file.

Routine Maintenance for the ICAP™ 6000 Duo Analyzer

A. Sample introduction system removal and cleaning: Remove and clean the sample introduction system when instrument performance declines (See **Figure 1**). Any adjustment to an instrument (replacement of parts, etc.) must be documented in the appropriate instrument logbook.

1. Turn plasma off and let instrument cool for approximately 5 to 10 minutes.

2. Remove spray chamber and nebulizer.

a. Unclamp spray chamber from spray chamber adapter by gently squeezing clamp with one hand while supporting the spray chamber with the other hand.

b. Gently remove the nebulizer from the spray chamber by pulling it out.

c. Disconnect the argon and sample tubing from the nebulizer by pinching the Luer lock and pulling the tubing off the nebulizer.

d. Remove the drain tubing from the spray chamber.

3. Prepare ultrasonic bath. Make sure the bath is at least ½ full with clean reagent water.

4. Clean radial cup
   a. remove gently from box by wiggling back and forth

   b. place radial cup in medicine cup and fill inside radial cup and medicine cup with matrix rinse or 1:1 HCL

   c. allow it to soak for approximately 10 minutes and then rinse off with reagent water

   d. dry radial cup and place back in torch box prior to reconnecting the torch

5. Clean torch, injector tip, and nebulizer.

   a. Invert the torch with tip assembly in a 250-mL vacuum flask of 50% HCl and place in the sonicator for approximatley 10 minutes. After sonication, rinse the torch with reagent water. (Be careful not to get a lot of water down into the base of the torch.) Carefully dry the torch with a paper towel.

   b. For a plastic nebulizer, use a syringe to force the 50% HCl solution through the nebulizer to clean and/or remove any clogs.

   c. Clean the spray chamber by filling with 50% HCL letting sit for approximately 5 minutes and then rinsing with reagent water.

6. Removal and disassemble the torch and tip if dirty or damaged (cracked,melted,ect)

   a. Gently pull the spray chamber adapter out of the torch assembly.

   b. Unlock the torch assembly by turning it clockwise and remove it from the instrument.

   c. Turn the injector tip assembly counter clockwise to separate it from the torch housing.

   d. Gently pull the center tube out of housing to clean.

   Note: If the torch and tip is disassembled a torch alignment must be performed before an ICAL is ran

B. Reassemble the sample introduction system: (See **Figure 1**)

1. Torch.

   a. Inspect The o-rings on the metal torch mount and replaced if any wear or damage is visible.

   b. Push on the quartz torch to ensure that it is firmly seated in the housing assembly

   c. The circular "target" design on the torch **MUST** align with the circular notch on the torch mount.

   d. Make sure the tip is fully inserted into the center tube holder.

   e. Mount the torch assembly back into the instrument by inserting it straight through the torch hole and coil, being careful not to disturb the quartz bonnet above the radial view lens.

   f. Turn the assembly counter-clockwise to lock it into position.

   g. Gently push the spray chamber adapter into the back of the center tube assembly.

2. Reassemble the spray chamber and nebulizer.

   a. Reattach the drain tube to the spray chamber.

b. With a twisting motion, insert the nebulizer into the spray chamber so that the collar is a tight fit.

c. Attach the sample and nebulizer gas tubing to the nebulizer.

d. Clamp the spray chamber to the spray chamber adapter.

3. Ignite the plasma.

C. Changing the pump tubing: Change pump tubing on the peristaltic pump when routine maintenance is performed or when the tubing shows wear. Inspect all tubing to insure that it is secure and in good condition.

D. Documentation for instrument/analysis tag out and return to service.

NOTE: The following information is taken from QA-SOP11901: In the event of an equipment failure, the following must be performed:

1. Document the nature of the failure in the maintenance logbook

2. Document how and when the defect was discovered

3. Notification of supervisor or responsible person who can decide on appropriate action to take

4. The instrument must be clearly tagged as *Out of Service*. The tag must contain the following information:

a. Date taken out of service

b. Employee who took the instrument out of service

c. Reason for tagout

Form Q-EQA-FRM6871is used for "tagging out".

5. The date taken out of service and the date returned to service must be documented in the maintenance logbook.

6. Document any corrective action that was taken to bring the equipment back into service.

7. Results of the corrective action (i.e., system calibration within specifications, etc.)

8. Supervisory personnel must perform a documented evaluation and review of instrumentation/equipment where a major or uncommon failure has occurred to assess the potential impact the failure could have on the calibration and/or qualification of the instrument. This is done on a case-by-case basis.

9. After repair, document whether the function has been fixed. Then determine if calibration or verification activities need to be performed before the instrumentation is put back into service.

Calculations

1. Final Result

a. Water sample (mg/L)

$$\text{Instrument Reading} \times \frac{\text{Dilution Volume}}{\text{Aliquot Volume}} \times \frac{\text{Final Volume}}{\text{Sample Volume}}$$

b. Solid sample (mg/kg)

$$\text{Instrument Reading} \times \frac{\text{Dilution Volume}}{\text{Aliquot Volume}} \times \frac{\text{Final Volume}}{\text{Sample Weight (grams)}}$$

2. Relative percent different (RPD)

$$RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where:

S = first sample value

D = duplicate sample value

3. Spike recovery

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = spiked sample result

SR = sample result

SA = spike added

4. Correlation Coefficient

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N})(\sum Y^2 - \frac{(\sum Y)^2}{N})}}$$

Where :

X = the known concentration

Y = the instrument response

N = the total number of data points

5. Serial Dilution

$$\%\ Difference = \frac{(5 \times SDR) - SR}{SR} \times 100$$

Where:

SDR = serial dilution result

SR = sample result

6. Total Hardness Calculation (SM2340B), Standard Methods 2340B-2011. The calcium result (mg/l) is multiplied by a factor of 2.497, the magnesium result is multiplied by a factor of 4.118, and the two values are added together for the hardness result.

7. Trivalent Chromium (7199_CR3) water and soils. Calculation is performed by subtracting hexavalent chromium from total chromium.

8. Ferric Iron (3500_F+3_B_Calc) is calculated by subtracting ferrous iron from the total iron.

Statistical Information/Method Performance

Generate MDLs and RLs according to *QA-SOP11892*. Perform an MDL study on each instrument used for the analysis. Determine the MDL by taking seven spiked replicates through the entire digestion and analysis procedure. Compare and pool results to determine the final reporting MDL. The department supervisor maintains annual study data. The department supervisor requests that a Quality Assurance Specialist update to the LIMS as needed. Update the department database via a download from the LIMS.

QC acceptance limits (MS, MSD, LCS and LCSD) are established as statistical limits (see *QA-SOP11896* for guidance). Limits are evaluated every 6 months by the department and updated in LIMS by QA as directed by the department supervisor.

Quality Assurance/Quality Control

A. For 6010B, 6010C, and 6010D each digestion batch (up to 20 samples) must contain a method blank (MB), LCS, unspiked sample (BKG), Duplicate (DUP), MS, and MSD. If there is not sufficient sample or per client requirement and LCSD is included.

B. For 200.7, each digestion batch (up to 10 samples) must contain a MB, LCS, BKG, DUP, and MS. If there is not sufficient sample or per client requirement and LCSD is included.

C. Batch Quality Control - For the preparation and concentrations see *T-MET-WI12063* and for the frequency, acceptance criteria and corrective action see SOP T-MET-WI35797.

D. Data Quality Checks

1) For SPLP and TCLP samples, an MSA (method of standard additions, EPA 1311 section 8.4.2, EPA 1312 section 8.4.2) is required if:

a. The sample concentration falls between 80% to 100% of the regulatory limits, AND

b. The SPLP or TCLP Matrix Spike (QA) recovers < 50%.

2) For all EW samples (samples from public drinking water sources); check the results against the MCL (maximum contaminant level). If an analyte **exceeds** the MCL, notify a verifier at once. An automated email is sent to the Client Service Representative and the state for the analytes listed in QA-SOP11886. Suppliers must be notified within 24 hours.

F. When raw data checks are complete, check the following:

1. All samples requiring reread/redigestion are listed on the reread/redigestion schedule forms. Any dilutions required have been calculated correctly and added to the reread/redigestion form. Specific instrument has been noted for client requirements if necessary.

2. Data for samples following Good Laboratory Practices (GLP) must be retained as permanent storage.

G. Instrument detection limits are performed when an instruments detector is changed or a new instrument is added to the lab. Method detection limits (MDLs) follow guidelines in SOP ***QA-SOP11892***. Inter-Element Correction factors (IECs) are checked routinely every 6 months for each analytical instrument. Linear ranges are verified semi-annually.

H. For data review reference SOP T-MET-WI35797

Appendix I

Definitions and explanations of the codes and symbols used on the raw data

A. Sample table information

1. The run number.

2. The page number.

3. The tube number.

4. The sample number.

5. The first and second of four asterisks denote whether the sample is a background (U*), duplicate (D*), spike (R*), MSD (M*), post-digestion spike (UP), serial dilution (UL), or not a QC sample (**).

6. The weight to volume or volume to volume digestion ratio, consisting of the initial quantity of sample used and the final digest volume.

7. The dilution factor – Indicating if the digest solution was diluted prior to analysis. An undiluted sample is labeled DF1.

8. Digestion batch number – Assigned when designated samples are scheduled for preparation, this number is used to track samples and QC prepared together.

9. The protocol by which the data is reviewed (SW-846, EPA-600).

10. Date and time of the sample injection into the instrument.

11. The ICAP identification number.

B. The ICP scans all of the method elements simultaneously during the analysis. The QC review lists all the samples on the run. The QC review lists elements verified, good phantom, and elements/phantom that are bad (need to be reread for run or batch QC). The reviewer or verifier documents on the QC review if any element(s)/sample(s) were selected/deselected.

C. The following are error codes in the iTEVA™ software.

1. S = Saturation – The concentration of the element is more than the detector can quantify.

2. K = The Elements Affected by a Saturated Element – The concentration listed is not accurate, and a more accurate result can be obtained by running the sample at a dilution.

D. Along with the average concentration (in ppm), the average intensity, %RSD and all three replicates are shown for each analyte. Internal standard values are intensities (cts/s).

Attachment:
Figure 1 (.doc)

10695 Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8
11892 Determining Method Detection Limits and Limits of Quantitation
11896 Establishing Control Limits
12063 ICP Solutions and Standards Preparation
35797 Metals Data Verification Process
9082 Working Instructions for Prep Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
13	12.JUL.2019		
14	23.NOV.2020		
15	09.MAY.2022		

eurofins	Always check on-line for validity. **Metals by ICPMS by Methods SW-846 6020/6020A/6020B(waters, solid, tissue) and EPA 200.8 (waters)**	Level: **Work Instruction**
Document number: **T-MET-WI11933**		
Old Reference: **1-P-QM-WI-9018443**		
Version: **13**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **27-JUL-2022**	Document users: **6_EUUSLA_Metals_ICP-MS Analysis, 6_EUUSLA_Metals_ICP-MS Analysis Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Scope
Routine Methods
Basic Principles
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control
Figure I - Daily Performance Acceptance Criteria and Tuning Solution Concentrations

Revision Log

Revision: 13	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout	Combined SOPs	Removed cross references to T-MET-WI11939.
Procedure E.2.	Enhancement	Added note to reference Internal Standard Attachment.
QAQC 11.	Enhancement	Added note to reference Internal Standard Attachment. Added reference to Verification SOP.
Attachment	Enhancement	Attachment references internal standards used for analysis

Revision: 12	**Effective Date:**	This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Throughout	Update to current LIMS	Updated method references to current LIMS
Throughout	Combined SOPs	Combined with T-MET-WI18027 and T-MET-215089
Cross Reference	Updated document list	Updated document list to reference combined 7700 and 7900 maintenance procedures into T-MET-21590, and combined operations procedures into this procedure

Revision: 12	**Effective Date:**	This version
Section	**Justification**	**Changes**
Cross Reference	Formatting requirement per G-DC-FRM7674	Added prep procedure cross references associated with this analysis and removed higher level references that are not required.
Scope	Added Clarification	Added RL is same as LOQ
Sample Collection, Preservation, and Handling	Reflects current protocol	Updated to reference water digestion and prep SOPs, and updated temperature for stored aqueous samples.

Reference

1. Method 200.8 (rev 5.4), Determination of Metals and Trace Metals in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry, USEPA 600/R-94/111 May 1994.

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 6020, September 1994.

3. Test Methods for Evaluating Solid Wastes, SW-846 Method 6020A, February 2007.

4. Test Methods for Evaluating Solid Wastes, SW-846 Method 6020B, Rev. 2, July 2014.

5. ESI SC Manual.

6. Agilent 7700 and 7900 Series ICP-MS MassHunter Workstation Guide and Hardware Maintenance Manual.

7. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI12065	Working Instructions for Preparation of ICP-MS Solutions and Standards
S-SS-WI10695	Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8
T-MET-WI21590	Instrument Maintenance for Agilent 7700 and 7900
T-MET-WI35797	Metals Data Verification Process
T-MET-WI11925	Client Specific - 3030 C. Treatment for Acid-Extractable Metals for North Carolina Groundwater Samples
T-MET-WI11938	Digestion of Waters by EPA 200.7/200.8 for the Analysis of Metals in Water by ICP or ICPMS
T-MET-WI11941	Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) and Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
T-MET-WI8636	Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS
T-MET-WI8639	Sample Preparation of Waters for Analysis of Total Recoverable Metals by ICP-OES and ICP-MS
T-MET-WI8732	Lab and Field Filtered Waters and <1NTU Drinking Water Preparation for ICP (EPA 200.7, 6010B/C/D) or ICP-MS (EPA 200.8, 6020/A/B)

Scope

This procedure applies to analyses performed at Eurofins Lancaster Laboratories Environmental (ELLE) using ICP-MS for identification and quantitation of metallic constituents.

Aqueous undigested samples and digestates (aqueous and solid matrices) are analyzed via this SOP.

Limits of Quantitation (LOQs/RLs), Method Detection Limits (MDLs) and linear ranges are maintained in the LIMS. These are subject to change without notification.

This procedure is used for analysis and instrument operation for the Agilent 7700 and 7900 series ICPMS instruments.

Routine Methods

Analyte	Mass
Be	9
B	11
Na	23
Mg	24
Al	27
K	39
Ca	44
Ti	47
V	51
Cr	52

Mn	55
Fe	57
Co	59
Ni	60
Cu	63
Zn	66
As	75
Se*	78
Se**	82
Sr	88
Mo	98
Ag	107
Cd	111
Sn	120
Sb	121
Ba	137
Tl	203
Pb 206	206
Pb 207	207
Pb 208***	208
U	238
*Se 78 is the mass reported from collision cell ICPMS only **Se 82 is the mass reported from non-collision cell ICPMS only ***For Pb masses 206, 207 and 208 are summed for calibration and analysis	

Basic Principles

ICP-MS is an analytical instrument that uses the energy of inductively coupled plasma to generate ions to be analyzed in the mass spectrometer.

The instruments use a discrete sampling system that first loads the sample into a Teflon sample loop. The sample is then pushed by a carrier solution using a computer controlled peristaltic pump that delivers the sample from the loop into the nebulizer attached to a cooled Scott double pass spray chamber.

The Agilent 7700 (E05) and 7900 (E07/E08/E09) can analyze samples in 3 different modes of operation, although typically analysis is done in 3 mode or No Gas mode only:

1. Mode 1 – no gas. This mode does not use a collision or reaction gas. Elements with a low atomic mass or that have no interferences can be analyzed using the "no gas" mode.

2. Mode 2 – Hydrogen (H_2) mode. This mode uses H_2 as a reaction gas, since it reacts quickly and efficiently with the Argon-based interfering species, but reacts slowly or not at all with the analyte(s) of interest. In this mode, interferences can be reduced to the level of baseline noise, allowing lower detection limits to be achieved for some difficult elements.

3. Mode 3 – Helium (He) mode. This mode uses He as a collision gas for reliable, predictable removal of unknown matrix interferences. No new interferences are formed in the cell, and no analytes are lost by a reaction.

Interferences

ICP-MS interferences include isobaric elemental interferences and polyatomic ion interferences derived from the plasma gas, reagents, and/or sample matrix. The Agilent 7900 utilize helium as an inert collision gas to reduce or eliminate many types of polyatomic ion interferences.

Physical interferences caused by the change in sample matrix affecting sample transport and/or nebulization must be compensated for using internal standardization.

Memory interference is the contribution of analyte signal from a previous sample onto the next sample analysis. Adequate rinse time with an appropriate rinse solution of the sample introduction system overcomes any memory interference.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.
See the *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Hydrochloric acid (HCl) – This acid can cause skin burns. Only mix with approved solutions. Always use this chemical in a fume hood.

Hydrofluoric acid (HF) – This acid is very toxic and absorbs through the skin without pain. This acid is found at trace levels in standard solutions.
Hydrogen Peroxide 30% (H2O2) **-** This oxidizer can cause skin burns. Always use in a fume hood.

Nitric acid (HNO3) – This acid can cause skin burns and burning of the respiratory tract. Add nitric acid to samples in a fume hood to avoid exposure to toxic fumes.

When diluting strong acids, never add water to acid; always add acid to water.
Store concentrated acids in the prep room acid cabinets. Only acids are to be stored in these cabinets. Flammable solvents are stored in flammable liquid storage cabinets. Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Large spills are cleaned by HSE. For large spills of concentrated acid, immediately evacuate the area and dial 1-1-1. HSE will use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.)

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each analyst performing the instrumental analysis must work with an experienced analyst for a period of time until they can independently calibrate the instrument, use the sequence editor to set up the run, perform calculations, interpret raw data, and enter/transfer data into the LIMS. Proficiency is measured through documented audits of the tasks listed, and checking of data as well as an IDOC (Initial Demonstration of Capability) and continued DOCs (Demonstration of Capability) as defined in *QA-SOP11178*.

The IDOC consists of four laboratory control samples (LCS) that are carried through all steps of the prep and analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

Sample Collection, Preservation, and Handling

Aqueous undigested samples, aqueous digestates, and solid digestates are analyzed via this SOP. Samples must be analyzed within 6 months of collection for all methods in this SOP.

Aqueous samples are collected in plastic or glass containers. Drinking Water samples are collected in 1-L plastic or glass containers. Aqueous samples are preserved with nitric acid with a pH of < 2 and stored at 0° to 6°C, not frozen, or at room temperature.

Aqueous digestates are digested per the method in *T-MET-WI11938* (aqueous samples 200.8), *T-MET-WI8639* (aqueous samples 3005A). Aqueous non-digested samples are prepared per the method in SOP *T-MET-WI8732* (lab and field filtered waters and <1NTU Drinking water). Aqueous samples are stored in 50 ml plastic vials at room temperature.

Solid samples are collected in glass containers and stored at 0° to 6°C, not frozen. Digestates are digested per the method in SOP *T-MET-WI8636*. Solid samples are stored in 100 ml plastic vials at room temperature.

Store standards and digestates separately.

The general practice in the metals group is to discard the digestions after all the required metals from a batch of samples have been analyzed and lab completed in the LIMS. Samples which require the digestate to be held for long term storage are periodically evaluated for discard.

Apparatus and Equipment

A. The following is a list of the hardware used in the Agilent 7700 and 7900 ICP-MS systems.

1. Inductively Coupled Plasma Mass Spectrometers (ICP-MS)

   a. The Agilent 7700 and 7900 - The sample introduction system consists of an ESI FAST discrete sampling system, Teflon nebulizer and cooled spray chamber attached to a concentric quartz tube plasma torch.

2. Autosampler

   a. The Agilent 7700 and 7900 (E08) systems use an ESI SC-8 FAST autosampler. The Agilent 7900 (E07 & E09) systems use an ESI SC-14 FAST autosampler. The autosampler parameters for each automated run are entered into the Sample List in MassHunter software.

3. Coolflow

   a. The Agilent 7700 and 7900 G3292A Recirculating Chillers are set up to deliver cooling liquid to the ICP-MS at a regulated pressure of ~40 psi.

4. Computer

   a.The Agilent 7700 and 7900 are controlled by a Windows-based IBM compatible PC with MassHunter software installed.

5. Vacuum Pumps

   a. The Agilent 7700 and 7900 both have a 2-stage vacuum system. A rotary pump evacuates the interface chamber; a turbo molecular pump evacuates the ion lens chamber and the analyzer chamber.

B. The following is a list of the apparatus necessary for the setup of an ICP-MS run for analysis:

1. ICP-MS prep batch sheets.
2. Test tube racks
3. Graduated 15-mL polypropylene tubes and caps
4. 50-mL polypropylene screw cap tubes
5. FilterMate 2 µm filters and plungers
6. 10-mL sterile disposable syringes
7. 25-mm syringe filters, PTFE, 0.45µm
8. 30-mL polypropylene medicine cups
9. Fixed volume hand-held pipettes (25 – 2000 µL) - Eppendorf or equivalent.

NOTE: For routine operation, calibration, and maintenance of fixed-volume, hand-held pipettes, see *QA-SOP11880*.

Reagents and Standards

Refer to Form *T-MET-WI12065* for reagent and standard information and the preparation of the following standards and solutions

1. ICP-MS Calibration Standards and ICP-MS LOQ Check Standard Solution (CRI)
2. ICP-MS Initial and Continuing Calibration Verification Standards
3. Interference Check Solutions

4. Rinse/Carrier, Tuning, and Calibration Solutions
5. Internal Standard Solution
6. PDS Solutions
7. General Acids and Chemicals

Calibration

Before calibration is performed, allow the instrument to warm up for the recommended time, usually at least 15 minutes, if the plasma has been off for 15 minutes or less, or at least 30 minutes if the plasma has been off for more than 15 minutes. Daily tuning requirements must be performed prior to calibration of the instrument and after warm up occurs. Full Tuning and Optimization is done as needed, or when required by the Group Leader or Manager.

Calibration is performed daily. Calibrations consist of a blank and one to three standards, followed by analysis of an ICV, ICB, CCV, CRI, ICSA/ICSAB, LRC, CCV, and CCB.

A single point calibration, consisting of a blank and one standard, is used for all analysis, except Non-TNI samples requiring a multi-point calibration (either MA MCP or CT RCP protocol or a lab note indicating a multi-point calibration is needed). For samples requiring a multi-point calibration the calibration consists of a blank, "S1", "S2", and "S3" standards. The concentrations of the calibration standards are defined in *T-MET-WI12065*.

For data review, acceptance criteria, and corrective action, see *T-MET-WI35797*.

Procedure

A. Instrument Start Up

This procedure is the same for the Agilent 7700 (E05) and the 7900 (E07/E08/E09) instruments.

1. Power on the ESI autosampler and start the ESI software.

2. Make sure the instrument is powered on before starting the ICP-MS software – the light on the front of the instrument will be red (shutdown mode), orange (standby mode) or green (analysis mode).

3. If the instrument is powered down: flip the main power switch on the back of the instrument to the on position, and then make sure the Foreline Pump (red switch) is also in the on position.

4. Make sure the recirculating chiller power switch is in the on position. If the orange light on the front of the chiller is on, you will need to turn off the chiller and add coolant before turning the chiller back on.

5. Verify that the program is in Online mode – the Hardware tab will have a green check mark if it is online.

6. If the Hardware tab has a red x instead of the green check, click on the arrow down in the Hardware tab and select Communication. Select Online and click OK.

7.Check the Instrument Status pane. The instrument should be in one of three modes: Shutdown (plasma and vacuum off, red light on the front of instrument); Standby (plasma off but vacuum on, orange light on the front of instrument); Analysis (plasma and vacuum on, green light on the front of instrument).

8. If in Shutdown mode click on the Hardware tab arrow down and select Vacuum On – the Foreline pump will start and the instrument will transition to Standby mode.

9. Once Standby mode has been reached select Plasma On from the Plasma tab arrow down.

10. When asked if you want to "Run 'Startup' after plasma ignition?", select No.

11. The plasma will ignite and the instrument will transition to Analysis mode.

12. Once Analysis mode is achieved you must allow the instrument to warm up for at least 20 minutes before running the EPA Daily Tune check sample.

B. Running the Daily Tune Check

1. To run the EPA Daily Tune check place both probes into the EPA Tune Solution and allow sufficient time for the solution to flush through both lines.

2. Make sure the FAST valve is in the LOAD position.

3. Once the EPA Tune Solution is aspirating into the spray chamber take the following steps to start the EPA Daily Tune check.

4. Click on the arrow down for the Batch tab.

5.Open the batch "~ICPMS.b" by clicking on the file in the drop down menu or the pop up menu if necessary.

6. In the Batch pane select the Acq Method tab then the Tune tab.

7. Right click in the Signal Monitor grid and select Report, then Generate Tune Report.

8. In the window that appears verify that the Report Template selected is as follows:

C:\Agilent\ICPMH\Report Templates\en\Letter\Tune Report\TuneCheckReport.xltx

9. Click Generate. The software will acquire the tune check data from the instrument and a report will be printed.

10. If the EPA Daily Tune fails any of the criteria rerun the tune a second time. If it fails a second time take corrective action before running the EPA Daily Tune check again (maintenance or optimization of tuning parameters).

C. Sample analysis

1. Once the EPA Daily Tune passes all criteria, place the internal standard probe in the internal standard solution and place the carrier probe into the carrier solution.

2. Once the carrier and internal standard solution have flushed through the tubing and are

aspirating into the spray chamber, sample analysis can begin.

3. In MassHunter open the method batch file used for analysis. Use ~ICPMS.b for non-potable waters and solids analyses, and ~ICPMS_nogas.b for drinking water analysis.

4. Save the batch with a new name:

YYMDDR## where:

YY is the two digit year
M is the letter of the alphabet corresponding to the month (A for January, B for February, etc.)
DD is the two digit day of the month
R is the letter of the alphabet that changes for each attempted run sequence

Example: For the first run started on March 19 in the year 2012 the batch folder would be named 12C19A01.b

5. Enter the calibration standards and lot numbers in the order of:

ICV/ICB/CRI/ICSA/ICSAB/LRC(s)/Rinse(s)/CCV/CCB

6. Scan all samples into the sample list and add PDS/SD and/or dilutions as needed.

7. Add a CCV/CCB block after every 10 samples (or ending the run) as well as an ending CRI/ICSA/ICSAB as needed per method or project note.

8. Enter the locations of the samples to match the rack in which they will loaded onto the auto-sampler. Ensure that the order of the samples on the batch paperwork/re-read sheet match the order in which they are loaded.

9. Right click on the sample list and print a copy.

10. Use the print out to confirm the sample ID(s) and locations of the samples on the auto-sampler.

11. Load the auto-sampler based off of the printed out sample list. Sign off on the sample list with your initials, employee number and the date.

12. Keep the sample list with the batch(es) paperwork until the batch is imported into the LIMS. Note the analytical and prep batch(es) numbers on the sample list and give to the Group Leader.

D. Pouring an ICP-MS run (Waters only in 50 mL digestion tubes):

It is important to minimize any chance of contamination, to both yourself and the samples. Keep your hands and the work area clean at all times. Wear appropriate PPE at all times to prevent exposure to chemicals and samples including lab coat, gloves, and safety glasses, and additional PPE as required by project or health and safety.

NOTE: See Form *T-MET-WI12065* for standards and solutions used during the analytical run.

1. Choose the appropriate prep batch sheet.

NOTE: When retrieving the batch from the shelf for the first time, record the batch location on the cap of the prep blank in black sharpie. This saves time when returning the batch to the proper location after analysis and shows that the batch has been poured before and verified to be in the correct order. To prevent more than one batch from being assigned to the same location, the digestion trays all have the location written on the foam holder.

2. Verify that each digestion tube is in the correct order according to the prep sheet. If anything is missing, correct the prep sheet and notify PREP or the Group Leader to correct the LIMS and put the sample back in for digestion. If the order is incorrect, reorder the sample digestion tubes to match the paperwork.

3. For batches prepared in hot blocks in 50-mL digestion tubes or prepared by the MTL_ND method:

a. The only tubes that typically need to be poured for the initial run are the post digestion spike (PDS) and serial dilution (SD)samples. These are prepared using the background sample (BKG) or the duplicate background sample (DUP) when limited sample volume is available.

b. All other samples remain in the 50-mL digestion tubes for analysis.

4. Samples that need to be poured into test tubes:

a. Obtain the appropriate number of tubes.

b. Write the last four digits of the sample number and the dilution factor if greater than 1 on each tube. If the MB or LCS must be in tubes, write MB/LCS and the prep batch number/location on the tubes.

c. Place tubes in test tube racks in the same order as the samples on the prep batch cover sheet and/or re-read.

d. The analyst must ensure that tubes are labeled correctly, that dilutions are performed accurately, and that the dilutions are recorded on the prep cover sheet and/or re-read.

5. Post-digest spike (PDS):

a. A PDS is required for each batch (sample volume permitting).

b. A PDS is prepared by pipetting 0.2 mL of the appropriate PDS solution into a 15-mL graduated test tube, and bringing it to a volume of 10 mL with the background sample, "BKG". If the PDS must be diluted, pipette 0.2 mL of the PDS solution into a 14 mL graduated test tube, add the appropriate amount of background sample, "BKG", and dilute to 10 mL using matrix rinse. If there is limited volume for the background sample, "BKG", then the "DUP" may be used for dilutions of the PDS or SD. If the duplicate is used for PDS or SD, make an internal NCM on the analytical batch after analysis.

c. Record the lot number of the PDS solution used on the prep batch cover sheet and/or re-read.

6. Serial dilution (SD)

a. Prepare the SD by diluting the background sample at a dilution that is equal to 5× the dilution factor of the PDS sample (i.e.if PDS= DF1, SD must = DF5; if PDS=DF5, SD must=DF25).

7. Filtering samples

a. Samples that are cloudy or have particulate suspended in solution must be filtered prior to analysis to prevent clogging of the sample introduction system, which causes run failures and instrument down time to correct the problem.

b. Samples that are in the 50-mL digestion tubes may be filtered using the FilterMate filtration devices and plunger or a syringe and syringe filter.

c. Attach a filtration device to the plunger and very carefully insert the filter into the digestion tube until the filter reaches the bottom of the digestion tube.

d. Remove and discard the plunger.

e. An alternative for samples in any type of vessel is to filter using a 10-mL sterile disposable syringe fitted with a 0.45µm PTFE syringe filter.

f. If any samples are filtered, the MB and LCS must also be filtered. If any QC sample is filtered (BKG, DUP, MS, or MSD), then all QC including the MB and LCS must be filtered.

g. Document all filtrations on the prep batch cover sheet.

NOTE: It is not necessary to filter all samples (in 50 mL digestion tubes only) that contain particulate, as long as all of the particulate is settled to the bottom of the tube below the 5-mL mark in 50-mL digestion vessels. The sampling depth of the autosampler probe is set such that the tip of the probe is approximately 100 mm above the bottom of the digestion tube. It is necessary to filter all solid samples and to dilute to DF2 prior to analysis.

8. Verify that all samples in the hotblock tray are in the correct position and/or pour each sample (or sample filtrate) into the appropriate tube. Usually, the order of the batch QC is MB, LCS, (LCSD), Bkg, PDS, DUP, MS, (MSD), and SD. Most importantly, the actual positions of the samples in the tray must match the autosampler table used for analysis.

NOTE: Immediately prior to beginning analysis, the analyst must visually verify that each sample is in the position indicated in the autosampler table used for the run.

9. If not being analyzed immediately, cap any poured tubes to prevent contamination of the samples (digestion tubes and dilutions prepared in graduated test tubes must be capped tightly except during pouring and/or analysis).

10. Return samples to sample storage, being sure to place the batch back into the location recorded on the prep batch sheet.

11. Record the following on the prep batch cover sheet: initials, employee number, and the date, and lot numbers for PDS, filters, test tubes, as used).

12. NOTES:

a. A PDS and a SD are performed on one sample in each digestion batch. Typically, the background sample is chosen. If the batch QC is split between two samples, the PDS is performed on the background sample accompanied by a matrix spike; the SD is performed on the background sample accompanied by a matrix duplicate. If sample volume is limited, it is acceptable to use the duplicate for the PDS and SD.

b. Batches with only field blanks or equipment blanks do not need a PDS or a SD.

c. Air filter batches need only a SD on one sample in the batch (a PDS is not required).

d. “As Received” samples are analyzed with a blank and LCS, LCSD (prepared by the analyst).

e. Documentation is of utmost importance. Verify all entries.

E. Data analysis and Import

1. Once the sample run is complete you will switch to or open the Offline ICP-MS Data Analysis program to make any changes to internal standard selection and generate the file for import into LIMS. Note, the Attachment Internal Standard Reference includes the appropriate internal standards to reference for each metal.

2. Once in the Offline ICP-MS Data Analysis program open the batch that contains the run data you are going to process by clicking Open Analysis File (open folder icon or from the File drop down menu).

3. Evaluate appropriate internal standard selection based on the Quality Control section of this SOP and method requirements for the samples analyzed.

4. If it is appropriate to change internal standard selection from the defaults in the method used click the DA Method Editor button (skip to step e. if alternate internal standard selection is not needed).

a. Under Method Development Tasks (in the left pane of the DA Method Editor window) select “FullQuant” under item number 4 (Set up Analysis Parameters).

b. Under the analyte list that appears in the right hand pane of the DA Method Editor you will see a list of the analytes.

c. Change internal standards for any analytes where alternate internal standard selection is both necessary and appropriate.

d. Then click “Return to Batch-at-a-Glance” in the left hand pane.

e. When prompted to “Update Analysis Method?” select “Yes”.

f. Click the “Process Batch” button to recalculate all concentration values in the batch folder using the internal standard selections you made while in the DA Method Editor.

5. To generate the file for import into LIMS you must first select all the data rows needed for your run, starting with the ICIS down to the last row in your run. If you restarted the run only select the most recent ICIS and all samples below it.

6. Once the appropriate rows of data are selected click on Tools and select “Upload to TALs” to run the script that compiles the file for import.

7. A pop up will appear once the script is complete stating that the file was created successfully. While the batch is still highlighted click on the Report tab. Generate the raw data PDF's and save them into the respective run's folder.

8. Open the ITUNE app and select the .rep file that was generated along with the tune file for that day. This will generate a new .rep file that will then be copied to the import folder. This will put the run into the LIMs system.

Calculations

1. Final Result

a. Water sample

$$\frac{Instrument}{Reading} \times \frac{Dilution\ Volume}{Aliquot\ Volume} \times \frac{Final\ Volume}{Sample\ Volume}$$

b. Solid sample (mg/kg)

$$\frac{Instrument}{Reading} \times \frac{Dilution\ Volume}{Aliquot\ Volume} \times \frac{Final\ Volume}{Sample\ Weight\ (grams)}$$

2. Relative percent different (RPD)

$$RPD = \frac{S - D}{(S + D)/2} \times 100$$

Where:

S = first sample value

D = duplicate sample value

3. Spike recovery

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

Where:

SSR = spiked sample result

SR = sample result

SA = spike added

4. Correlation Coefficient

$$r = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N})(\sum Y^2 - \frac{(\sum Y)^2}{N})}}$$

Where :

X = the known concentration

Y = the instrument response

N = the total number of data points

5. Serial Dilution

$$\%\ Difference = \frac{(5 \times SDR) - SR}{SR} \times 100$$

Where:

SDR = serial dilution result

SR = sample result

6. Methods of standard additions (MSA)
Take either 4 identical aliquots (for 3 point MSA) or 2 identical aliquots (for one point MSA) of the same sample. Leave one unspiked. Spike the other 3 aliquots with different levels of a standard solution (for 3 point MSA) and spike the other aliquot at approximately the indigenous concentration of the sample (for one point MSA). Add blank solution to sample aliquots so that the final volume is the same for all. Use small volumes of spiking solution to avoid diluting the sample more than 10%. Analyze the 4 aliquots or 2 aliquots and record the instrument readings in absorbance. Use the readings and spike values to find the slope and x- and y- intercepts. The x- intercept is the result.

$$\text{Slope} = m = \frac{\sum x_i y_i - (\sum x_i \sum y_i)/n}{\sum x_i^2 - (\sum x_i)^2/n}$$

$$\text{Y-Intercept} = b = \bar{y} - m\bar{x}$$

$$\text{Result} = -\frac{b}{m}$$

$$\text{Correlation Coefficient} = r = \frac{\sum\{(x_i - \bar{x})(y_i - \bar{y})\}}{\sqrt{\left[\sum (x_i - \bar{x})^2\right]\left[\sum (y_i - \bar{y})^2\right]}}$$

The correlation coefficient (r) for the least squares fit must be ³0.995. If the r value is <0.995, the MSA must be repeated at the same dilution. If the r value is again low, the result with the higher r value is verified and both are flagged with a "+" in the data package. If the r value is <0.990, the sample is run at an interference dilution to overcome matrix effects. This usually requires a raised limit of quantitation. If a client requests a particular limit of quantitation that prohibits further dilution, then the sample is repeated at the same dilution and the best of the two results is verified.

7. Average, Standard Deviation and Relative Standard Deviation

The average result, $\bar{x}$, is calculated by summing the individual results and dividing this sum by the number (n) of individual values:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + x_4 + \ldots x_n}{n}$$

Standard deviation is a measure of how precise the average is or how well the individual numbers agree with each other.

$$\text{Standard deviation, } S = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2 + \ldots + (x_n - \bar{x})^2}{n-1}}$$

Relative standard deviation (RSD) is expressed in percent and is obtained by multiplying the standard deviation by 100 and dividing this product by the average.

$$\text{Relative standard deviation, RSD} = \frac{100 \times S}{\bar{x}}$$

Statistical Information/Method Performance

Generate MDLs and LOQs according to *QA-SOP11892*.

The department principal scientist and manager maintain annual study data. The department principal scientist, manager, and/or group leader requests that a Quality Assurance Specialist update to the LIMS as needed by department email.

Refer to *QA-SOP11896* for statistical information.

Quality Assurance/Quality Control

A. For 6020, 6020A and 6020B, each digestion batch (up to 20 samples) must contain a method blank, LCS, and either an BKG, DUP, MS, MSD or an LCS/LCSD (limited volume or approved by manager and QA only).

B. For 200.8, each digestion batch (up to 10 samples) must contain a method blank, LCS, and either an BKG, DUP, MS or an LCS/LCSD (limited volume or approved by manager and QA only). An additional BKG and MS are added for batches over 10 samples up to 20 samples.

C. QC limits for MS/MSD, and LCS/LCSD are established through statistical analysis of historical data.

1. The limits are maintained in the LIMS in Method Limit Groups.
2. The limits are evaluated every 6 months and updated as needed.
3. The limits are subject to change without notification.

D. Batch Quality Control

1. For the preparation and concentrations of Quality Control samples see *T-MET-WI12065*.

2. For the frequency, acceptance criteria and corrective action see *T-MET-WI35797*.

E. Raw data quality checks

1. Make sure that the run is correctly labeled, and dated and that the corresponding prep sheet is attached to the run.

2. Verify that the appropriate Tuning Report is with the run.

3. For run and batch QC/Calibration frequency, acceptance criteria and corrective action, see *T-MET-WI35797* tables.

4. Spike levels of batch QC are available in the LIMS and on T-MET-WI9082.

5. LOQs (RLs), MDLs, and IDLs are available to analysts in the LIMS in Method Limit Groups and Equipment Limit Groups.

6. Check to make sure that all results are not> 90% of the Linear Range, according to LIMS Equipment Limit Groups. If a sample reading is above 90% of the linear range, then reread the sample at a dilution sufficient to bring the sample concentration to approximately the middle of the calibration range.

7. Check that the **absolute** value of all non-detected analytes is less than the RL. A technical decision must be made as to whether a reread is warranted for readings <|RL|.

8. Check for carryover between samples. Sample RSD >20%, with a concentration > the LOQ decreasing progressively over time (i.e., Reading 3<2<1). Flag any suspect samples for reread.

NOTE: Whenever a sample is encountered that exceeds the calibration range, the following sample must be checked for carryover for the over range analyte (s) and any suspect results must be deselected and reanalyzed. During reanalysis the sample order must be modified as needed to avoid carryover from any over range sample(s).

9. For all EW (samples from public drinking water sources), highlighted mint green in the LIMS, check the results against the MCL (maximum contaminant level) by reviewing the limits tab in analyst desktop II. If an analyte **exceeds** the MCL, is a certified analyte for the SDWA method, and is associated with a mint green compliance drinking water sample, notify the verification group at once by NCM or email. An automated email is sent to the Client Service Representative and the state for the analytes listed below with the exception of Pb and Cu which follow the 90th percentile rule (the CSR tracks the lead and copper and notifies the supplier when necessary). Suppliers must be notified within the required time limit as stated in QA-SOP11886.

10. To avoid the risks associated with polyatomic interferences in wastewater and soil matrices all analytes must be analyzed on the collision cell ICP-MS instruments which include Agilent 7900, Equipment E07 - 27813, Equipment E08 - 30647, Equipment E09 - 30921).

a. Because EPA 200.8 rev. 5.4 does not currently allow the analysis of drinking water samples using collision cell ICP-MS all drinking water samples must be analyzed using a method with no gas mode for all analytes on the Agilent 7700, which includes Equipment E05 - 19204.

11. Check the internal standard level for the entire run. Reference the Internal Standard Reference attachment in this SOP for the appropriate internal standards to use for each metal. If the internal standard reading for any sample is out of the acceptance range of the S0 reading, evaluate whether this is a result of the sample matrix or drift from other samples in the run. Only reread the sample at a dilution if the internal standard appears to be out of range due to the sample matrix. For samples where an internal standard is above the acceptance range it is acceptable to reprocess the data using an alternate internal standard. This is the preferred approach in order to avoid raised reporting limits. The acceptance criteria differ based on the method being used. Refer to *T-MET-WI35797* for the method acceptance criteria.

NOTE: The internal standard is added in equal concentration to all of the samples and standards via a dedicated line on the peristaltic pump. The analytical lines referenced to an internal standard report a corrected concentration value based on the ratio of analyte to internal standard intensities. All the calculations for determining concentration are based on Intensity Ratio (IR). The IR is defined as the background corrected intensity signal of the analyte line (Ia) divided by the internal standard value (Iis). IR= Ia/Iis.

12. For TCLP and SPLP samples, an MSA (method of standard additions) is required if:

a. The sample concentration falls between 80% and 100% of the regulatory limit.

b. If the TCLP or SPLP matrix spike (QA) recovers <20%, all samples in the leachate batch must be reanalyzed using the method of standard additions for that analyte.

13. When items 1 – 12 are complete, check the following:

a. All samples requiring reread/redigestion are listed on the reread paperwork, and redigestions are communicated to the verification group by email.

b. The data are uploaded to LIMS via data transfer to TALS.

Figure I - Daily Performance Acceptance Criteria and Tuning Solution Concentrations

Be (9)	10 or 100 PPB
Mg (24)	10 or 100 PPB
Co (59)	10 or 100 PPB
In (115)	10 or 100 PPB

Pb (208)	10 or 100 PPB
CeO/Ce	<3%
Ce++/Ce	<3%
Background	<30 cps @ Mass 220
RSD	<5%
Peak Width at 10% Peak Height	<0.9 AMU
Res/Axis	< +/- 0.1 AMU from unit mass

Attachment:
Internal Standard Reference (.pdf)

10695 Liquid Sample Preservation, Sample Splitting, and Turbidity for metals by EPA Methods 200.7 and 200.8
11178 Demonstrations of Capability
11880 Laboratory Equipment Verifications - Balance, Syringe, Pipette, Weights, and Other Equipment
11892 Determining Method Detection Limits and Limits of Quantitation
11896 Establishing Control Limits
11901 Instrument Maintenance and Calibration
11925 Client Specific - 3030 C. Treatment for Acid-Extractable Metals for North Carolina Groundwater Samples
11938 Digestion of Waters by EPA 200.7/200.8 for Analysis of Metals by ICP/ICPMS
11941 Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) and Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
12065 Working Instructions for Preparation of ICP-MS Solutions and Standards
21590 Instrument Maintenance for Agilent 7900
35797 Metals Data Verification Process
6869 Nonconformance Form
8636 Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for ICP and ICP-MS
8639 Sample Preparation of Waters for Analysis of Total Recoverable Metals by ICP-OES and ICP-MS
8732 Lab and Field Filtered Waters and <1NTU Drinking Water Preparation for ICP (EPA 200.7, 6010B/C/D) or ICP-MS (EPA 200.8, 6020/A/B)
8822 ICPMS Analysis

End of document

Version history

Version	Approval	Revision information	
11	12.NOV.2020		
12	15.APR.2022		
13	27.JUL.2022		

eurofins	Always check on-line for validity.	Level:
Document number: **T-MET-WI11941**	**Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) and Inductively Coupled Plasma Mass Spectrometer (ICP-MS)**	**Work Instruction**
Old Reference: **1-P-QM-WI-9015159**		
Version: **14**		Organisation level: **5-Sub-BU**
Approved by: **ULJC** Effective Date: **08-FEB-2022**	Document users: **6_EUUSLA_Metals_ICP Prep, 6_EUUSLA_Metals_ICP Prep Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Purpose
Scope
Basic Principles
Reference Modifications
Definitions
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Block Digestion Instructions
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 14	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	Update to current practice	Added new TALS method IDs
Reagents and Standards	Update to current practice	Updated reagent supplier and grade
Throughout Document	Clarification	Updated terminology to new LIMS terminology
Throughout Document	Clarification	Updated to D4 references
Procedure	Update to current practice	Updated procedure for preparation of leachate samples and the method blank and LCS for leachate batches.

Revision:	13	**Effective Date:**	14-DEC-2020
Section	**Justification**	**Changes**	
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version	
LIMs ID	Update to current practice	Added new LIMs method IDs	
Cross Reference	Update to current practice	Updated Document number and added Document 11933	
Purpose	Update to current practice	Added information for ICPMS	
Throughout Document	Clarification	Updated terminology to new LIMs terminology	

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 3010A, July 1992

2. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI11931	Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)
T-MET-WI11933	Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A/6020B(aqueous, solid, tissue) and EPA 200.8 (aqueous)
T-MET-WI9082	Working Instructions for Prep Solutions and Standards
QA-SOP11178	Demonstrations of Capability

Purpose

This digestion procedure is used to prepare wastewater and leachate samples for measurement of total/total recoverable metals by ICP and ICP-MS following SW-846.

Scope

This digestion procedure is used by the Metals department of the Environmental Sciences division.

Basic Principles

A mixture of nitric acid and the sample is refluxed in a covered beaker or a covered polypropylene container (digestion vessel) at low volume. Then it is refluxed with hydrochloric acid and brought up to volume with reagent water.

Reference Modifications

1. A 50-mL final volume is used instead of 100-mL to improve digestion throughout, conserve sample usage, and limit waste generation. Because all reagents are also adjusted so that concentrations are equivalent to a 100-mL aliquot, there is no impact on the data.

2. Ribbed watch glasses are not used; samples are evaporated without watch glasses in nonmetallic hoods to speed evaporation. No contamination trends have been observed in prep blanks evaporated without using watch glasses.

Definitions

1. ACS – American Chemical Society

2. ASTM – American Society of Testing and Materials

3. DUP – Sample Duplicate

4. DOC – Demonstration of Capability

5. IDOC – Initial Demonstration of Capability

6. LCS/LCSD – Laboratory Control Sample/Laboratory Control Sample Duplicate

7. LIMS – Laboratory Information Management Systems

8. LOQ – Limit of Quantitation

9. MDL – Method Detection Limit

10. MS – Matrix Spike

11. MSD – Matrix spike duplicate

12. MB– Method Blank equivalent to a Preparation Blank. A designated sample designed to monitor for sample contamination during the analysis process. A volume of reagent laboratory water is typically used to monitor water sample analysis, while solids blanks consist of a purified solid matrix or just the reagents used in the test. The blank demonstrates that no artifacts were introduced during the analysis process.

13. QC – Quality Control

14. SOP – Standard Operating Procedure

15. SPLP – Synthetic Precipitation Leaching Procedure

16. STLC – Soluble Threshold Limit Concentration

17. TCLP – Toxicity Characteristic Leaching Procedure

18. BKG – unspiked background sample

Interferences

Not applicable to this procedure.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO_3) – This acid can cause skin burns. Add nitric acid to samples in a hood or use the designated dispensing equipment to avoid exposure to toxic fumes.

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCl with concentrated H_2SO_4 to avoid a violent reaction. Always use in a fume hood or use the designated dispensing equipment.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds.

Samples that contain dust may be hazardous. Open in a fume hood.

When a hazardous flag is added indicating possible cyanide, special precautions are required to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills (small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water. Spill pillows and SPILL-X-A are stored on the prep room shelf.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and a documented Demonstration of Capability for this or an equivalent procedure.

Initially, each employee performing this digestion procedure must work with an experienced employee for a period of time until they can independently set up batches and perform the necessary steps outlined in this procedure. Proficiency is measured through documentation of the critical steps in this procedure, over checking of data as well as an IDOC.

The IDOC and the DOC consists of four laboratory control samples that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Refer to *QA-SOP11178* for specific requirements. A DOC is performed annually and is maintained in the analyst's training records.

Sample Collection, Preservation, and Handling

Samples are collected in plastic containers and preserved to a pH of < 2 with HNO_3 (Samples submitted for soluble metals that are to be lab filtered must be unpreserved. The sample is run through a 0.45 micron filter within 5 days of receipt and then preserved.) The pH is checked upon receipt and adjusted as necessary by

Sample Support; samples that are pH adjusted at the lab must not be digested for a minimum of 24 hours. If samples fail to maintain a pH of <2 the Client Service Representative is notified for further direction. Samples are stored at 0° to 6°C, but not frozen, prior to digestion. Sample must be digested within 6 months of collection. Digested samples are stored in plastic at room temperature and have a 6 month holding time.

Apparatus and Equipment

1. Polypropylene containers (digestion vessels) – certified clean and Class A equivalent

2. Watch glasses or reflux caps

3. 50-mL graduated cylinders or other appropriate graduated cylinders if necessary

4. 50-mL volumetric flasks or other appropriate Class A volumetric flasks if necessary

5. 250-mL beakers, or other appropriate beakers

6. Hotblocks or hot plates, adjustable and capable of maintaining a temperature of 90° to 95°C

Reagents and Standards

For reagent preparation, shelf life, and storage conditions, see T-MET-FRM9082.

1. Nitric Acid, HNO_3 - J.T. Baker, Reagent Grade, or equivalent. Store at room temperature and re-evaluate annually.

2. Hydrochloric acid, HCl - J.T. Baker, Reagent Grade, or equivalent. Store at room temperature and re-evaluate annually.

3. Hydrochloric Acid (1:1) - Add 500 mL of HCl to 500 mL of reagent water. Store at room temperature. Expires in 6 months.

NOTE: It is acceptable to prepare solutions using multiples of indicated volumes if exact ratios are maintained.

Calibration

Not applicable to this procedure.

Procedure

This SOP has been set up to outline the procedures for both hot plate and HotBlock digestions (see below). Choose the procedure that corresponds to the sample heating technique being used for sample digestion.

A. HotBlocks

NOTE: When insoluble matter is present in the digested sample, allow it to settle by gravity or filter prior to introduction to the instrument. If any samples are filtered, the method blank and LCS must also be filtered.

NOTE: For soluble metals analysis, filter unpreserved sample through 0.45-micron filter paper. Adjust the filtered sample to pH <2 with nitric acid preserving solution. Measure the volume of sample, as stated in this procedure, and digest as normal. The method blank and spiked LCS must also be prepared with filtered reagent water.

NOTE: If the sample contains high solids, use a smaller aliquot of the sample and bring sample to final volume as stated in this procedure. Make appropriate acid, reagent, and spike volume adjustments based on

sample final volume.

NOTE: It is acceptable to reduce the volume of sample being analyzed as long as the sample reagent ratios are maintained.

1. Shake sample well. Transfer 50 mL of well-mixed sample to a 68-mL digestion vessel. After the sample has been poured, add the spiking solution. For sample batch spiking procedures see *T-MET-WI9082*.

NOTE: For leachate samples, transfer 5 mL of well-mixed sample to a 68-mL digestion vessel. Bring to a final volume of 50 mL using reagent water. Use 5 mL of the appropriate extraction fluid for the MB and LCS/D and bring to a final volume of 50 mL using reagent water. The extraction fluid are as follows: TCLP, SPLP, STLC, ASTM, Filtration, and Elutriate.

2. Add 1.5 mL of concentrated HNO_3. Place the digestion vessel in a HotBlock at 90° to 95°C, and cautiously evaporate to low volume (about 5 mL), making certain that the sample does not boil and that no portion of the bottom of the digestion vessel is allowed to go dry.

3. Allow the digestion vessel to cool then add another 1.5-mL portion of concentrated HNO_3.

4. Cover the digestion vessel with a reflux cap and return to the HotBlock. Increase the temperature of the HotBlock so that a gentle reflux action occurs.

NOTE: If a sample is allowed to go to dryness, low recoveries result. If this occurs, discard the sample and re-prepare in a new batch.

5. Continue heating (refluxing), adding additional acid as necessary, until the digestion is complete (generally indicated when the digestate is light in color or does not change in appearance with continued refluxing).

6. When digestion is complete, uncover the digestion vessel and evaporate to low volume (about 3 mL). Do not allow any portion of the bottom of the digestion vessel to go dry. Allow the digestion vessel to cool.

7. Add 5 mL (1:1) HCl, cover the digestion vessel, and reflux for an additional 15 minutes to dissolve any precipitate or residue from evaporation. Allow the digestion vessel to cool.

8. Adjust sample volume to 50-mL mark on the certified digestion vessel with reagent water, cap and mix.

9. The sample is now ready for analysis.

B. Hotplates

NOTE: When insoluble matter is present in the digested sample, allow it to settle by gravity or filter prior to introduction to the instrument. If any samples are filtered, the method blank and LCS must also be filtered.

NOTE: For soluble metals analysis, filter unpreserved sample through 0.45-micron filter paper. Adjust the filtered sample to pH <2 with nitric acid preserving solution. Measure the volume of sample, as stated in this procedure, and digest as normal. The method blank and spiked LCS must also be prepared with filtered reagent water.

NOTE: If the sample contains high solids, use a smaller aliquot of the sample and bring sample to final volume as stated in this procedure. Make appropriate acid, reagent, and spike volume adjustments based on sample final volume.

NOTE: It is acceptable to reduce the volume of sample being analyzed as long as the sample reagent ratios are maintained.

1. Shake sample well. Use a 50-mL graduated cylinder to transfer 50 mL of well-mixed sample to a 250-mL beaker. After the sample has been poured, add the spiking solution. For sample batch spiking procedures see *T-MET-WI9082*.

NOTE: For leachate samples,transfer 5 mL of well-mixed sample to a 68-mL digestion vessel. Bring to a final volume of 50-mL using reagent water. Use 5 mL of the appropriate extraction fluid for the MB and LCS/D and bring to a final volume of 50-mL using reagent water. The extraction fluid are as follows: TCLP, SPLP, STLC, ASTM, Filtration, and Elutriate.

2. Add 1.5 mL of concentrated HNO_3. Place the beaker on a hot plate and cautiously evaporate to low volume (about 5 mL), making certain that the sample does not boil and that no portion of the bottom of the beaker is allowed to go dry.

3. Allow the beaker to cool then add another 1.5-mL portion of concentrated HNO_3.

4. Cover the beaker with a watch glass and return to the hot plate. Increase the temperature of the hot plate so that a gentle reflux action occurs.

NOTE: If a sample is allowed to go to dryness, low recoveries result. If this occurs, discard the sample and re-prepare in a new batch.

5. Continue heating (refluxing), adding additional acid as necessary, until the digestion is complete (generally indicated when the digestate is light in color or does not change in appearance with continued refluxing).

6. When digestion is complete, uncover the beaker and evaporate to low volume (about 3 mL). Do not allow any portion of the bottom of the beaker to go dry. Allow the beaker to cool.

7. Add 5 mL (1:1) HCl, cover the beaker, and reflux for an additional 15 minutes to dissolve any precipitate or residue from evaporation. Allow the beaker to cool.

8. Transfer the solution to a 50-mL volumetric flask. Adjust sample volume to the 50-mL mark with reagent water and mix.

9. Pour the mixed sample into a polypropylene container and cap.

10. The sample is now ready for analysis.

Block Digestion Instructions

1. Turn block digestor on by pressing rocker switch located on the cord.

2. Wait about 8 seconds until controller display indicates current block temperature.

3. Press and hold Star (*) key.

4. The display shows the Set Point Temperature.

5. The digits can be changed to the desired value by pressing the up and down arrow keys while holding the (*) key.

6. Confirm Control Point temperature is set to the block temperature that provides 90° to 95°C.

NOTE: See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used for digestion. If necessary, adjust Control Point temperature to the proper setting.

NOTE: Polypropylene containers must not be heated above 130°C.

Calculations

Not applicable to this procedure.

Statistical Information/Method Performance

Not applicable to this procedure.

Quality Assurance/Quality Control

Perform a method blank, sample duplicate, sample matrix spike, sample matrix spike duplicate, and laboratory control sample with every digestion batch (20 samples or less). Each piece of batch QC is digested following the procedure in this SOP.

11178 Demonstrations of Capability
11931 Metals by ICP for Methods SW-846 6010B/C/D (aqueous, solid, tissue) and EPA 200.7 (aqueous)
11933 Metals by ICPMS by Methods SW-846 6020/6020A/6020B(waters, solid, tissue) and EPA 200.8 (waters)
9082 Working Instructions for Prep Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
12	19.JAN.2015		
13	30.NOV.2020		
14	25.JAN.2022		

eurofins	Always check on-line for validity. **Preparation of Solids by EPA 7471A or B for Mercury Analysis**	Level: **Work Instruction**
Document number: **T-MET-WI11948**		
Old Reference: **1-P-QM-WI-9015161**		
Version: **22**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date: **01-JUL-2022**	Document users: **6_EUUSLA_Metals_Hg Prep, 6_EUUSLA_Metals_Hg Prep Verifiers, 6_EUUSLA_Metals_Management**	Responsible: **5_EUUSLA_Metals_Manager**

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Block Digestor Instructions
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

	Revision: 22	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	Updated	Removed old LIMS references
Basic Principles and Procedure	Clarification	Added notes about sample splitting process

	Revision: 21	**Effective date:** 13.MAY.2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
LIMS ID	Enhancement	Added TALS Method IDs
Appartus and Equipment	Reflects current procedure	Removed references to LLENS
Reagents and Standards	Enhancement	Clarified acid manufacturer. removed g/mL. Added "or equivalent".

	Revision: 21	**Effective date:** 13.MAY.2021
Section	**Justification**	**Changes**
Procedure	Reflects current procedure	Enter weight as 1, add actual weight to Comments
Quality Assurance/Quality Control	Reflects current procedure	Corrected QC names

Reference

1. Test Methods for Evaluating Solid Wastes, SW-846 Method 7471A, Rev. 1, September 1994.
2. Test Methods for Evaluating Solid Wastes, SW-846 Method 7471B, Rev. 2, February 2007
3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-MET-WI7965	Mercury in Aqueous, Solid and Tissue Samples by Cold Vapor AA
T-MET-WI9084	Working Instructions for Preparation of Mercury Solutions and Standards

Scope

This procedure is used to prepare soil, sediment, sludge, oil, tissue and wipe samples for the measurement of mercury by atomic absorption cold vapor technique following SW-846 7471A or 7471B protocol. If this dissolution procedure is not sufficient to dissolve a specific matrix type or sample, then this method is not applicable for that matrix. Samples that require additional homogenization are addressed on a case-by-case basis and homogenized by the Sample Support Group (Department 6055).

Basic Principles

Soil and solid samples are mixed and aliquoted during soil sample splitting by Sample Administration staff or by metals staff. Full homogenization must be requested additionally by clients.

Samples are digested with aqua regia and potassium permanganate to oxidize mercury compounds to mercuric ions and eliminate possible interference from sulfide. Samples high in chlorides require additional permanganate. At the time of analysis, excess permanganate is reduced with sodium chloride/hydroxylamine hydrochloride. Mercuric ions are reduced to mercury metal using stannous chloride. Mercury measurement is performed using mercury cold vapor technique.

Reference Modifications

To increase efficiency, polypropylene containers are used in place of BOD bottles. Prior to analysis (after excess potassium permanganate is reduced with sodium chloride/hydroxylamine hydrochloride solution) samples are adjusted to 100 mL in volumetric flasks. This allows aliquots to be taken as required for analysis; aliquots cannot be taken when BOD bottles are used. No impact on the quality of the data generated using this modification has been observed.

Interferences

Not applicable to this procedure.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state, and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Preparing samples for inorganic analysis involves working with concentrated acids and other chemicals which are dangerous if not handled carefully:

Nitric acid (HNO_3) – This acid can cause skin burns. Add nitric acid to samples in a hood or use the designated dispensing equipment to avoid exposure to toxic fumes.

Hydrochloric acid (HCl) – This acid can cause skin burns. Never mix HCl with concentrated H_2SO_4 to avoid a violent reaction. Always use in a fume hood or use the designated dispensing equipment.

When diluting strong acids, never add water to acid; always add acid to water.

Store concentrated acids in the prep room acid lockers. Only acids are to be stored in these lockers. (Store solvents in the flammable liquid storage cabinet.) Some concentrated acids are kept in the acid reagent bottles on prep room counters. Fill reagent bottles in an operating fume hood using caution to avoid spills.

Perform acid digestions in hoods that are turned on and have active alarms. Notify a supervisor immediately if the hood is malfunctioning or the alarm sounds.

Samples that contain dust may be hazardous. Open in a fume hood.

When a hazardous flag is added indicating possible cyanide, special precautions are required to avoid exposure to hydrogen cyanide gas. Contact your supervisor prior to adding acid. Always open these samples and add the acid in a hood.

Use spill pillows to absorb large acid spills. (Small spills are cleaned with wet paper towels.) Use SPILL-X-A powder or equivalent to neutralize any remaining acid and then rinse the area thoroughly with water. Spill pillows and SPILL-X-A are stored on the prep room shelf.

Dispose of acid waste properly. Collect all acid digestions, waste solutions, and expired reagent solutions in waste containers. When the acid waste containers are full, a designated acid waste handler transfers the waste to the acid neutralization tank.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC) which is maintained in the analyst's training records.

Initially, each employee performing this digestion procedure must work with an experienced employee for a period of time until they can independently set up batches and perform the necessary steps outlined in this procedure.

Proficiency is measured through an Initial Demonstration of Capability (IDOC) that consists of four laboratory control samples (LCS) that are carried through all steps of the analysis and meet the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation. Various options are available for a DOC and can include four LCS's or one blind sample.

Sample Collection, Preservation, and Handling

Samples are collected in either glass or plastic containers with no preservatives. They must be stored at 0° to 6°C, not frozen and digested and analyzed within 28 days of collection.

Digested samples are stored in plastic containers at room temperature. Store samples, standards, and digested samples separately.

Apparatus and Equipment

1. Polypropylene containers (digestion vessels) - Certified clean and Class A equivalent
2. Balance, capable of reading 0.1 mg

3. Polypropylene covers, (digestion vessel covers)

4. Chemware Ultra-Pure PTFE boiling stones, or equivalent

5. Environmental Express HotBlock (block digestor), adjustable and capable of maintaining a temperature of 95° ± 1°C

Reagents and Standards

A. Store all prepared standards and reagents in glass or polyethylene bottles at room temperature. Label the bottle with the solution name, lot number, date prepared, the expiration date, the initials of the person preparing the solution, and the storage conditions.

B. Standard/ spiking concentration and reagent vendors are subject to change without notification.

C. Reagents - Follow manufacturer's storage conditions and expiration date. If no expiration date is provided, re-evaluate annually or set a one year expiration date. Use the following or equivalent:

1. Hydrochloric acid, 36.5% to 38.0% HCl, JT Baker Trace Metal Grade reagent
2. Nitric acid, 70.0% to 71.0% HNO_3, JT Baker. Trace Metal Grade reagent
3. Potassium permanganate, $KMNO_4$, Fisher or equivalent. Certified ACS.
4. Sodium chloride, NaCl, J.T. Baker or equivalent. Certified ACS.
5. Hydroxylamine hydrochloride, $NH_2OH{\cdot}HCl$, J.T. Baker or equivalent. Certified ACS.
6. 1000 mg/L Hg standard solution, Inorganic Ventures or equivalent.

D. Working instructions for the preparation of mercury solutions and standards are contained within *T-MET-WI9084*. This form includes shelf life and storage conditions.

1. Hg intermediate standard (10 mg/L).
2. Hg intermediate standard (1.0 mg/L).
3. 40 ppb Hg Water Standard.
4. 100 ppb Hg Soil Standard.
5. Potassium permanganate solution (5%).
6. Aqua regia.
7. Sodium chloride/hydroxylamine hydrochloride solution.

E. Adjust all additions according to final solution volume if larger or smaller volumes are needed. Thoroughly mix the solution after diluting to volume.

Calibration

Not applicable to this procedure.

Block Digestor Instructions

1. Turn block digestor on by pressing rocker switch located on the cord.

2. Wait about 8 seconds until controller display indicates current block temperature.

3. Press and hold STAR (*) key.

4. The display shows the Set Point Temperature.

5. The digits can be changed to the desired value by pressing the up and down arrow keys while holding the (*) key.

6. Confirm Control Point temperature is set to the block temperature that provides 95° ± 1°C sample temperature.

NOTE: See HotBlock Control Point Temperature Logbook to obtain control point temperature setting for the HotBlock being used for digestion. If necessary, adjust Control Point temperature to the proper setting.

Procedure

1. Turn block digestor on and allow block to reach the Control Point setting that provides 95° ± 1°C sample temperature.

   Note: Soil samples for metals typically go through soil splitting. Mixing and aliquoting is performed in soil splitting, and splits are delivered to the metals preparation laboratory in the digestate tube. Solids are mixed. Full homogenization must be requested additionally by the client.

2. Collect samples and batch from the split bins. If a sample is not located in a split bin, weigh three aliquots, ~ 0.2000g each, taken from three different areas (combined 0.6000 to 0.6500 g to the nearest 0.0001 g) of a well-mixed, as-received sample into a polypropylene digestion vessel.

3. Add 0.6000g to 0.6499g of Chemware Ultra-Pure PTFE boiling stones to the vessel for the MB and LCS.

4. Enter the MB weight as 1.0 g with final volume of 100 mL and the LCS weight as 1.0 g with final volume 100 mL in the LIMS. In the notes section, record the actual weight in grams of boiling stones used.

5. Matrix exceptions:

   a. Samples with a liquid consistency: increase weight to 1 g (1.00 to 1.05 g).

   b. Oil samples: weigh 0.2000 g to 0.2500 g (to the nearest 0.0001 g) of sample and add 0.2000 g to 0.2499 g of Teflon Chips to the MB and LCS container. Enter the blank weight as 0.2000 to 100.0000 final volume, and the LCS weight as 1.0000 to 100.0000 final volume in LIMS.

   c. Wipes: one blank media each must be used for the batch MB, the LCS, and the LCSD. Use reagent water to rinse any particulate matter from the wipe container into the vessel containing the wipe before digesting. Digest wipes in their own batch.

   d. Tissue samples: spike the LCS, LCSD in the same manner as the matrix spike and matrix spike duplicate (Refer to *T-MET-WI9084*). Digest tissue samples in their own batch.

6. For sample batch quality control preparation, spiking procedures and concentration levels see *T-MET-WI9084*.

7. All spiking must be performed prior to starting the digestion procedure.

8. Add about 5 mL reagent water and about 5 mL of aqua regia solution.

9. Place sample containers in block digestor, bring to 95°C ± 1°C and heat approximately 2 minutes. (Place a calibrated thermometer in batch blank container.)

10. Remove sample containers from block and allow to cool.

11. Add 50 mL of reagent water and 15 mL of 5% $KMnO_4$ solution and mix by carefully swirling the container.

    a. Add additional portions of 5% $KMnO_4$ solution (in 5-mL increments, up to as much as 25 mL), if necessary, until the purple color persists for at least 15 minutes.

    b. Add the same amount of $KMnO_4$ solution to entire digestion batch.

    c. If the maximum amount of 25 mL of 5% $KMnO_4$ solution was added and the purple color did not persist for at least 15 minutes, then contact group leader, further dilutions are required. A comment must be placed on the batch sheet documenting the reason for the dilution.

12. Transfer sample containers to block digestor.

13. Place a calibrated thermometer in batch blank container.
14. Put a polypropylene cover on each container.
15. When the thermometer indicates 95° ± 1°C, continue heating for 30 minutes.
16. Remove sample containers from digestion block and allow to cool.
17. Add 6 mL of sodium chloride/hydroxylamine hydrochloride solution to reduce excess permanganate. Adjust volume to the 100 mL mark with reagent water, seal container with screw cap and mix.
18. The sample is now ready for analysis.

Calculations
Not applicable to this procedure.

Statistical Information/Method Performance
Not applicable to this procedure.

Quality Assurance/Quality Control

Each digestion batch (up to 20 samples) must contain a method blank (MB), LCS, and either an unspiked background sample, duplicate (DU), matrix spike (MS), matrix spike duplicate (MSD) or an LCS/LCSD.

Refer to *T-MET-WI7965* for sample batch quality control requirements, acceptance criteria, and corrective action.

7965 Mercury in Aqueous, Solid and Tissue Samples by EPA 7471A, 7471B, 7470A, and 245.1 rev 3 by Cold Vapor AA
9084 Preparation of Mercury Solutions and Standards

End of document

Version history

Version	Approval	Revision information	
20	06.MAR.2019		
21	13.MAY.2021		
22	22.JUN.2022		

eurofins	Always check on-line for validity. **DFS HRGC/HRMS Preventative and Corrective Maintenance**	Level: **Work Instruction**
Document number: **T-HRMS-WI19229**		
Old Reference:		
Version: **2**		Organisation level: **5-Sub-BU**
Approved by: **UKL3** Effective Date: **23-APR-2019**	Document users: **5_EUUSLA_HRMS_Manager, 6_EUUSLA_HRMS_Analyst, 6_EUUSLA_HRMS_Management_Team**	Responsible: **5_EUUSLA_HRMS_Manager**

Revision Log
Reference
Purpose
Scope
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Maintenance Authorization
Procedure

Revision Log

Revision 2		**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reference	Reflect current references	Updated to current reference documents
Procedure	Clarification	Update names and page references, clarify column maintenance cooling requirements

Revision: 1		**Effective Date:** 13-APR-2018
Section	**Justification**	**Changes**
		New

Reference

1. *DFS Double Focusing Sector Mass Spectrometer Hardware Manual,* ThermoFisher Scientific, Revision F, 1194840, October 2012.

2. *DFS Double Focusing Sector Mass Spectrometer Operating Manual,* ThermoFisher Scientific, Revision B, 1195600, February 2011

3. *Trace GC Ultra Gas Chromatograph Maintenance and Troubleshooting Manual*, Thermo Scientific, P/N 31709180, Revision March 2011.

4. *Trace 1300 and Trace 1310 Hardware Manual Gas Chromatographs*, Thermo Scientific, 31715002, Revision H, April 2018.

5. *NESLAB ThermoFlex Recirculating Chiller Installation, Operation, Basic Maintenance,* Thermo Scientific, P/N U00933 Rev. 07/24/09

6. *UnoLine/DuoLine Rotary Vane Pump Operating Instructions UNO/DUO 2.5, DUO 2.5 C, UNO 5,* Pfeiffer Vacuum Technology

7. *DUOLine Rotary Vane Pump Operating Instructions DUO 5M, DUO 5 MC*, Pfeiffer Vacuum Technology

8. *TurboDrag Pump Operating Instructions* TMH 071 P, TMU 071 P, Pfeiffer Vacuum Technology

9. *TurboDrag Pump Operating Instructions* TMH 262, TMU 262, Pfeiffer Vacuum Technology

10. *Chemical Hygiene Plan*, current version.

Purpose
Preventative and corrective maintenance are crucial in maintaining the overall performance of the High Resolution Gas Chromatograph/High Resolution Mass Spectrometer (HRGC/HRMS) system. This SOP explains the basic principles of managing the integrity of the HRGC/HRMS system.

Scope
This document serves as a guideline for the performance of preventative and corrective maintenance on the DFS High Resolution Magnetic Sector Mass Spectrometer system with a TRACE GC Ultra gas chromatograph.

Safety Precautions and Waste Handling
Safety glasses must be worn and all necessary safety precautions taken when performing any type of preventative or corrective maintenance. See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention. All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal and State laws and regulations.

Personnel Training and Qualifications
Personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of the SOP. Each new chemist will train with an experienced chemist for the first 12 weeks depending on the individual and his or her previous experience. The first 12 weeks is spent working one-on-one with the trainer. This time may be less if the new chemist has prior experience.

During the training period, the new chemist will learn daily preventative maintenance and corrective maintenance procedures, column and source cleaning procedures. S/he is also required to read all relevant SOPs and EPA methods.

Maintenance Authorization
Routine preventative maintenance is required to maintain a HRGC/HRMS system that will perform to method specifications. The performance of preventative maintenance is at the discretion and determination of the chemist, based on experience and what may be required to meet method performance specifications. Corrective maintenance may be performed by the chemist, at the chemist's discretion, based on the observed non-conformance. If, however, it is determined that an outside contractor must be contacted to perform certain types of preventative or corrective maintenance on a system, the chemist should consult with his/her group leader. The group leader will then help determine if contact must be made with the outside contractor and who will make that contact.

Procedure

A. DFS Preventative Maintenance Schedule:

System Component	Procedure	Frequency	Procedure Location
DFS Analyzer	System bakeout	If necessary (e.g. after performing maintenance work on the vacuum system)	DFS Hardware Manual page 5-13
	Replacing the Secondary Electron Multiplier (SEM)	If necessary (When it is impossible to compensate the loss of gain with a higher setting of the SEM voltage)	DFS Hardware Manual page 5-85
DFS Ion source	Adjusting potentials	Daily	
	Check sensitivity and resolution	Daily	DFS Operating Manual pages 1-12 thru 1-21
	Cleaning	as needed	DFS Hardware Manual pages 7-23 thru 7-78
	Replace filament	as needed	DFS Hardware Manual page 7-63
DFS Rotary-vane pumps (forepumps)	Check oil level	monthly	Pfeiffer Uno/Duo 2.5 Manual p. 47; Duo 5 Manual p. 54
	Change oil	Yearly or if oil is cloudy or discolored	
DFS Turbopumps	Exchange lubricant reservoir	At least every three years	Call Field Service Engineer
GC Injection Port	Replace liner	As needed	Trace Ultra GC Manual, p. 28 or Trace 1300 Manual p. 86-88
GC column	Clip injection port end of column	As needed	See procedure below
GC Injection port septum	Replace septum	As needed	Trace Ultra GC Manual, p. 28 or Trace 1300 GC Manual p. 85
NESLAB Cooling water recirculating chiller	Check filters and clean if needed	Monthly	ThermoFlex Chiller Manual, p. 6-1

B. Column maintenance

1. Cool the injection port, transfer line, and GC over to below 45°C.

2. Disconnect the column from the injection port. Slide the desired amount of column to be removed through the column nut and clip the head of the column with a column-cleaving tool. Check for a clean break. The amount of column removed is at the analyst's discretion based on the type of samples analyzed. Six inches to one foot is typical; however, more may be taken if extremely dirty samples were analyzed. The reason for sliding the column through the column nut and ferrule BEFORE clipping is to avoid blockage by graphite particles at the head of the column. Using the ThermoFisher Scientific ruler guide, set the distance between column nut with ferrule and the end of the column using the S'Less marker on the ruler. Insert the column into the injector port and tighten only 1/8 to 1/4 turn past finger tight.

Check for leaks according to the TRACE Ultra GC Manual, p. 179 or TRACE 1300 Manual, p. 76. Close the oven door and reset the temperature zones to the levels they were prior to performing maintenance.

3. Fill out the appropriate maintenance log (normally found next to the instrument). Record all maintenance performed in a clear, concise manner.

C. Corrective Maintenance Basic Principles:

Corrective maintenance is performed on the gas chromatograph and mass spectrometer only when symptoms indicate they are necessary to ensure maximum system performance, or to correct poor system performance. The specific maintenance required will vary depending on the observed problem(s), instrument setup, types of samples run, and method requirements. Following is a list of

possible corrective maintenance and related symptoms; to properly troubleshoot the instrument symptoms, analyst should refer to the proper hardware manual referenced above. This maintenance is often performed by an outside contractor.

D. Corrective maintenance may, depending on symptoms, include the following:

1. Remove and clean the ion source
2. Replace the column
3. Replace ion source parts
4. Replace filaments
5. Replace electron multiplier (detector)

E. Related symptoms may be grouped in the following categories:

1. Chromatographic symptoms
   a. No peaks
   b. Peaks are tailing or fronting
   d. Peaks have flat or split tops
   e. Baseline is high
   f. Baseline is rising or falling
   g. Baseline wanders
   h. Retention times for all peaks drift
   i. Poor sensitivity
   j. Poor repeatability
2. Mass spectral symptoms
   a. High background
   b. Mass assignments incorrect
   c. Vacuum manifold pressure is too high or too low
3. Air leaks
   a. Higher than normal vacuum pressure
   b. Higher than normal background
   c. Peaks characteristic of air (m/z 18, 28, 32, 44)
   d. Poor sensitivity

All corrective maintenance procedures, whether performed internally or by outside contractor, must be fully documented in the instrument maintenance log. Documentation must include the issue leading to the maintenance, the actions taken, and the condition of the instrument after maintenance (i.e. “as found”, “actions”, “as left”).

End of document

Version history

Version	Approval	Revision information	
1	09.APR.2018		
2	09.APR.2019		

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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Precaution to Minimize Method Interference
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision: 03		**Effective date:** This version
Section	**Justification**	**Changes**
Revision log	Required section	Removed revision logs up to previous version
Header	Enhancement	Updated Company name to Eurofins Lancaster Laboratories Environment Testing, LLC
Title and references	Enhancement	Update to QSM5.4
Throughout document and attachments.	Enhancement/reflect current procedure.	Added references to PES, PFECA A, PFECA B, PFECA F, 3:3 FTCA, 5:3 FTCA, 7:3 FTCA as needed, updated SPE cartridge and procedure added in envi-carb cleanup

Revision:	03	**Effective date:** This version
Section	**Justification**	**Changes**
Attachment 1	Reflect current procedure	Updated as needed to reflect current practice.
Attachment 5	Correction	Added attachment 5 which was omitted in the previous version

Revision:	02	**Effective date:** 14-FEB-2022
Section	**Justification**	**Changes**
Revision log	Required section	Add revision log for version 2
Procedure	Reflect current procedure	Procedure B.10,12,13 volumes updated to 7 ml from 5ml
Cross reference	enhancement	Add *G-DC-FRM23907*

Reference

1. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LCMSMS), EPA 537 Version 1.1, September 2009. Department of Defense Quality System Manual Version 5.4, Table B-15.

2. US EPA Method 537 Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LCMSMS), Version 1.1, September 2009.

3. Standard Test Method for Determination of Perfluorinated Compounds in Soil by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS), ASTM Method D7968, 2014.

4. ISO 25101:2009(E) Water quality - Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) - Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry, March 2009.

5. Method for Trace Level Analysis of C8, C9, C10, C11, and C13 Perfluorocarbon Carboxylic Acids in Water. Karen Risha, John Flaherty, Roice Wille, Warren Buck, Francesco Morandi, and Tsuguhide Isemura. Anal. Chem. 2005, 77, 1503-1508.

6. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title

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Document	Document Title
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses
T-PFAS-WI13881	Standards Management in the PFAS Laboratory
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation
G-DC-FRM23907	Redacted SOPs

Scope

This method is applicable for the determination of selected per- and polyfluorinated alkyl substances (PFAS) in aqueous samples to include non-potable waters and non-regulatory potable water when directed by the client. The compounds analyzed in this method are listed in the table below. The most current MDLs and LOQs are listed in the LIMS.

Analyte	Acronym	CAS#
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorododecanoic acid	PFDoDA	307-55-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
8:2 - Fluorotelomersulfonic acid	8:2FTS	39108-34-4
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA	2355-31-9

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N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
4:2-Fluorotelomersulfonic acid	4:2-FTS	757124-72-4
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
6:2-Fluorotelomersulfonic acid	6:2-FTS	27619-97-2
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
10:2-Fluorotelomersulfonic acid	10:2-FTS	120226-60-0
Perfluorododecanesulfonic acid	PFDoDS	79780-39-5
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
Perfluorooctanesulfonamide	PFOSA	754-91-6
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	NMePFOSAE	24448-09-7
N-methylperfluoro-1-octanesulfonamide	NMePFOSA	31506-32-8
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	NEtPFOSAE	1691-99-2
N-ethylperfluoro-1-octanesulfonamide	NEtPFOSA	4151-50-2
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid	HFPODA	13252-13-6
4,8-Dioxa-3H-perfluorononanoic acid	DONA **	919005-14-4 *
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1 *
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9 *
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
Perfluoro-3-methoxypropanoic acid	PFMPA/PFECA F	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA/PFECA A	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA/PFECA B	151772-58-6
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA/PES	113507-82-7

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* = CAS number for the free acid form of the analyte.

** = The acronym for the free acid form of the analyte.

Irreproducible

Basic Principles

A 250-mL aqueous sample is fortified with isotopically-labeled extraction standards and is passed through a solid phase extraction (SPE) cartridge to extract the analytes. The compounds are eluted from the solid phase with a combination of solvents. The extract is concentrated to ~400-500µl with nitrogen in a heated water bath, and then reconstituted to 1ml with methanol. The sample extract is analyzed by LC/MS/MS operated in negative electrospray ionization (ESI) mode for detection and quantification of the analytes. Quantitative analysis is performed using isotope dilution.

Reference Modifications

EPA Method 537 is written specifically for the analysis of drinking water samples. The following modifications to the method have been made to accommodate all aqueous samples.

1. A labeled isotopic analog is spiked into samples for all compounds where an isotopic analog is commercially available. These isotopic compounds are referred to as extraction standards. For those compounds, an isotope dilution calibration model is used. Where labeled isotopes are not available, an internal standard calibration model using the extraction standards is used.

2. Field reagent blanks are not processed as listed in EPA 537 Version 1.1 section 8.3.

3. Trizma is not used for waters except in the cases where the water comes from a chlorinated water source.

4. Peak asymmetry factors are not calculated.

5. MRL confirmation is not performed.

6. Spike concentrations are not rotated between low, medium and high levels.

7. SPE is used for sample preparation. Cartridge types and elution profiles differ from EPA 537 Version 1.1.

MDL studies and IDOCs have been performed to validate method performance.

Interferences

Compounds which have similar structures to the compounds of interest and similar molecular weights would potentially interfere. Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene)

products, LC solvent lines, methanol, aluminum foil, etc. A laboratory blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Precaution to Minimize Method Interference

1. Proprietary Content

2. Proprietary Content

3. PFAS standards, extracts and samples should not come in contact with any glass containers as these analytes can potentially adsorb to glass surfaces. PFAS analytes and labeled extraction standards commercially purchased in glass ampules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be stored in polypropylene containers.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. PFOA has been described as "likely to be carcinogenic to humans". Each chemical should be treated as a potential health hazard and exposure to these chemicals should be minimized.

Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves. Gloves, lab coats, and safety glasses should be worn when preparing standards and handling samples. Avoid inhaling solvents and chemicals and getting them on the skin. Wear gloves when handling neat materials. When working with acids and bases, take care not to come in contact and to wipe any spills. Always add acid to water when preparing reagents containing concentrated acids.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. All solvent waste and extracts are collected in approved solvent waste containers in the laboratory and subsequently emptied by personnel trained in hazardous waste disposal into the lab-wide disposal facility. HPLC vials are disposed of in the lab container for waste vials, and subsequently lab packed. Any solid waste material (disposable pipettes and broken glassware, etc.) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC).

Each chemist performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Also, several batches of sample extractions must be performed under the direct observation of another experienced chemist to assure the trainee is

Template

capable of independent preparation. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

Each LC/MS/MS analyst must work with an experienced employee for a period of time until they can independently calibrate the LC/MS/MS, review and process data, and perform maintenance procedures. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and DOC consist of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meets the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

See *QA-SOP11178* for additional information on IDOC and DOC.

Sample Collection, Preservation, and Handling

A. Sample Collection

The samples are collected in 250-mL polyethylene bottles. Keep the sample sealed from time of collection until extraction.

NOTE: PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

B. Sample Storage and Shipment

1. Samples must be chilled during shipment and must not exceed 10°C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10°C when the samples are received at the laboratory.

2. Samples stored in the lab must be held at a temperature of 0° to 6°C, not frozen, until extraction.

3. Water samples must be extracted within 14 days. Extracts must be analyzed within 28 days after extraction. Extracts are stored at room temperature.

Apparatus and Equipment

A. Apparatus

1. 250mL HDPE bottles: Scientific Specialties; # 334008-blk-1, or equivalent.

2. Centrifuge tubes – 15-mL conical polypropylene with polypropylene screw caps; Fisher Scientific, Cat. No. 05-539-5 or equivalent

3. 10-mL polypropylene volumetric flask, class A – Fisher Scientific, Inc., Cat. No. S02288 or equivalent.

4. HPDE bottles for extraction fluid storage: L; Environmental Sampling Supply, Cat. No. 1000-1902-PC

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5. Analytical Balance – Capable of weighing to 0.0001 g
6. Top-Loading Balance – Capable of weighing to 0.01 g
7. Proprietary Content
8. Proprietary Content
9. Proprietary Content
10. SPE vacuum extraction manifold –"Resprep" 24-port manifold; Restek Corp catalogue # 26080, or equivalent.
11. Proprietary Content
12. Centrifuge – "Q-Sep 3000"; Restek Corp. Cat. No. 26230, or equivalent, capable of a minimum rotational speed of 3000 rpm.
13. Disposable polyethylene pipette – Fisher Scientific, Cat. No. S30467-1 or equivalent
14. Auto Pipettes – Eppendorf; capable of accurately dispensing 10- to 1000-µL. Fisher Scientific cat # 14-287-150, or equivalent.
15. Polypropylene pipette tips: 0-200µl. Fisher; Cat. No. 02-681-135
16. Polypropylene pipette tips: 101-1000µl. Fisher, Cat. No. 02-707-508
17. Pipettes – Disposable transfer. Fisher Scientific, Cat. No. 13-711-7M
18. Vortex mixer, variable speed, Fisher Scientific or equivalent
19. N-Evap sample extract concentrator with N_2 supply and water bath for temperature control. Organomation, Inc. Cat. #11250, or equivalent.
20. Reagent Water Purification System: Capable of producing ultrapure "Type 1/Milli-Q"-grade water from in-house deionized water system. Millipore SAS; Cat. No. FTPF08831.
21. Thermo Target PP Polyspring inserts, catalog number C4010-630P
22. Agilent 9mm vial kit pack, catalog number 5190-2278, or equivalent
23. Centrifuge tubes – 50 mL conical polypropylene with polypropylene screw caps; Fisher Scientific, Cat. No. 06-443-21 or equivalent
24. Polypropylene bottles for standard storage - 4 mL; Fisher Scientific, Cat. No. 2006-9125
25. Stainless steel spatula/scoop set. Bel-Art SP Scienceware; Product # 11-865-130

B. Equipment

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1. AB Sciex Triple Quad 4500/5500/5500 Plus Turbo V Ion Source
   ExionLC Controller
   ExionLC AC Pump
   ExionLC AC Autosampler
   Exion AC Column Oven
   Data system –Analyst 1.7

2. HPLC columns

   a. Proprietary Content

   b. Proprietary Content

Reagents and Standards

All solvents, acids, and bases are stored in glass bottles in flammable proof cabinets or pressure resistant steel drums. Solvents, acids, and bases are stored at ambient temperature for up to 1 year. All non-solvents are stored according to manufacturer's storage conditions.

A. Reagents:

1. Methanol (MeOH) – Honeywell Burdick and Jackson "Chromasolv LC-MS" grade Cat. No. BJ34966-4L or equivalent

2. Proprietary Content

3. Proprietary Content

4. Proprietary Content

5. Proprietary Content

6. Proprietary Content

7. Proprietary Content

8. Proprietary Content

9. Graphitized Non-Porous Carbon - Supelco/Millipore Sigma Superclean ENVI-Carb SPE Bulk Packing; Cat. No. 57210-U, or equivalent.

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B. Standards: See SOP *T-PFAS-WI13881*.

Calibration

A. Initial Calibration

1. A minimum of five calibration standards are required. In general, Cal1, Cal2, Cal3, Cal4, Cal5, Cal6, and Cal 7 are included in the initial calibration. The calibration standards contain the branched isomers for PFHxS, PFOS, NMeFOSAA and NEtFOSAA. S/N ratio must be greater than or equal to 10:1 for all ions used for quantification.

2. Analyze a Cal3 level standard that contains linear and branch chained isomers of PFOA. The analysis of this standard is used to demonstrate where the branch chained isomers elute and not included in the calibration curve. This will assist the chemist in identifying and properly integrating this compound in samples.

3. Isotopically-labeled compounds are not available for PFPeS, PFHpS, PFNS, PFDS, PFDoS, 10:2-FTS, PFTrA, PFHxDA, PFODA, DONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, 3:3FTCA, 5:3FTCA, 7:3FTCA, PFEESA, PFMPA, PFMBA, and NFDHA. See below for referenced extraction standards. See *Attachment 2* for additional information about compound relationships.

Compound	Extraction standard
10:2-FTS	13C2-8:2-FTS
PFTrDA	13C2-PFDoDA
PFHxDA	13C2-PFTeDA
PFODA	
PFPeS	13C3-PFBS
PFHpS	13C3-PFHxS
DONA	13C4-PFHpA
PFNS	13C8-PFOS
PFDS	
PFDoS	
9Cl-PF3ONS	
11Cl-PF3OUdS	
3:3FTCA	13C5-PFPeA
PFMPA	
PFMBA	
5:3FTCA	13C5-PFHxA

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7:3FTCA	
PFEESA	
NFDHA	

4. Fit the curve

   a. If the % RSD for the response factors is less than or equal to 20%, the average response factor (Ave RRF) can be used to quantitate the data.

   b. If the %RSD is greater than 20%, then a linear regression with a concentration weighing factor of 1/x forced through zero is tried for the compounds not meeting the criteria in 4.a. R^2 for each analyte using the linear regression must be greater than or equal to 0.99.

   c. If the linear regression curve fails, then a quadratic regression with a concentration weighing factor $1/x^2$ is tried for the compounds not meeting 4.a or 4.b. R^2 for each analyte using the quadratic regression must be greater than or equal to 0.99. A minimum or six standards must be analyzed to use a quadratic fit.

   d. For all curve fits, each calibration point is calculated back against the curve. The back calculated concentration should be within ±30% of its true value.

   e. If the criteria are not met, the source of the problem must be determined and corrected. Situations may exist where the initial calibration can be used. In those cases, the data will be reported with a qualifying comment.

   NOTE: The concentrations referenced for the sulfonate salts, (for example PFBS, PFHxS and PFOS) have already been corrected to the acid form by the standards supplier as noted in the example Certificate of Analysis (CofA). See *Attachment 4*.

5. Initial Calibration Verification (ICV)

   A check standard prepared from a second source (ICV) is injected to confirm the validity of the calibration curve/standard. If a second source is not available, a separate preparation from the same stock may be used. The calculated amount for each analyte must be within ± 30% of the true value. If this criteria is not met, re-inject or remake the standard. If the criteria is still not met, recalibration is necessary. Instrument maintenance may be needed prior to recalibrating.

B. Continuing Calibration

1. Once the calibration curve has been established, the continuing accuracy must be verified by analysis of a continuing calibration verification (CCV) standard every ten field samples and at the end of the analysis sequence.

   a. The CCV run after the initial calibration must be at the CAL3 level.

   b. The CCV standards must alternate between the CAL2, CAL3, and CAL4 levels.

2. Acceptance criteria

   a. The calculated amount for each native compound in the CCV standard must be within ±30% of the true value. Samples that are not bracketed by acceptable CCV analyses must be

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reanalyzed. The exception to this would be if the CCV recoveries are high, indicating increased sensitivity, and there are no positive detections in the associated samples, the data may be reported with a qualifying comment.

b. The absolute areas of the extraction standards for the opening CCV on the day following the ICAL should be within 50-150% of the areas measured during the initial calibration CAL3 standard. On subsequent days where an ICAL is not performed, the absolute areas of the extraction standards from the opening CCV are compared to the absolute areas of the extraction standards from the previous day's opening CCV and should be within 50-150%.

c. If acceptance criteria are not met, immediately analyze two additional consecutive CCVs. If both pass acceptance criteria, samples may be reported without reanalysis. If either fails, or two consecutive CCVs cannot be run, repeat CCV and reanalyze all samples since last successful CCV.

Procedure

A. Sample Preparation

1. Weigh sample container with contents on a calibrated top loading balance and record the first reading in the automated prep entry system.

    a. For all samples, the full bottle must be extracted.

    b. If the sample matrix is such that SPE extraction cannot be performed, the client must be contacted to determine if using a reduced volume is an acceptable alternative. If the client directive is to use a reduced sample volume, see Procedure C.

    c. If the sample has dissolved and/or settleable solid content (i.e; is cloudy or has a layer of sediment/solids at the bottom of the bottle), the sample must be centrifuged in order to minimize the difficulty of passing through the SPE sorbent bed. In order to preserve the integrity of the sample and ensure the full volume of the container is used, see Procedure D.

2. Use a 250-mL HDPE bottle for the method blank and the laboratory control sample (LCS) and LCSD if needed. Fill each bottle with 250 ml of Milli-Q water. Record 250 mL as the volume for the batch QC samples on the batchlog.

B. Solid Phase Extraction (SPE)

1. Proprietary Content

2. Proprietary Content

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3. Proprietary Content
4. Proprietary Content
5. Proprietary Content
6. Proprietary Content
7. Proprietary Content
8. Proprietary Content
9. Proprietary Content
10. Proprietary Content
11. Proprietary Content
12. Proprietary Content
13. Proprietary Content
14. Proprietary Content
15. Proprietary Content

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16. Proprietary Content

17. Place each empty sample bottle on the top-loading balance and weigh. Record the second reading in the automated prep entry system. The prep entry system will calculate the sample weight. Record the calculated weight as the sample volume on the batchlog.

Note: The instrument lab chemist performs the next steps.

18. Extract Clean Up: DoD requires all sample/QC extracts be treated with a carbon sorbent to remove potential interferences. Once the SPE extracts have been brought to final volume 1 mL, (see step 17 above), 25 mg loose/bulk "ENVI-Carb" carbon sorbent is added to the extract in its centrifuge tube.

19. The sorbent is added with a stainless steel scoop such that, when a level scoop is measured, a 25 mg amount of sorbent is drawn.The 25 mg of sorbent is added directly to the extracts in the 15 mL centrifuge tube. The scoop is rinsed with MeOH and dried between samples to avoid cross-contamination.

20. After addition of the ENVI-Carb the extracts are centrifuged for a complete cycle and are ready for vialing into LC vials for analysis.

21. Transfer 400 µL of the final extract to the corresponding labeled auto-sampler vial. Cap and vortex the auto-sampler vial. Samples are now ready for analysis.

22. Cap the centrifuge tube. Store the remaining centrifuged extracts at room temperature for dilution or reinjection if needed.

C. Reduced Sample Volume

1. Determine the aliquot to be used for extraction (i.e.; 50 mL, 100 mL).

2. Label a clean 250-mL HDPE bottle with the associated ELLE sample number.

3. Label the appropriate number of 50-mL centrifuge tubes with the associated ELLE sample number. The number required will be determined by the volume to be used for extraction.

1. 4.Shake/invert the sample bottle to thoroughly mix the sample before pouring aliquot(s).

4. Pour sample from original bottle into centrifuge tubes. Cap tubes and centrifuge for 5 minutes at full speed (one full cycle).

5. On a calibrated, top-loading balance, place labeled empty 250 mL PP wide-mouthed bottle.

6. Decant centrifuged sample aliquot(s) from centrifuge tube(s) to the 250 mL bottle until desired volume (weight in grams) is reached. 100 g = 100 mL, 50 g = 50 mL, etc. If the weight is exceeded, remove excess volume with a disposable pipette and discard to a waste container.

7. Add Milli-Q water to the bottle until a weight of 250 g (total of 250 mL) is reached.

8. Shake/invert several times to mix thoroughly.

9. Record the aliquot taken from the original bottle (50 mL, 100 mL) as the sample volume.

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10. Extract sample beginning with Procedure B.

D. Samples Containing Dissolved and/or Settleable Solids

1. Spike sample with appropriate spikes as in Procedure B.5.
2. Centrifuge the full bottle.
3. DO NOT SHAKE BOTTLE FOLLOWING THE CENTRIFUGE STEP.
4. Follow steps in Procedure B, 1 through 3.
5. Attach a 25-mL SPE reservoir to each cartridge. Decant centrifuged sample onto its respective SPE cartridge. Allow full volume to pass through each cartridge by gravity, if possible. Apply light vacuum if necessary. The drip rate should be approximately 1-2 drops per second.
6. Rinse the sample bottle with 5 mL of Milli-Q water, add the rinseate to the cartridge, and repeat.
7. Continue extraction process with Procedure B. 7.

E. LC/MS/MS Analysis

1. Mass Calibration and Tuning

   a. At instrument set up and installation and after the performance of major maintenance, calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. The entire mass range must be calibrated.

   b. When masses fall outside of the ±0.5 amu of the true value, the instrument must be retuned using PPG according to the manufacturer's specifications. Mass assignments of the tuning standard must be within 0.5 amu of the true value. Refer to the instrument manufacturer's instructions for tuning and conditions. These values are stored in the tune file for future reference.

2. The mass spectral acquisition rate must include a minimum of 10 spectra scans across each chromatographic peak. See the AB Sciex (4500/5500/5500 plus) Acquisition, Quantitation, Gradient, and detector condition files for the most up to date chromatographic conditions. Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process.
3. Example Acquisition method: See *Proprietary Content*.
4. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NEtPFOSAE, NEtPFOSA, PFDoS, DONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, PFMPA, 3:3 FTCA, PFMBA, PFEESA, and 7:3 FTCA. See *Attachment 1*.

.

5. Instrument Sensitivity Check (ISC) and Instrument Blanks

Controlled Copy

a. Prior to sample analysis and at least every 12 hours, an instrument sensitivity check (ISC) must be performed. The ISC standard concentration must be at the LOQ. The CAL2 standard's concentration is at the LOQ. The CAL2 standard will be analyzed. All analyte concentrations must be within ±30% of their true values. If the criteria is not met, correct problem and rerun ISC. If problem persists, repeat the ICAL. No samples can be analyzed until the ISC meets acceptance criteria.

b. Instrument blanks need to be analyzed immediately following the highest standard analyzed and daily or at the start of a sequence. The concentration of all analytes must be less than or equal to 1/2 the LOQ. If acceptance criteria are not met the calibration must be performed using a lower concentration standard for the high standard until the criteria are met.

6. Load sample vials containing standards, quality control samples, and sample extracts into autosampler tray. Allow the instrument adequate time to equilibrate to ensure the mass spec and LC have reached operating conditions (approximately 5 minutes) before the first injection. Analyze several solvent blanks to clean the instrument prior to sample acquisition.

7. After the initial calibration, inject an instrument blank, followed by the ICV, Linear Branched (L/B) standard, closing Cal3 level CCV, extraction batch QC, and samples. Bracket each set of ten samples with a CCV standard, alternating between the Cal2, Cal3, and Cal4 levels.

8. After injections are completed, check all CCV recoveries and absolute areas to make sure they are within method control limits. See Calibration section B.2 for acceptance criteria. Process each chromatogram and closely evaluate all integrations, baseline anomalies, and retention time differences. If manual integrations are performed, they must be documented and a reason given for the change in integrations. The manual integrations are documented during data processing and all original integrations are reported at the end of the sample PDF file with the reason for manual integration clearly listed.

9. Quantitate results for the extraction blank. No target analytes detected greater than 1/2 the LOQ or greater than 1/10 the regulatory limit, whichever is greater. If criteria is exceeded, reextract all samples with positive detections associated with the method blank. If the target analyte in the sample is detected at a concentration greater than 10 times the amount detected in the method blank, the data is reported.

10. Calculate the recoveries of spiked analytes for the LCS, matrix spike and matrix spike duplicate (MS/MSD) by comparing concentrations observed to the true values.

a. Method defined limits are used for the evaluation of the LCS and MS/MSD recoveries. Where there are no limits stated an advisory window of 70-130% will be used until sufficient data points are available to generate statistical windows. The QC acceptance limit for the relative percent difference (%RPD) between LCS/LCSD and MS/MSD is less than or equal to 30%.

b. If LCS and/or LCSD recoveries are acceptable, proceed to sample quantitation.

c. If the LCS recoveries are above QC acceptance criteria and there are no detections for the compound(s) in the associated sample(s), the data can be reported with a qualifying comment. In all other cases, the samples associated with the LCS must be reextracted.

d. If MS/MSD recoveries are outside QC acceptance criteria, the associated data will be flagged or noted in the comments section of the report.

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11. Isotopically-labeled extraction standards are added to all samples, extraction blank, LCS/LCSD, and MS/MSD prior to extraction. The absolute areas of the extraction standards must be within ±50% of the areas measured in the ICAL mid-point standard (CAL3 standard). On days when an ICAL is not performed, the absolute areas must be within ±50% of the absolute areas measured in the daily opening initial CCV. If the extraction standards fall outside the acceptance window, analyze a second aliquot of the extract. If none remains, reanalyze the first aliquot.

    Refer to *Attachment 5* for the Eurofins DOD variances for isotopically labeled recoveries. If these variances are accepted by the client, the laboratory will follow these guidelines in determining when to re-extract samples. If the client does not accept these variances, samples with recoveries that are outside the ±50% of the true value acceptance criteria must be re-extracted.

12. Compare the retention times of all of the analytes and extraction standards to the retention time from the initial calibration. The retention times should not vary from the expected retention time by more than:

    a. 0.4 minutes for isotopically-labeled compounds

    b. 0.1 minutes from their analog for native compounds with an exact isotopically-labeled compound

    c. 0.4 minutes from their assigned analog for native compounds without an exact isotopically-labeled compound.

    If the retention time is outside of the criteria, the compound is considered a false positive unless it is a compound with branched isomers. Compounds with branched isomers can vary in intensity of the individual isomers that are used for reporting and must be reviewed and compared to the preceding CCV to determine if it should be reported.

13. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NEtPFOSAE, NEtPFOSA, PFDoS, DONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, PFMPA, 3:3 FTCA, PFMBA, PFEESA, and 7:3 FTCA. The expected ion ratio for each compound is calculated by using the average of ion ratios of each compound from initial calibration standards. When an ion ratio for a compound differs from the expected ion ratio by more than 50%, a qualifier is placed on the raw data and on the sample report. No corrective action is required.

14. The linear/branch chain standard is used when assessing the correctness of the computer generated peak integrations for PFOA.

15. If the calculated concentration exceeds the calibration range of the system, determine the appropriate dilution required and dilute the extract with MeOH. If the sample dilution required exceeds 100 fold, the client must be contacted to determine if the data can be reported with result(s) that exceed the calibration range or if the sample should be re-prepped at a reduced volume.

    Dilution Example 1/10: Mix 900 µL of MeOH with 100 µL of sample extract. Vortex to mix. Using an auto-pipette, transfer 400 µL of the mixed solution into a labeled auto-sampler vial. Cap and vortex thoroughly to mix.

Calculations

Eurofins

A. Peak Area Ratio

$$\text{Peak Area Ratio} = \frac{\text{Analyte Response}}{\text{Labeled Analyte Response}}$$

B. On-Column Analyte Concentration using linear through zero curves

On-column Concentration = (peak area ratio x Isotope Dilution Analyte concentration)÷ slope

C. Sample Concentration

Sample concentration (ng/l) = (On-column concentration x Final Sample volume x DF)÷ Sample weight

D. Ion Ratio

ion ration = (peak area or height of quantifier)/(peak area or height of qualifier)

E. See *T-PEST-WI9847* for additional calculations used to evaluate the calibrations and quality control samples.

Statistical Information/Method Performance

The LCS should contain all compounds of interest. LCS, MS, extraction standard recoveries and RPD are compared to the limits stored on the LIMS. These limits are defined by the method. For compounds not defined by the method, these limits are statistically derived when sufficient data points are available. If sufficient data points are not available to generate statistical windows, an advisory window of 70% to 130% will be used. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

Quality Assurance/Quality Control

For each batch of 20 samples extracted, a method blank and an LCS/LCSD (Milli Q water spiked with all compounds to be determined carried through the entire procedure) must be extracted and analyzed. If an MS/MSD is submitted then an LCSD would not be extracted. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Attachment:
Attachment 1 - Mass Transitions (.doc)

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Attachment 2 - Compound Relationships (.docx)
Attachment 3 – Proprietary Content
Attachment 4 - Example Certificate of Analysis (.pdf)
Attachment 5 - Eurofins DoD variances (.doc)

G-DC-FRM23907 Redacted SOPs
QA-SOP11178 Demonstrations of Capability
QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation
T-PEST-WI9847 Common Equations Used During Chromatographic Analyses
T-PFAS-WI13881 Standards Management in the PFAS Laboratory
Attachment: Attachment 1 - Mass Transitions (doc)
Attachment: Attachment 2 - Compound Relationships (docx)
Attachment: Attachment 3 – Proprietary Content
Attachment: Attachment 4 - Example Certificate of Analysis (pdf)
Attachment: Attachment 5 - Eurofins DoD variances (doc)

End of document

Version history

Version	Approval	Revision information	
1	28.JAN.2021		
2	14.FEB.2022		
3	25.MAY.2022		

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Attachment 1

Mass Transitions AB Sciex 4500/5500/5500+

Compound	Parent Ion	Daughter Ion
13C4-PFBA	217	172
PFBA	213	169
13C5-PFPeA	268	223
PFPeA	263	219
13C3-PFBS	302	80
PFBS	299	80
PFBS (2)	299	99
13C2-4:2-FTS	329	81
4:2-FTS	327	307
4:2-FTS (2)	327	81
13C5-PFHxA	318	273
PFHxA	313	269
PFHxA (2)	313	119
PFPeS	349	80
PFPeS (2)	349	99
13C3-PFHxS	402	80
PFHxS	399	80
PFHxS (2)	399	99
13C4-PFHpA	367	322
PFHpA	363	319
PFHpA (2)	363	169
13C2-6:2-FTS	429	81
6:2-FTS	427	407
6:2-FTS (2)	427	81
PFHpS	449	80
PFHpS (2)	449	99
13C8-PFOA	421	376
PFOA	413	369
PFOA (2)	413	169
13C8-PFOS	507	80
PFOS	499	80
PFOS (2)	499	99
13C9-PFNA	472	427
PFNA	463	419
PFNA (2)	463	169
13C8-PFOSA	506	78
PFOSA	498	78

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Attachment 1

Compound	Parent Ion	Daughter Ion
PFNS	549	80
PFNS (2)	549	99
13C6-PFDA	519	474
PFDA	513	469
PFDA (2)	513	169
13C2-8:2-FTS	529	81
8:2-FTS	527	507
8:2-FTS (2)	527	81
d7-NMePFOSAE	623	59
NMePFOSAE	616	59
d3-NMePFOSA	515	169
NMEPFOSA	512	169
d3-NMeFOSAA	573	419
NMeFOSAA	570	419
NMeFOSAA (2)	570	483
d9-NEtPFOSAE	639	59
NEtPFOSAE	630	59
d5-NETPFOSA	531	169
NEtPFOSA	526	169
PFDS	599	80
PFDS (2)	599	99
13C7-PFUnDA	570	525
PFUnDA	563	519
PFUnDA (2)	563	169
d5-NEtFOSAA	589	419
NEtFOSAA	584	419
NEtFOSAA (2)	584	526
13C2-PFDoDA	615	570
PFDoDA	613	569
PFDoDA (2)	613	169
10:2-FTS	627	607
10:2-FTS (2)	627	81
PFDoS	699	80
PFTrDA	663	619
PFTrDA (2)	663	169
13C2-PFTeDA	715	670
PFTeDA	713	669
PFTeDA (2)	713	169
PFHxDA	813	769
PFHxDA (2)	813	169

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Attachment 1

Compound	Parent Ion	Daughter Ion
PFODA	913	869
PFODA (2)	913	169
13C3-HFPODA	332	287
HFPODA	329	285
HFPODA (2)	285	169
DONA	377	251
9Cl-PF3ONS	531	351
11Cl-PF3OUdS	631	451
PFECA B (NFDHA)	201	85
PFECA B(NFDHA) (2)	295	201
PFECA F (PFMPA)	229	85
3:3 FTCA	241	177
PFECA A (PFMBA)	279	85
PFEESA (PES)	315	135
5:3 FTCA	341	237
5:3 FTCA (2)	339	217
7:3 FTCA	441	317

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Attachment 2

PFAS Native Compounds/Extraction Standards

Native PFAS Compounds

Native	Extraction Standard
PFBA	13C4-PFBA
PFPeA	13C5-PFPeA
3:3FTCA	
PFMPA	
PFMBA	
PFBS	13C3-PFBS
PFPeS	
4:2-FTS	13C2-4:2-FTS
PFHxA	13C5-PFHxA
NFDHA	
5:3FTCA	
7:3FTCA	
PFEESA	
PFHxS	13C3-PFHxS
PFHpS	
PFHpA	13C4-PFHpA
DONA	
6:2-FTS	13C2-6:2-FTS
PFOA	13C8-PFOA
PFOS	13C8-PFOS
PFNS	
PFDS	
9Cl-PF3ONS	
11Cl-pf3OUdS	
PFDoS	
PFNA	13C9-PFNA
PFOSA	13C8-PFOSA
PFDA	13C6-PFDA

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Native	Extraction Standard
8:2-FTS	13C2-8:2-FTS
10:2-FTS	
NMePFOSAE	d7-NMePFOSAE
NMePFOSA	d3-NMePFOSA
NMeFOSAA	d3-NMeFOSAA
NEtPFOSAE	d9-NEtPFOSAE
NEtPFOSA	d5-NEtPFOSA
PFUnDA	13C7-PFUnDA
NEtFOSAA	d5-NEtFOSAA
PFDoDA	13C2-PFDoDA
PFTrDA	
PFTeDA	13C2-PFTeDA
PFHxDA	
PFODA	
HFPODA	13C3-HFPODA

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CERTIFICATE OF ANALYSIS
DOCUMENTATION

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PFAC-MXC

Native Perfluorinated Compound Solution/Mixture

PRODUCT CODE:	PFAC-MXC
LOT NUMBER:	PFACMXC0617
SOLVENT(S):	Methanol / Water (<1%)
DATE PREPARED: (mm/ddlyyyy)	06/14/2017
LAST TESTED: (mm/dd/yyyy)	03/19/2019
EXPIRY DATE: (mmldd/yyyy)	03/19/2024
RECOMMENDED STORAGE:	Store ampoule in a cool, dark place

DESCRIPTION:

PFAC-MXC is a solution/mixture of thirteen native perfluoroalkylcarboxylic acids (C_4-C_{14} C, $_6$ and C $_)$ and eight native perfluoroalkylsulfonates (C.-C $_1$ and C,J The full name, abbreviation and concentration for each of the components are given in Table A.

The individual perfluoroalkylcarboxylic acids and perfluoroalkylsulfonates all have chemical purities of >98%.

DOCUMENTATION/ DATA ATTACHED:

Table A: Components and Concentrations of the Solution/Mixture
Figure 1: LC/MS Data (SIR)
Figure 2: LC/MS/MS Data (Selected MRM Transitions)

ADDITIONAL INFORMATION:

See page 2 for further details.
Contains 4 mole eq. of NaOH to prevent conversion of the carboxylic acids to their respective methyl esters.

FOR LABORATORY USE ONLY: NOT FOR HUMAN OR DRUG USE

INTENDED USE:

The products prepared by Wellington Laboratories Inc. are for laboratory use only. This certified reference material (CRM) was designed to be used as a standard for the identification and/or quantification of the specific chemical compounds it contains.

HANDLING:

This product should only be used by qualified personnel familiar with its potential hazards and trained in the handling of hazardous chemicals. Due care should be exercised to prevent unnecessary human contact or ingestion. All procedures should be carried out in a well-functioning fume hood and suitable gloves, eye protection, and clothing should be worn at all times. Waste should be disposed of according to national and regional regulations. Safety Data Sheets (SDSs) are available upon request.

SYNTHESIS / CHARACTERIZATION:

Our products are synthesized using single-product unambiguous routes whenever possible. They are then characterized, and their structures and purities confirmed, using a combination of the most relevant techniques, such as NMR, GC/MS, LC/MS/MS, SFC/UV/MS/MS, x-ray crystallography, and melting point. Isotopic purities of mass-labelled compounds are also confirmed using HRGC/HRMS and/or LC/MS/MS.

HOMOGENEITY:

Prior to solution preparation, crystalline material is tested for homogeneity using a variety of techniques (as stated above) and its solubility in a given diluent is taken into consideration. Duplicate solutions of a new product are prepared from the same crystalline lot and, after the addition of an appropriate internal standard, they are compared by GC/MS, LC/MS/MS, and/or SFC/UV/MS/MS. The relative response factors of the analyte of interest in each solution are required to be <5% RSD. New solution lots of existing products, as well as mixtures and calibration solutions, are compared to older lots in a similar manner. This further confirms the homogeneity of the crystalline material as well as the stability and homogeneity of the solutions in the storage containers. In order to maintain the integrity of the assigned value(s), and associated uncertainty, the dilution or injection of a subsample of this product should be performed using calibrated measuring equipment.

UNCERTAINTY:

The maximum combined relative standard uncertainty of our reference standard solutions is calculated using the following equation:

The combined relative standard uncertainty, uc(y), of a value y and the uncertainty of the independent parameters $x_1, x_2 \ldots x_n$ on which it depends is:

$$ur(y(x_1, x_2, \ldots x_n)) = \sqrt{\sum_{i=1} u(y, x_i)^2}$$

where x is expressed as a relative standard uncertainty of the individual parameter.

The individual uncertainties taken into account include those associated with weights (calibration of the balance) and volumes (calibration of the volumetric glassware). An expanded maximum combined percent relative uncertainty of ±5% (calculated with a coverage factor of 2 and a level of confidence of 95%) is stated on the Certificate of Analysis for all of our products.

TRACEABILITY:

All reference standard solutions are traceable to specific crystalline lots. The microbalances used for solution preparation are regularly calibrated by an external ISO/IEC 17025 accredited laboratory. In addition, their calibration is verified prior to each weighing using calibrated external weights traceable to an ISO/IEC 17025 accredited laboratory. All volumetric glassware used is calibrated, of Class **A** tolerance, and traceable to an ISO/IEC 17025 accredited laboratory. For certain products, traceability to international interlaboratory studies has also been established.

EXPIRY DATE / PERIOD OF VALIDITY:

Ongoing stability studies of this product have demonstrated stability in its composition and concentration, until the specified expiry date, in the unopened ampoule. Monitoring for any degradation or change in concentration of the listed analyte(s) is performed on a routine basis.

LIMITED WARRANTY:

At the time of shipment, all products are warranted to be free of defects in material and workmanship and to conform to the stated technical and purity specifications.

QUALITY MANAGEMENT:

This product was produced using a Quality Management System registered to the latest versions of ISO 9001 by SAi Global, ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA; A 1226), and ISO 17034 by ANSI-ASQ National Accreditation Board **(ANAB;** AR-1523).

CALA

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ACCREDITED

REFERENCE MATERIAL PRODUCER

**For additional information or assistance concerning this or any other products from Wellington Laboratories Inc.,

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Table A: **PFAC-MXC; Components and Concentrations (ng/ml, ± 5% in Methanol/ Water (<1%))**

Compound	Abbreviation	Concentration (ng/ml)*		Peak Assignment in Figure 1
Perfluoro-n-butanoic acid	PFBA	2000		A
Perfluoro-n-pentanoic acid	PFPeA	2000		B
Perfluoro-n-hexanoic acid	PFHxA	2000		D
Perfluoro-n-heptanoic acid	PFHpA	2000		F
Perfluoro-n-octanoic acid	PFOA	2000		**H**
Perfluoro-n-nonanoic acid	PFNA	2000		J
Perfluoro-n-decanoic acid	PFDA	2000		L
Perfluoro-n-undecanoic acid	PFUdA	2000		**N**
Perfluoro-n-dodecanoic acid	PFDoA	2000		p
Perfluoro-n-tridecanoic acid	PFTrDA	2000		Q
Perfluoro-n-tetradecanoic acid	PFTeDA	2000		**S**
Perfluoro-n-hexadecanoic acid	PFHxDA	2000		**T**
Perfluoro-n-octadecanoic acid	PFODA	2000		**U**
Compound	**Abbreviation**	**Concentration (ng/ml)***		**Peak Assignment in Figure 1**
		As the salt	**As the anion**	
Potassium perfluoro-1-butanesulfonate	L-PFBS	2000	1770	C
Sodium perfluoro-1-pentanesulfonate	L-PFPeS	2000	1880	E
Sodium perfluoro-1-hexanesulfonate	L-PFHxS	2000	1890	G
Sodium perfluoro-1-heptanesulfonate	L-PFHpS	2000	1900	I
Sodium perfluoro-1-octanesulfonate	L-PFOS	2000	1910	K
Sodium perfluoro-1-nonanesulfonate	L-PFNS	2000	1920	**M**
Sodium perfluoro-1-decanesulfonate	L-PFDS	2000	1930	0
Sodium perfluoro-1-dodecanesulfonate	L-PFDoS	2000	1940	R

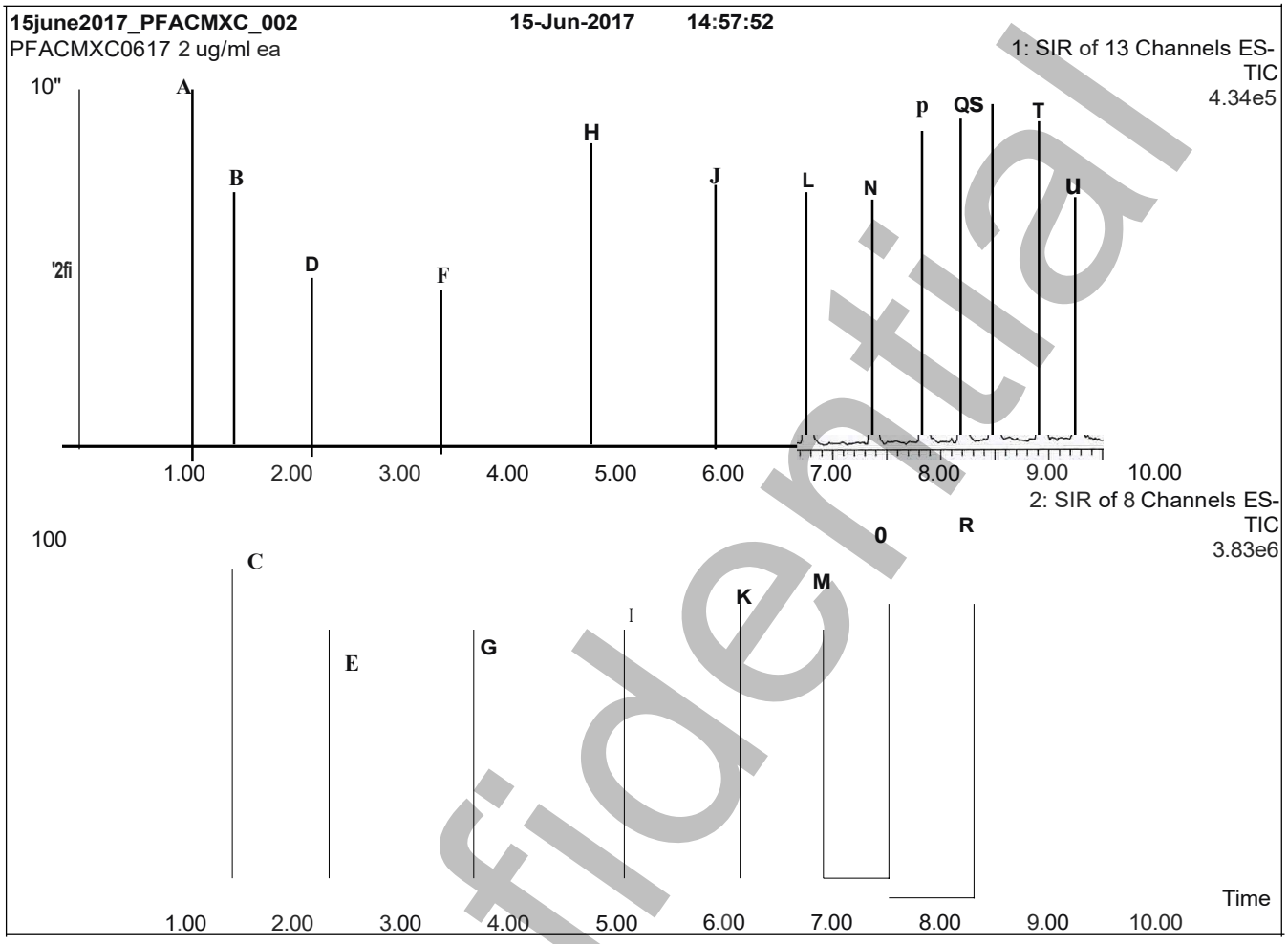
* Concentrations have been rounded to three significant figures.

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Certified By: _____ **Date:** 06/06/2019
(mm/dd/yyyy)

B.G. Chittim, General Manager

Fi.9yr!L1 **PFAC-MXC; LC/MS Data (Total Ion Current Chromatogram; SIR)**



Conditions for Figure 1:

LC: **Waters Acquity Ultra Performance LC**
MS: **Micromass Quattro *micro* API MS**

Chromatographic Conditions

Column: Acquity UPLC BEH Shield RP.,
1.7 µm, 2.1 x 100 mm

Mobile phase: Gradient
Start: 50% H,O / 50% (80:20 MeOH:ACN)
(both with 10 mM NH,OAc buffer)
Ramp to 90% organic over 8 min and hold for 2 min
before returning to initial conditions in 1 min.

Time: 12 min

Flow: 300 µl/min

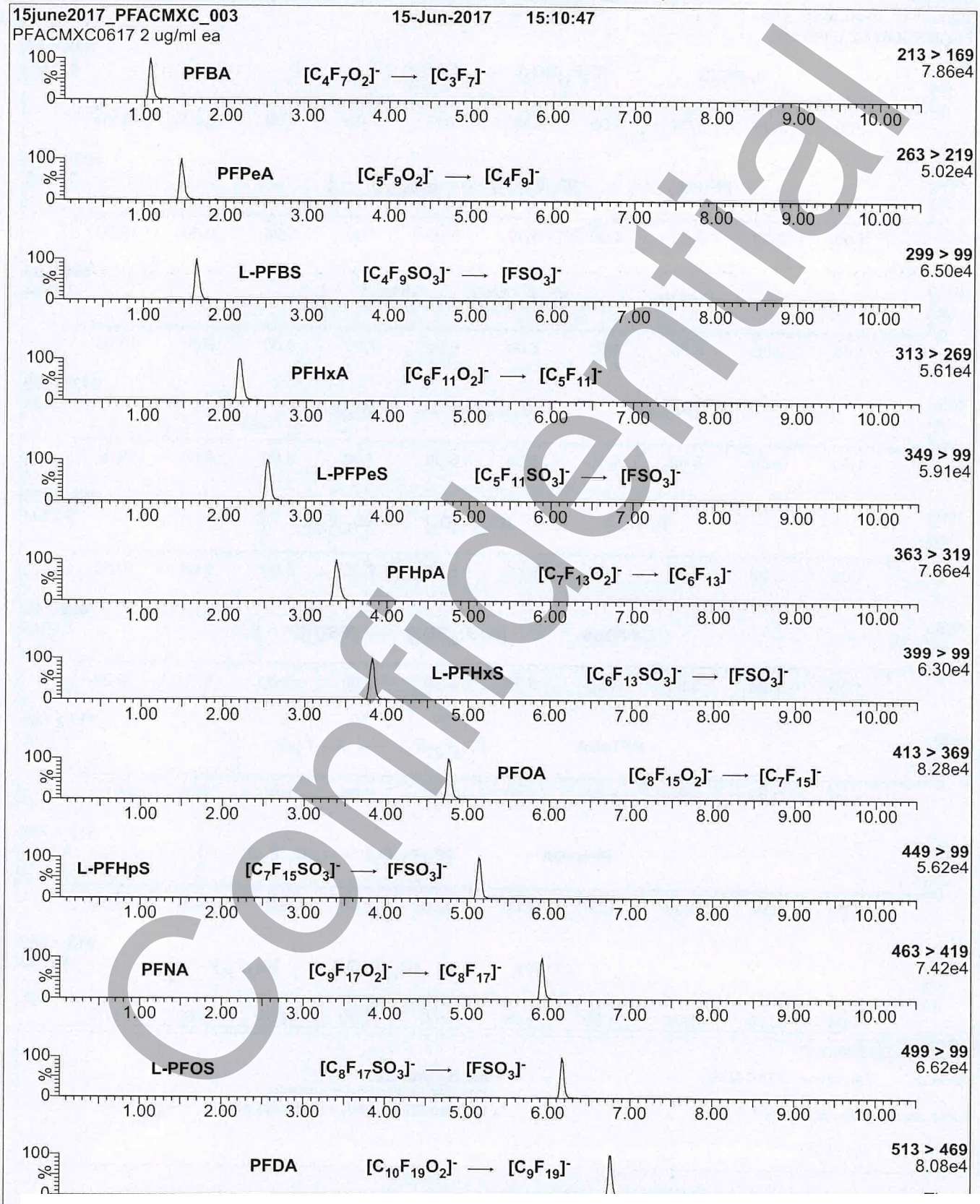
MS Parameters

Experiment: SIR of 21 Channels

Source: Electrospray (negative)
Capillary Voltage (kV) = 3.00
Cone Voltage (V) = variable (10-80)
Cone Gas Flow (l/hr) = 50
Desolvation Gas Flow (l/hr) = 750

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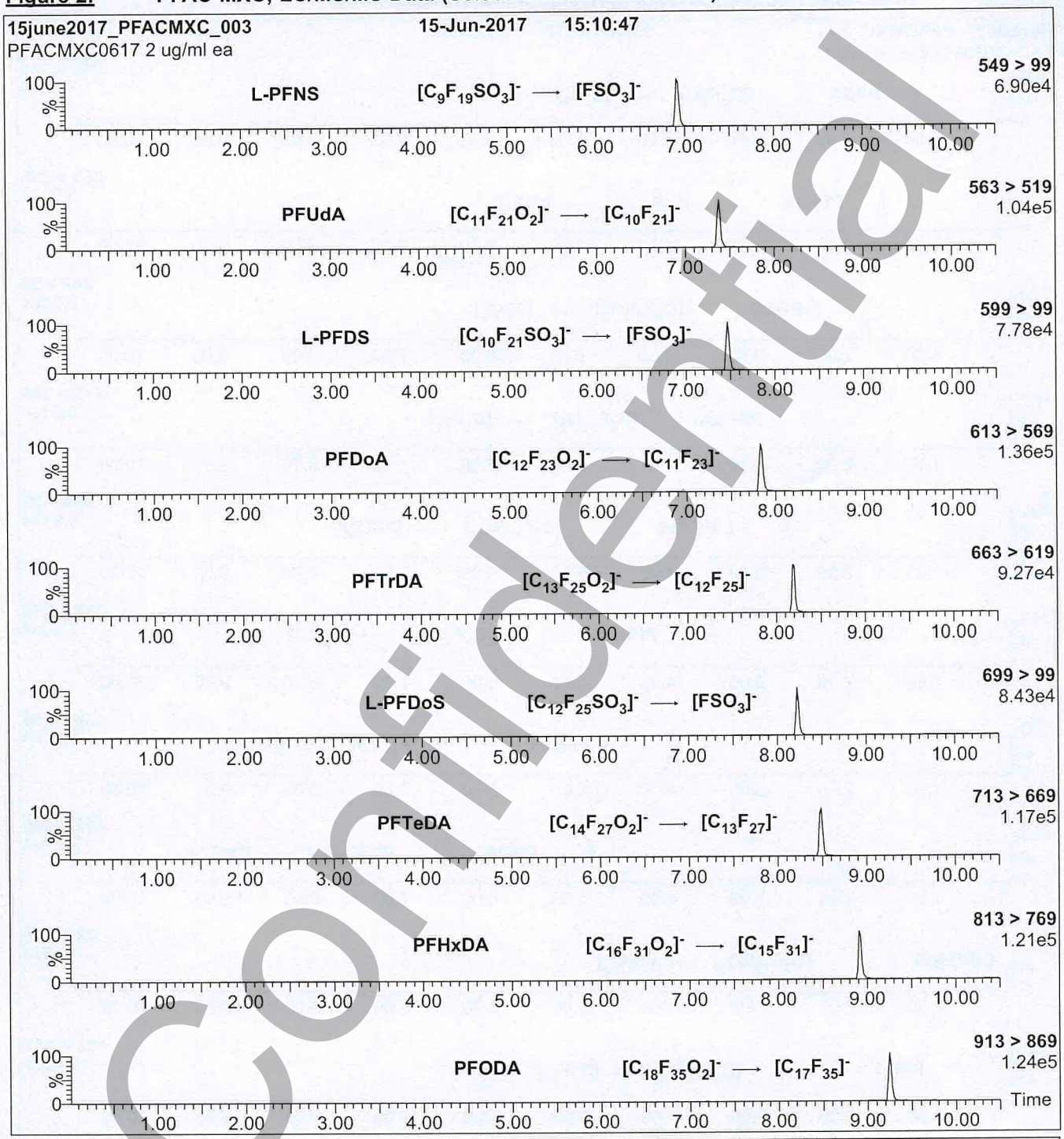
Figure 2: **PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



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Figure 2: **PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



Conditions for Figure 2:

Injection: On-column (PFAC-MXC)

Mobile phase: Same as Figure 1

Flow: 300 µl/min

MS Parameters

Collision Gas (mbar) = 3.46e-3

Collision Energy (eV) = 8-50 (variable)

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Eurofins Lancaster Laboratories Environmental, LLC Variance Requests

Item	Parameter	Scope of Work	ELLE SOP	Approval
1	QSM 5.3 Table B-15 PFAS Using LC/MS/MS	Extraction internal standard (EIS) recovery criteria of 50-150%	For all PFAS compounds if EIS recovery is <50%, we will check for laboratory error and correct if identified. If no laboratory error is identified, additional corrective action will be performed if EIS recovery is <10%. If EIS recovery is >10% and samples have detections above the reporting limit, no additional corrective action is performed. If EIS recovery is >10% and samples have no detections for associated native analytes, the native analyte response will be evaluated to confirm the validity of the reporting limit. Reporting limits will be proportionately increased as necessary and appropriate to ensure that reported values accurately reflect the sensitivity of the analysis.	
2	QSM 5.3 Table B-15 PFAS Using LC/MS/MS	Extraction internal standard (EIS) recovery criteria of 50-150%	For all PFAS compounds, if EIS recovery is >150%, we will check for laboratory error and correct if identified. If no laboratory error is identified, additional corrective action will be performed only when field samples have detections above the reporting limits for the associated native target analytes and EIS recovery is >200%.	
3	QSM 5.3 Table B-15 PFAS Using LC/MS/MS	Sample Preparation	If persistent matrix effects are observed for multiple samples from a given project that necessitate a high rate of additional corrective actions, these matrix effects will be mitigated prior to sample preparation and analysis, typically by processing a smaller sample mass or volume.	

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Document number: **T-PFAS-WI36459** Old Reference:	Always check on-line for validity. **Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Version 1.1 Modified QSM 5.4 Table B-15 Using LC/MS/MS**	Level: **Work Instruction**
Version: **2**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date **25-MAY-2022**	Document users: **5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_Data_Reviewers, 6_EUUSLA_PFAS_Management_Team, 6_EUUSLA_PFAS_Sample_Prep**	Responsible: **5_EUUSLA_PFAS_Manager**

Revision:	01	**Effective date:** 28-JAN-2021
Section	**Justification**	**Changes**
	NEW	

Reference

1. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LCMSMS), EPA 537 Version 1.1, September 2009. Department of Defense Quality System Manual Version 5.4, Table B-15.

2. US EPA Method 537, Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LCMSMS), Version 1.1, September 2009.

3. Standard Test Method for Determination of Perfluorinated Compounds in Soil by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS), ASTM Method D7968, 2014.

4. Method for Trace Level Analysis of C8, C9, C10, C11, and C13 Perfluorocarbon Carboxylic Acids in Water. Karen Risha, John Flaherty, Roice Wille, Warren Buck, Francesco Morandi, and Tsuguhide Isemura. Anal. Chem. 2005, 77, 1503-1508.

5. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-PEST-WI9847	Common Equations Used During Chromatographic Analyses
T-PFAS-WI13881	Standards Management in the PFAS Laboratory
G-DC-FRM23907	Redacted SOPs
QA-SOP11178	Demonstrations of Capability
QA-SOP11892	Determining Method Detection Limits and Limits of Quantitation

Scope

This method is applicable for the determination of selected per- and polyfluorinated alkyl substances (PFAS) in soil and solid samples. The compounds analyzed in this method are listed in the table below. The most current MDLs and LOQs are listed in the LIMS.

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Analyte	Acronym	CAS#
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorododecanoic acid	PFDoDA	307-55-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
8:2 - Fluorotelomersulfonate	8:2FTS	39108-34-4
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
4:2-Fluorotelomersulfonic acid	4:2-FTS	757124-72-4
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
6:2-Fluorotelomersulfonic acid	6:2-FTS	27619-97-2
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
10:2-Fluorotelomersulfonic acid	10:2-FTS	120226-60-0

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Analyte	Acronym	CAS#
Perfluorododecanesulfonic acid	PFDoDS	79780-39-5
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
Perfluorooctanesulfonamide	PFOSA	754-91-6
2-(N-methylperfluoro-1-octanesulfonamido)- ethanol	NMePFOSAE	24448-09-7
N-methylperfluoro-1-octanesulfonamide	NMePFOSA	31506-32-8
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	NEtPFOSAE	1691-99-2
N-ethylperfluoro-1-octanesulfonamide	NEtPFOSA	4151-50-2
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid	HFPODA	13252-13-6
4,8-dioxa-3H-Perfluorononanoic acid	DONA **	919005-14-4 *
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1 *
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9 *
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
Perfluoro-3-methoxypropanoic acid	PFMPA/PFECA F	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA/PFECA A	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA/PFECA B	151772-58-6
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA/PES	113507-82-7

* = CAS number for the free acid form of the analyte
** = The acronym for the free acid form of the analyte

Basic Principles

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A soil sample is fortified with isotopically-labeled extraction standards, and extracted for an hour with acetonitrile:methanol mixture (1:1) using ultrasonic extraction. The sample extracts are vortexed and centrifuged. A 2.0 mL portion of supernatant is transferred and concentrated with nitrogen in a heated water bath and then reconstituted to 1.0 mL with methanol. The sample extract is analyzed by LC/MS/MS operated in negative electrospray ionization (ESI) mode for detection and quantification of the analytes. Quantitative analysis is performed using isotope dilution.

Reference Modifications

EPA Method 537 is written specifically for the analysis of drinking water samples. Modifications are made to accommodate the preparation of soil samples which are not addressed in EPA 537 Version 1.1. In addition, the following modifications have been made.

1. A labeled isotopic analog is spiked into samples for all compounds where an isotopic analog is commercially available. These isotopic compounds are referred to as extraction standards. For those compounds, an isotope dilution calibration model is used. Where labeled isotopes are not available, an internal standard calibration model using the extraction standards is used.

2. Field reagent blanks are not processed as listed in EPA 537 Version 1.1 section 8.3.

3. Peak asymmetry factors are not calculated.

4. MRL confirmation is not performed.

5. Spike concentrations are not rotated between low, medium, and high levels.

MDL studies and IDOCs have been performed to validate method performance.

Interferences

Compounds which have similar structures to the compounds of interest and similar molecular weights would potentially interfere. Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, etc. A laboratory blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

Precaution to Minimize Method Interference

1. Proprietary Content

2. Proprietary Content

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3. PFAS standards, extracts and samples should not come in contact with any glass containers as these analytes can potentially adsorb to glass surfaces. PFAS analytes and labeled extraction standards commercially purchased in glass ampules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be stored in polypropylene containers.

Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. PFOA has been described as "likely to be carcinogenic to humans". Each chemical should be treated as a potential health hazard and exposure to these chemicals should be minimized.

Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves. Gloves, lab coats, and safety glasses should be worn when preparing standards and handling samples. Avoid inhaling solvents and chemicals and getting them on the skin. Wear gloves when handling neat materials. When working with acids and bases, take care not to come in contact and to wipe any spills. Always add acid to water when preparing reagents containing concentrated acids.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. All solvent waste and extracts are collected in approved solvent waste containers in the laboratory and subsequently emptied by personnel trained in hazardous waste disposal into the lab-wide disposal facility. HPLC vials are disposed of in the lab container for waste vials, and subsequently lab packed. Any solid waste material (disposable pipettes and broken glassware, etc.) may be disposed of in the normal solid waste collection containers.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC).

Each chemist performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Also, several batches of sample extractions must be performed under the direct observation of another experienced chemist to assure the trainee is capable of independent preparation. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

Each LC/MS/MS analyst must work with an experienced employee for a period of time until they can independently calibrate the LC/MS/MS, review and process data, and perform maintenance procedures. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and DOC consist of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meets the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

See *QA-SOP11178* for additional information on IDOC and DOC.

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Sample Collection, Preservation, and Handling

A. Sample Collection

The samples are collected in 250-mL polyethylene bottles with polyethylene screw caps. Keep the sample sealed from time of collection until extraction.

NOTE: PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

B. Sample Storage and Shipment

1. Samples must be chilled during shipment and must not exceed 10°C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10°C when the samples are received at the laboratory.

2. Samples stored in the lab must be held at a temperature of 0° to 6°C, not frozen, until extraction.

3. Samples must be extracted within 28 days of collection. Extracts must be analyzed within 28 days after extraction. Extracts are stored at room temperature.

Apparatus and Equipment

A. Apparatus

1. Centrifuge tubes – 15-mL conical polypropylene with polypropylene screw caps; Fisher, Cat. No. 05-539-5 or equivalent

2. Centrifuge tubes - 50-mL – conical, polypropylene with polypropylene screw caps; Fisher, Cat. No. 06-443-21, or equivalent.

3. 10-mL polypropylene volumetric flask, class A – Fisher Scientific, Cat. No. S02288, or equivalent.

4. HPDE bottles for extraction fluid storage: L; Environmental Sampling Supply, Cat. No. 1000-1902-PC

5. Auto-dispenser/Pump: Dispensette S Analog bottletop dispenser, 5-50ml; Fisher Cat. No. 13-689-017.

6. Analytical Balance – Capable of weighing to 0.0001 g

7. Top-Loading Balance – Capable of weighing to 0.01 g

8. Centrifuge – "Q-Sep 3000"; Restek Corp. Cat. No. 26230 or equivalent, capable of minimum rotational speed of 3000 rpm.

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9. Disposable polyethylene pipette – Fisher Scientific, Cat. No. S30467-1 or equivalent.
10. Auto Pipettes – Eppendorf; capable of accurately dispensing 10- to 1000-µL. FisherScientific cat # 14-287-150, or equivalent.
11. Polypropylene pipette tips: 0-200µL. Fisher Cat. No. 02-681-135
12. Polypropylene pipette tips: 101-1000µL. Fisher, Cat. No. 02-707-508
13. Pipettes – Disposable transfer. Fisher, Cat. No. 13-711-7M
14. Disposable polypropylene spatulas – VWR; Cat. No. 80081-190.
15. Vortex mixer, variable speed, Fisher Scientific or equivalent
16. Proprietary Content
17. Ultrasonic Bath – Branson; Model 3800 or 5800, or equivalent.
18. Reagent Water Purification System: Capable of producing ultrapure "Type 1/Milli-Q"-grade water from in-house deionized water system. Millipore SAS; Cat. No. FTPF08831.
19. Proprietary Content
20. Proprietary Content
21. Wooden Tongue Depressors - Fisher; Cat. # 11-700-555, or equivalent.
22. Stainless steel spatula/scoop set. Bel-Art SP Scienceware; Product # 11-865-130

B. Equipment

1. AB Sciex Triple Quad 4500/5500/5500 Plus Turbo V Ion Source

   ExionLC Controller
   ExionLC AC Pump
   ExionLC AC Autosampler
   Exion AC Column Oven
   Data system –Analyst 1.7

2. HPLC columns

   a. Proprietary Content

   b. Proprietary Content

Reagents and Standards

A. Reagents:

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1. Proprietary Content
2. Proprietary Content
3. Proprietary Content
4. Proprietary Content
5. Proprietary Content
6. Proprietary Content
7. Graphitized Non-Porous Carbon - Supelco/Millipore Sigma Superclean ENVI-Carb SPE Bulk Packing; Cat. No. 57210-U, or equivalent.

B. Standards: See SOP *T-PFAS-WI13881*

Calibration

A. Initial Calibration

1. A minimum of five calibration standards are required. In general, Cal1, Cal2, Cal3, Cal4, Cal5, Cal6, and Cal7 are included in the initial calibration. The calibration standards contain the branched isomers for PFHxS, PFOS, NMeFOSAA and NEtFOSAA. S/N ratio must be ≥ 10:1 for all ions used for quantification.

2. Analyze a Cal3 level standard that contains linear and branch chained isomers of PFOA. The analysis of this standard is used to demonstrate where the branch chained isomers elute and not included in the calibration curve. This will assist the chemist in identifying and properly integrating this compound in samples.

3. Isotopically-labeled compounds are not available for PFPeS, PFHpS, PFNS, PFDS, PFDoS, 10:2-FTS, PFTrA, PFHxDA, PFODA, DONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, 3:3FTCA, 5:3FTCA, 7:3FTCA, PFEESA, PFMPA, PFMBA, and NFDHA. See below for referenced extraction standards. See *Attachment 2* for additional information about compound relationships.

Compound	Extraction standard
10:2-FTS	13C2-8:2-FTS
PFTrDA	13C2-PFDoDA
PFHxDA	13C2-PFTeDA

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PFODA	
PFPeS	13C3-PFBS
PFHpS	13C3-PFHxS
DONA	13C4-PFHpA
PFNS	13C8-PFOS
PFDS	
PFDoS	
9Cl-PF3ONS	
11Cl-PF3OUdS	
3:3FTCA	13C5-PFPeA
PFMPA	
PFMBA	
5:3FTCA	13C5-PFHxA
7:3FTCA	
PFEESA	
NFDHA	

4. Fit the curve

   a. If the % RSD for the response factors is less than or equal 20%, the average response factor (Ave RRF) can be used to quantitate the data.

   b. If the %RSD is greater than 20%, then a linear regression with a concentration weighing factor of 1/x forced through zero is tried for the compounds not meeting the criteria in 4.a. R^2 for each analyte using the linear regression must be greater than or equal to 0.99.

   c. If the linear regression curve fails, then a quadratic regression with a concentration weighing factor $1/x^2$ is tried for the compounds not meeting 4.a or 4.b. R^2 for each analyte using the quadratic regression must be greater than or equal to 0.99. A minimum or six standards must be analyzed to use a quadratic fit.

   d. For all curve fits, each calibration point is calculated back against the curve. The back calculated concentration should be within ±30% of its true value.

   e. If the criteria are not met, the source of the problem must be determined and corrected. Situations may exist where the initial calibration can be used. In those cases, the data will be reported with a qualifying comment.

NOTE: The concentrations referenced for the sulfonate salts, (for example PFBS, PFHxS and PFOS) have already been corrected to the acid form by the standards supplier as noted in the example Certificate of Analysis (CofA). See *Attachment 4*.

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5. Initial Calibration Verification (ICV)

A check standard prepared from a second source (ICV) is injected to confirm the validity of the calibration curve/standard. If a second source is not available, a separate preparation from the same stock may be used. The calculated amount for each analyte must be within ± 30% of the true value. If this criteria is not met, re-inject or remake the standard. If the criteria is still not met, recalibration is necessary. Instrument maintenance may be needed prior to recalibrating.

B. Continuing calibration

1. Once the calibration curve has been established, the continuing accuracy must be verified by analysis of a continuing calibration verification (CCV) standard every ten field samples and at the end of the analysis sequence.

    a. The CCV run after the initial calibration must be at the CAL3 level.

    b. The CCV standards must alternate between the CAL2, CAL3, and CAL4 levels.

2. Acceptance criteria

    a. The calculated amount for each native compound in the CCV standard must be within ±30% of the true value. Samples that are not bracketed by acceptable CCV analyses must be reanalyzed.

    b. The absolute areas of the extraction standards for the opening CCV on the day following the ICAL should be within 50-150% of the areas measured during the initial calibration CAL3 standard. On subsequent days where an ICAL is not performed, the absolute areas of the extraction standards from opening CCV are compared to the absolute areas of the extraction standards from the previous day's opening CCV and should be within 50-150%.

    c. If acceptance criteria are not met, immediately analyze two additional consecutive CCVs. If both pass acceptance criteria, samples may be reported without reanalysis. If either fails, or two consecutive CCVs cannot be run, repeat the CCV and reanalyze all samples since the last successful CCV.

Procedure

A. Sample preparation

NOTE: Prior to weighing out samples, thoroughly mix each sample using a wooden tongue depressor to ensure a homogeneous sample matrix.

1. On a calibrated, top-loading balance, accurately weigh 1.0g ± 0.10g of solid sample into a tared, labeled 15-mL centrifuge tube using a disposable polypropylene spatula. Record sample weight on sample batch log and in the prep entry system.

2. For each batch - maximum 20 samples - include the following quality control samples:

    a. Method Blank: Weigh 1.0g ± 0.10g of sand.

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b. LCS/LCSD: Fortify 1.0g ± 0.10g of sand with 40 µL of Native Spiking Solution (MSMODSX).

c. Matrix Spike (MS): Fortify 1.0g ± 0.10g of sample as specified in sample preparation log with 40 µL of Native Spiking Solution (MSMODSX).

3. Add 50µL working labeled extraction surrogate solution to each sample/QC tube.

4. Proprietary Content

5. Proprietary Content

6. Proprietary Content

7. Proprietary Content

8. Proprietary Content

9. Proprietary Content

10. Reconstitute extract to 1 mL with methanol.Vortex to thoroughly mix.

The instrument lab chemist performs the next steps.

11. Extract Clean Up: DoD requires all sample/QC extracts be treated with a carbon sorbent to remove potential interferences. Once the extracts have been brought to final volume 1 mL, (see step 10 above), 25 mg loose/bulk "ENVI-Carb" carbon sorbent is added to the extract in its centrifuge tube.

    The sorbent is added with a stainless steel scoop such that, when a level scoop is measured, a 25 mg amount of sorbent is drawn.The 25 mg of sorbent is added directly to the extracts in the 15 mL centrifuge tube. The scoop is rinsed with MeOH and dried between samples to avoid cross-contamination.

    After addition of the ENVI-Carb the extracts are centrifuged for a complete cycle and are ready for vialing into LC vials for analysis.

12. Transfer 400 µL of the final extract to the labeled auto-sampler vial. Cap and vortex the auto-sampler vial. Samples are now ready for analysis.

13. Cap the centrifuge tube. Store the remaining centrifuged extracts at room temperature for dilution or reinjection if needed.

B. LC/MS/MS Analysis

1. Mass Calibration and Tuning

    a. At instrument set up and installation and after the performance of major maintenance, calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. The entire mass range must be calibrated.

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b. When masses fall outside of the ±0.5 amu of the true value, the instrument must be retuned using PPG according to the manufacturer's specifications. Mass assignments of the tuning standard must be within 0.5 amu of the true value. Refer to the instrument manufacturer's instructions for tuning and conditions. These values are stored in the tune file for future reference.

2. The mass spectral acquisition rate must include a minimum of 10 spectra scans across each chromatographic peak.

   See the AB Sciex(4500/5500/5500 plus) Acquisition, Quantitation, Gradient, and detector condition files for the most up to date chromatographic conditions. Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process.

3. Example Acquisition method: See *Proprietary Content*.

4. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NEtPFOSAE, NEtPFOSA, PFDoS, DONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, PFMPA, 3:3 FTCA, PFMBA, PFEESA, and 7:3 FTCA. See *Attachment 3*.

5. Instrument Sensitivity Check (ISC) and Instrument Blanks

   a. Prior to sample analysis and at least every 12 hours, an instrument sensitivity check (ISC) must be performed. The ISC standard concentration must be at the LOQ. The CAL1 standard's concentration is at the LOQ. The CAL1 standard will be analyzed. All analyte concentrations must be within ±30% of their true values. If the criteria is not met, correct problem and rerun ISC. If problem persists, repeat the ICAL. No samples can be analyzed until the ISC meets acceptance criteria.

   b. Instrument blanks need to be analyzed immediately following the highest standard analyzed and daily or at the start of a sequence. The concentration of all analytes must be less than or equal to 1/2 the LOQ. If acceptance criteria are not met the calibration must be performed using a lower concentration standard for the high standard until the criteria are met.

6. Load sample vials containing standards, quality control samples, and sample extracts into autosampler tray. Allow the instrument adequate time to equilibrate to ensure the mass spec and LC have reached operating conditions (approximately 5 minutes) before the first injection. Analyze several solvent blanks clean the instrument prior to sample acquisition.

7. After the initial calibration, inject an instrument blank, followed by the ICV, Linear Branched (L/B)standard, closing Cal 3 level CCV, extraction batch QC, and samples. Bracket each set of ten samples with a CCV standard, alternating between the Cal2, Cal3, and Cal4 levels.

8. After injections are completed, check all CCV recoveries and absolute areas to make sure they are within method control limits. See Calibration section B.2 for acceptance criteria. Process each chromatogram and closely evaluate all integrations, baseline anomalies, and retention time differences. If manual integrations are performed, they must be documented and a reason given for the change in integrations. The manual integrations are documented during data processing and all original integrations are reported at the end of the sample PDF file with the reason for manual integration clearly listed.

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9. Quantitate results for the extraction blank. No target analytes detected greater than 1/2 the LOQ or greater than 1/10 the regulatory limit, whichever is greater. If the criteria is exceeded, reextract all samples with positive detections associated with the method blank. If the target analyte in the sample is detected at a concentration greater than 10 times the amount detected in the method blank, the data is reported.

10. Calculate the recoveries of spiked analytes for the LCS, matrix spike and matrix spike duplicate (MS/MSD) by comparing concentrations observed to the true values.

    a. Method defined limits are used for the evaluation of the LCS and MS/MSD recoveries. Where there are no limits stated, an advisory window of 70-130% will be used until sufficient data points are available to generate statistical winodows. The QC acceptance limit for the relative percent difference (%RPD) between LCS/LCSD and MS/MSD is less than or equal to 30%.

    b. If LCS and/or LCSD recoveries are acceptable, proceed to sample quantitation.

    c. If the LCS recoveries are above QC acceptance criteria and there are no detections for the compound(s) in the associated sample(s), the data can be reported with a qualifying comment. In all other cases, the samples associated with the LCS must be reextracted.

    d. If MS/MSD recoveries are outside QC acceptance criteria, the associated data will be flagged or noted in the comments section of the report.

11. Isotopically-labeled extraction standards are added to all samples, extraction blank, LCS/LCSD, and MS/MSD prior to extraction. The absolute areas of the extraction standards must be within ±50% of the areas measured in the ICAL mid-point standard (CAL3 standard). On days when an ICAL is not performed, the absolute areas must be within ±50% of the absolute areas measured in the daily opening initial CCV. If the extraction standards fall outside the acceptance window, analyze a second aliquot of the extract. If none remains, reanalyze the first aliquot.

    Refer to *Attachment 5* for the Eurofins DOD variances for isotopically-labeled recoveries. If these variances are accepted by the client, the laboratory will follow these guidelines in determining when to re-extract samples. If the client does not accept these variances, samples with recoveries that are outside the ±50% of the true value acceptance criteria must be re-extracted.

12. Compare the retention times of all of the analytes and extraction standards to the retention time from the initial calibration. The retention times should not vary from the expected retention time by more than

    a. 0.4 minutes for isotopically-labeled compounds

    b. 0.1 minutes from their analog for native compounds with an exact isotopically-labeled compound

    c. 0.4 minutes from their assigned analog for native compounds without an exact isotopically-labeled compound.

    If the retention time is outside of the criteria, the compound is considered a false positive unless it is a compound with branched isomers. Compounds with branched isomers can vary in intensity of the individual isomers that are used for reporting and must be reviewed and compared to the preceding CCV to determine if it should be reported.

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13. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NEtPFOSAE, NEtPFOSA, PFDoS, DONA, 9Cl-PF3ONS, 11Cl-PF3OUdS, PFMPA, 3:3 FTCA, PFMBA, PFEESA, and 7:3 FTCA. The expected ion ratio for each compound is calculated by using the average of ion ratios of each compound from initial calibration standards. When an ion ratio for a compound differs from the expected ion ratio by more than 50%, a qualifier is placed on the raw data and on the sample report. No corrective action is required.

14. The linear/branch chain standard is used when assessing the correctness of the computer generated peak integrations for PFOA.

15. If the calculated concentration exceeds the calibration range of the system, determine the appropriate dilution required and dilute the extract with MeOH. If the sample dilution required exceeds 100 fold, the client must be contacted to determine if the data can be reported with result(s) that exceed the calibration range or if the sample should be re-prepped at a reduced volume.

    Dilution Example 1/10: Mix 900 µL of MeOH with 100µL of sample extract. Vortex to mix. Using an auto-pipette, transfer 400µL of the mixed solution into a labeled auto-sampler vial containing a plastic insert. Cap and vortex thoroughly to mix.

Calculations

A. Peak Area Ratio

$$\text{Peak Area Ratio} = \frac{\text{Analyte Response}}{\text{Labeled Analyte Response}}$$

B. On-Column Analyte Concentration using linear through zero curves

On-column Concentration = (peak area ratio x Isotope Dilution Analyte concentration) ÷ slope

C. Sample Concentration

Sample concentration (ng/g) = (On-column concentration x Final Sample volume x DF x prep factor) ÷ Sample weight

Where: prep factor = 2

D. Ion Ratio

ion ration = (peak area or height of quantifier)/(peak area or height of qualifier)

E. See *T-PEST-WI9847* for additional calculations used to evaluate the calibrations and quality control samples.

Statistical Information/Method Performance

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The LCS should contain all compounds of interest. LCS, MS, extraction standard recoveries and RPD are compared to the limits stored on the LIMS. These limits are defined by the method. For compounds not defined by the method, these limits are statistically derived when sufficient data points are available. If sufficient data points are not available to generate statistical windows, an advisory window of 70% to 130% will be used. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to *QA-SOP11892* for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

Quality Assurance/Quality Control

For each batch of 20 samples extracted, a method blank and an LCS/LCSD (Sand spiked with all compounds to be determined carried through the entire procedure) must be extracted and analyzed. If an MS/MSD is submitted then an LCSD would not be extracted. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Attachment:
Attachment 1 – Proprietary Content
Attachment 2 - Compound Relationships (.docx)
Attachment 3 - Mass Transitions (.doc)
Attachment 4 - Example Certificate of Analysis (.pdf)
Attachment 5 - Eurofins DoD Variances (.doc)

G-DC-FRM23907 Redacted SOPs
QA-SOP11178 Demonstrations of Capability
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T-PEST-WI9847 Common Equations Used During Chromatographic Analyses
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Attachment: Attachment 4 - Example Certificate of Analysis (pdf)
Attachment: Attachment 5 - Eurofins DoD Variances (doc)

End of document

Version history

Version	Approval	Revision information	
1	29.JAN.2021		
2	25.MAY.2022		

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Attachment 2

PFAS Native Compounds/Extraction Standards

Native PFAS Compounds

Native	Extraction Standard
PFBA	13C4-PFBA
PFPeA	13C5-PFPeA
3:3FTCA	
PFMPA	
PFMBA	
PFBS	13C3-PFBS
PFPeS	
4:2-FTS	13C2-4:2-FTS
PFHxA	13C5-PFHxA
NFDHA	
5:3FTCA	
7:3FTCA	
PFEESA	
PFHxS	13C3-PFHxS
PFHpS	
PFHpA	13C4-PFHpA
DONA	
6:2-FTS	13C2-6:2-FTS
PFOA	13C8-PFOA
PFOS	13C8-PFOS
PFNS	
PFDS	
9Cl-PF3ONS	
11Cl-pf3OUdS	
PFDoS	
PFNA	13C9-PFNA
PFOSA	13C8-PFOSA
PFDA	13C6-PFDA

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Native	Extraction Standard
8:2-FTS	13C2-8:2-FTS
10:2-FTS	
NMePFOSAE	d7-NMePFOSAE
NMePFOSA	d3-NMePFOSA
NMeFOSAA	d3-NMeFOSAA
NEtPFOSAE	d9-NEtPFOSAE
NEtPFOSA	d5-NEtPFOSA
PFUnDA	13C7-PFUnDA
NEtFOSAA	d5-NEtFOSAA
PFDoDA	13C2-PFDoDA
PFTrDA	
PFTeDA	13C2-PFTeDA
PFHxDA	
PFODA	
HFPODA	13C3-HFPODA

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Attachment 3

Mass Transitions AB Sciex 4500/5500/5500+

Compound	Parent Ion	Daughter Ion
13C4-PFBA	217	172
PFBA	213	169
13C5-PFPeA	268	223
PFPeA	263	219
13C3-PFBS	302	80
PFBS	299	80
PFBS (2)	299	99
13C2-4:2-FTS	329	81
4:2-FTS	327	307
4:2-FTS (2)	327	81
13C5-PFHxA	318	273
PFHxA	313	269
PFHxA (2)	313	119
PFPeS	349	80
PFPeS (2)	349	99
13C3-PFHxS	402	80
PFHxS	399	80
PFHxS (2)	399	99
13C4-PFHpA	367	322
PFHpA	363	319
PFHpA (2)	363	169
13C2-6:2-FTS	429	81
6:2-FTS	427	407
6:2-FTS (2)	427	81
PFHpS	449	80
PFHpS (2)	449	99
13C8-PFOA	421	376
PFOA	413	369
PFOA (2)	413	169
13C8-PFOS	507	80
PFOS	499	80
PFOS (2)	499	99
13C9-PFNA	472	427
PFNA	463	419
PFNA (2)	463	169
13C8-PFOSA	506	78
PFOSA	498	78

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Compound	Parent Ion	Daughter Ion
PFNS	549	80
PFNS (2)	549	99
13C6-PFDA	519	474
PFDA	513	469
PFDA (2)	513	169
13C2-8:2-FTS	529	81
8:2-FTS	527	507
8:2-FTS (2)	527	81
d7-NMePFOSAE	623	59
NMePFOSAE	616	59
d3-NMePFOSA	515	169
NMEPFOSA	512	169
d3-NMeFOSAA	573	419
NMeFOSAA	570	419
NMeFOSAA (2)	570	483
d9-NEtPFOSAE	639	59
NEtPFOSAE	630	59
d5-NETPFOSA	531	169
NEtPFOSA	526	169
PFDS	599	80
PFDS (2)	599	99
13C7-PFUnDA	570	525
PFUnDA	563	519
PFUnDA (2)	563	169
d5-NEtFOSAA	589	419
NEtFOSAA	584	419
NEtFOSAA (2)	584	526
13C2-PFDoDA	615	570
PFDoDA	613	569
PFDoDA (2)	613	169
10:2-FTS	627	607
10:2-FTS (2)	627	81
PFDoS	699	80
PFTrDA	663	619
PFTrDA (2)	663	169
13C2-PFTeDA	715	670
PFTeDA	713	669
PFTeDA (2)	713	169
PFHxDA	813	769
PFHxDA (2)	813	169

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Attachment 3

Compound	Parent Ion	Daughter Ion
PFODA	913	869
PFODA (2)	913	169
13C3-HFPODA	332	287
HFPODA	329	285
HFPODA (2)	285	169
DONA	377	251
9Cl-PF3ONS	531	351
11Cl-PF3OUdS	631	451
PFECA B (NFDHA)	201	85
PFECA B(NFDHA) (2)	295	201
PFECA F (PFMPA)	229	85
3:3 FTCA	241	177
PFECA A (PFMBA)	279	85
PFEESA (PES)	315	135
5:3 FTCA	341	237
5:3 FTCA (2)	339	217
7:3 FTCA	441	317

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DOCUMENTATION

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PFAC-MXC

Native Perfluorinated Compound Solution/Mixture

PRODUCT CODE:	PFAC-MXC
LOT NUMBER:	PFACMXC0617
SOLVENT(S):	Methanol / Water (<1%)
DATE PREPARED: (mm/ddlyyyy)	06/14/2017
LAST TESTED: (mm/dd/yyyy)	03/19/2019
EXPIRY DATE: (mmldd/yyyy)	03/19/2024
RECOMMENDED STORAGE:	Store ampoule in a cool, dark place

DESCRIPTION:

PFAC-MXC is a solution/mixture of thirteen native perfluoroalkylcarboxylic acids (C_4-C_{14} C, $_6$ and C $_)$ and eight native perfluoroalkylsulfonates (C.-C $_1$ and C,J The full name, abbreviation and concentration for each of the components are given in Table A.

The individual perfluoroalkylcarboxylic acids and perfluoroalkylsulfonates all have chemical purities of >98%.

DOCUMENTATION/ DATA ATTACHED:

Table A: Components and Concentrations of the Solution/Mixture
Figure 1: LC/MS Data (SIR)
Figure 2: LC/MS/MS Data (Selected MRM Transitions)

ADDITIONAL INFORMATION:

See page 2 for further details.
Contains 4 mole eq. of NaOH to prevent conversion of the carboxylic acids to their respective methyl esters.

FOR LABORATORY USE ONLY: NOT FOR HUMAN OR DRUG USE

INTENDED USE:

The products prepared by Wellington Laboratories Inc. are for laboratory use only. This certified reference material (CRM) was designed to be used as a standard for the identification and/or quantification of the specific chemical compounds it contains.

HANDLING:

This product should only be used by qualified personnel familiar with its potential hazards and trained in the handling of hazardous chemicals. Due care should be exercised to prevent unnecessary human contact or ingestion. All procedures should be carried out in a well-functioning fume hood and suitable gloves, eye protection, and clothing should be worn at all times. Waste should be disposed of according to national and regional regulations. Safety Data Sheets (SDSs) are available upon request.

SYNTHESIS / CHARACTERIZATION:

Our products are synthesized using single-product unambiguous routes whenever possible. They are then characterized, and their structures and purities confirmed, using a combination of the most relevant techniques, such as NMR, GC/MS, LC/MS/MS, SFC/UV/MS/MS, x-ray crystallography, and melting point. Isotopic purities of mass-labelled compounds are also confirmed using HRGC/HRMS and/or LC/MS/MS.

HOMOGENEITY:

Prior to solution preparation, crystalline material is tested for homogeneity using a variety of techniques (as stated above) and its solubility in a given diluent is taken into consideration. Duplicate solutions of a new product are prepared from the same crystalline lot and, after the addition of an appropriate internal standard, they are compared by GC/MS, LC/MS/MS, and/or SFC/UV/MS/MS. The relative response factors of the analyte of interest in each solution are required to be <5% RSD. New solution lots of existing products, as well as mixtures and calibration solutions, are compared to older lots in a similar manner. This further confirms the homogeneity of the crystalline material as well as the stability and homogeneity of the solutions in the storage containers. In order to maintain the integrity of the assigned value(s), and associated uncertainty, the dilution or injection of a subsample of this product should be performed using calibrated measuring equipment.

UNCERTAINTY:

The maximum combined relative standard uncertainty of our reference standard solutions is calculated using the following equation:

The combined relative standard uncertainty, uc(y), of a value y and the uncertainty of the independent parameters $x_1, x_2 \ldots x_n$ on which it depends is:

$$ur(y(x_1, x_2, \ldots x_n)) = \sqrt{\sum_{i=1} u(y, x_i)^2}$$

where x is expressed as a relative standard uncertainty of the individual parameter.

The individual uncertainties taken into account include those associated with weights (calibration of the balance) and volumes (calibration of the volumetric glassware). An expanded maximum combined percent relative uncertainty of ±5% (calculated with a coverage factor of 2 and a level of confidence of 95%) is stated on the Certificate of Analysis for all of our products.

TRACEABILITY:

All reference standard solutions are traceable to specific crystalline lots. The microbalances used for solution preparation are regularly calibrated by an external ISO/IEC 17025 accredited laboratory. In addition, their calibration is verified prior to each weighing using calibrated external weights traceable to an ISO/IEC 17025 accredited laboratory. All volumetric glassware used is calibrated, of Class **A** tolerance, and traceable to an ISO/IEC 17025 accredited laboratory. For certain products, traceability to international interlaboratory studies has also been established.

EXPIRY DATE / PERIOD OF VALIDITY:

Ongoing stability studies of this product have demonstrated stability in its composition and concentration, until the specified expiry date, in the unopened ampoule. Monitoring for any degradation or change in concentration of the listed analyte(s) is performed on a routine basis.

LIMITED WARRANTY:

At the time of shipment, all products are warranted to be free of defects in material and workmanship and to conform to the stated technical and purity specifications.

QUALITY MANAGEMENT:

This product was produced using a Quality Management System registered to the latest versions of ISO 9001 by SAi Global, ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA; A 1226), and ISO 17034 by ANSI-ASQ National Accreditation Board **(ANAB;** AR-1523).

CALA

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ACCREDITED

REFERENCE MATERIAL PRODUCER

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Table A: **PFAC-MXC; Components and Concentrations (ng/ml, ± 5% in Methanol/ Water (<1%))**

Compound	Abbreviation	Concentration (ng/ml)*		Peak Assignment in Figure 1
Perfluoro-n-butanoic acid	PFBA	2000		A
Perfluoro-n-pentanoic acid	PFPeA	2000		B
Perfluoro-n-hexanoic acid	PFHxA	2000		D
Perfluoro-n-heptanoic acid	PFHpA	2000		F
Perfluoro-n-octanoic acid	PFOA	2000		**H**
Perfluoro-n-nonanoic acid	PFNA	2000		J
Perfluoro-n-decanoic acid	PFDA	2000		L
Perfluoro-n-undecanoic acid	PFUdA	2000		**N**
Perfluoro-n-dodecanoic acid	PFDoA	2000		P
Perfluoro-n-tridecanoic acid	PFTrDA	2000		Q
Perfluoro-n-tetradecanoic acid	PFTeDA	2000		**S**
Perfluoro-n-hexadecanoic acid	PFHxDA	2000		**T**
Perfluoro-n-octadecanoic acid	PFODA	2000		**U**
Compound	**Abbreviation**	**Concentration (ng/ml)***		**Peak Assignment in Figure 1**
		As the salt	**As the anion**	
Potassium perfluoro-1-butanesulfonate	L-PFBS	2000	1770	C
Sodium perfluoro-1-pentanesulfonate	L-PFPeS	2000	1880	E
Sodium perfluoro-1-hexanesulfonate	L-PFHxS	2000	1890	G
Sodium perfluoro-1-heptanesulfonate	L-PFHpS	2000	1900	I
Sodium perfluoro-1-octanesulfonate	L-PFOS	2000	1910	K
Sodium perfluoro-1-nonanesulfonate	L-PFNS	2000	1920	**M**
Sodium perfluoro-1-decanesulfonate	L-PFDS	2000	1930	0
Sodium perfluoro-1-dodecanesulfonate	L-PFDoS	2000	1940	R

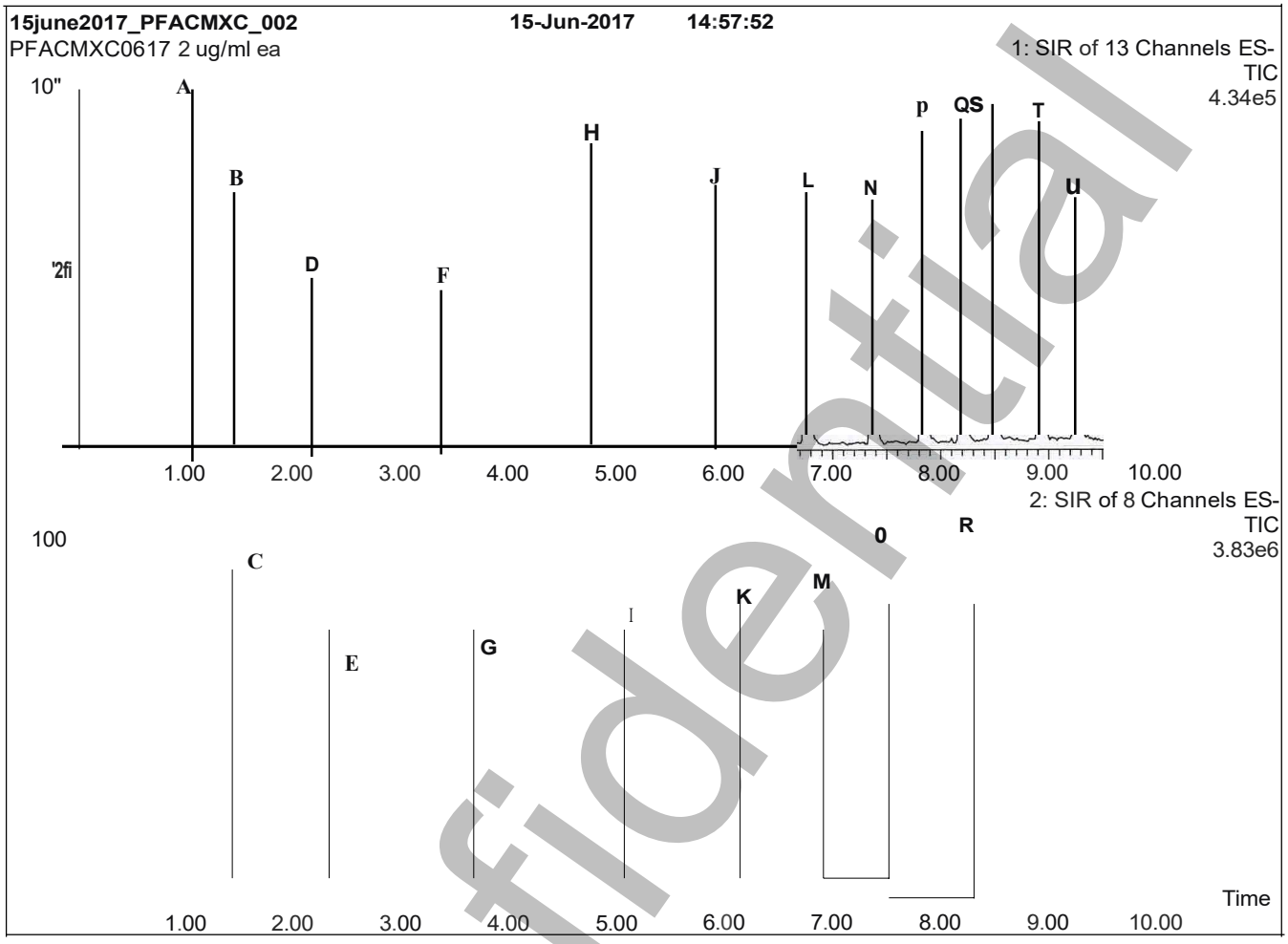
* Concentrations have been rounded to three significant figures.

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Certified By: _____ **Date:** 06/06/2019
(mm/dd/yyyy)

B.G. Chittim, General Manager

Fi.9yr!L1 **PFAC-MXC; LC/MS Data (Total Ion Current Chromatogram; SIR)**



Conditions for Figure 1:

LC: **Waters Acquity Ultra Performance LC**
MS: **Micromass Quattro *micro* API MS**

Chromatographic Conditions

Column: Acquity UPLC BEH Shield RP.,
1.7 µm, 2.1 x 100 mm

Mobile phase: Gradient
Start: 50% H,O / 50% (80:20 MeOH:ACN)
(both with 10 mM NH,OAc buffer)
Ramp to 90% organic over 8 min and hold for 2 min
before returning to initial conditions in 1 min.

Time: 12 min

Flow: 300 µl/min

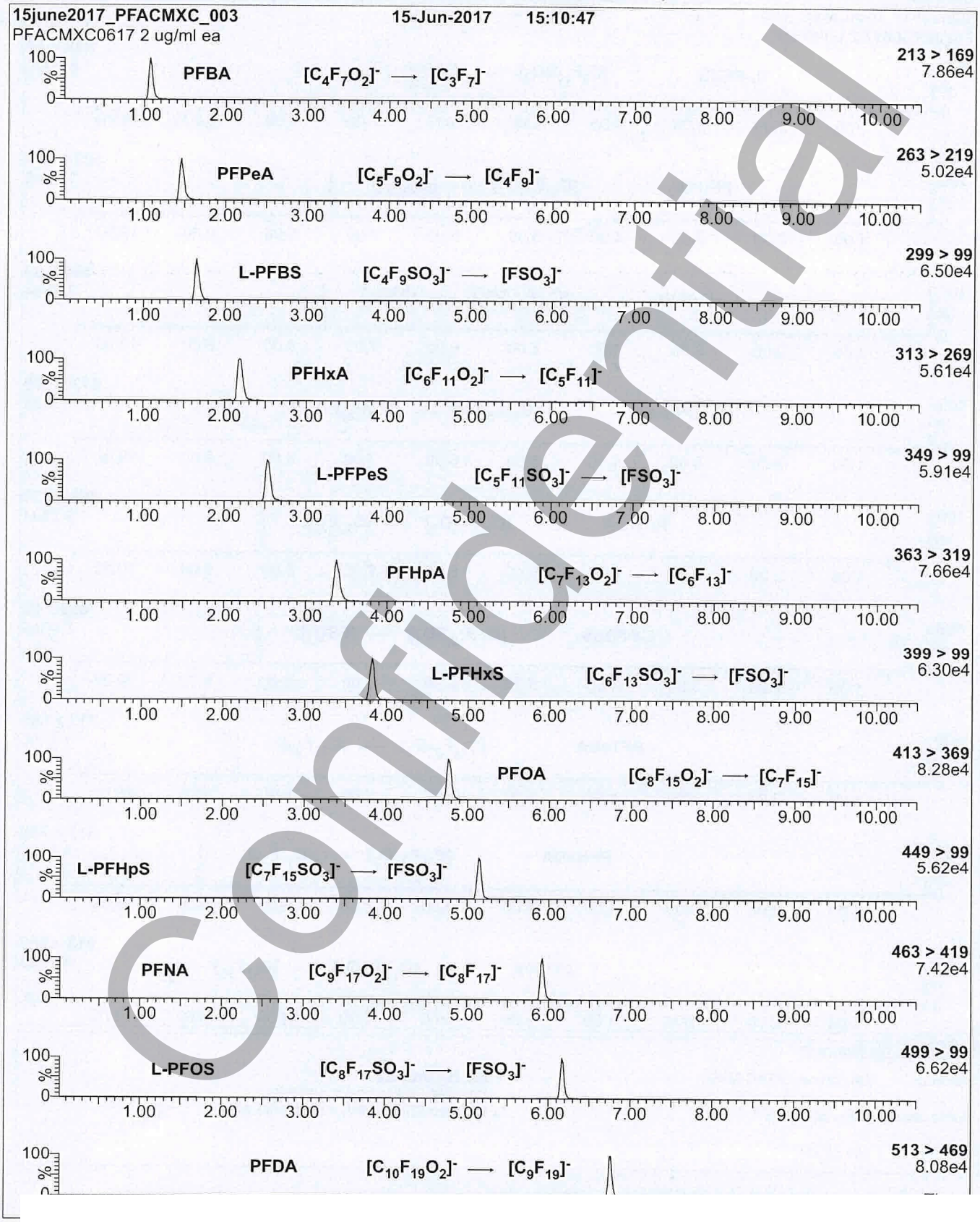
MS Parameters

Experiment: SIR of 21 Channels

Source: Electrospray (negative)
Capillary Voltage (kV) = 3.00
Cone Voltage (V) = variable (10-80)
Cone Gas Flow (l/hr) = 50
Desolvation Gas Flow (l/hr) = 750

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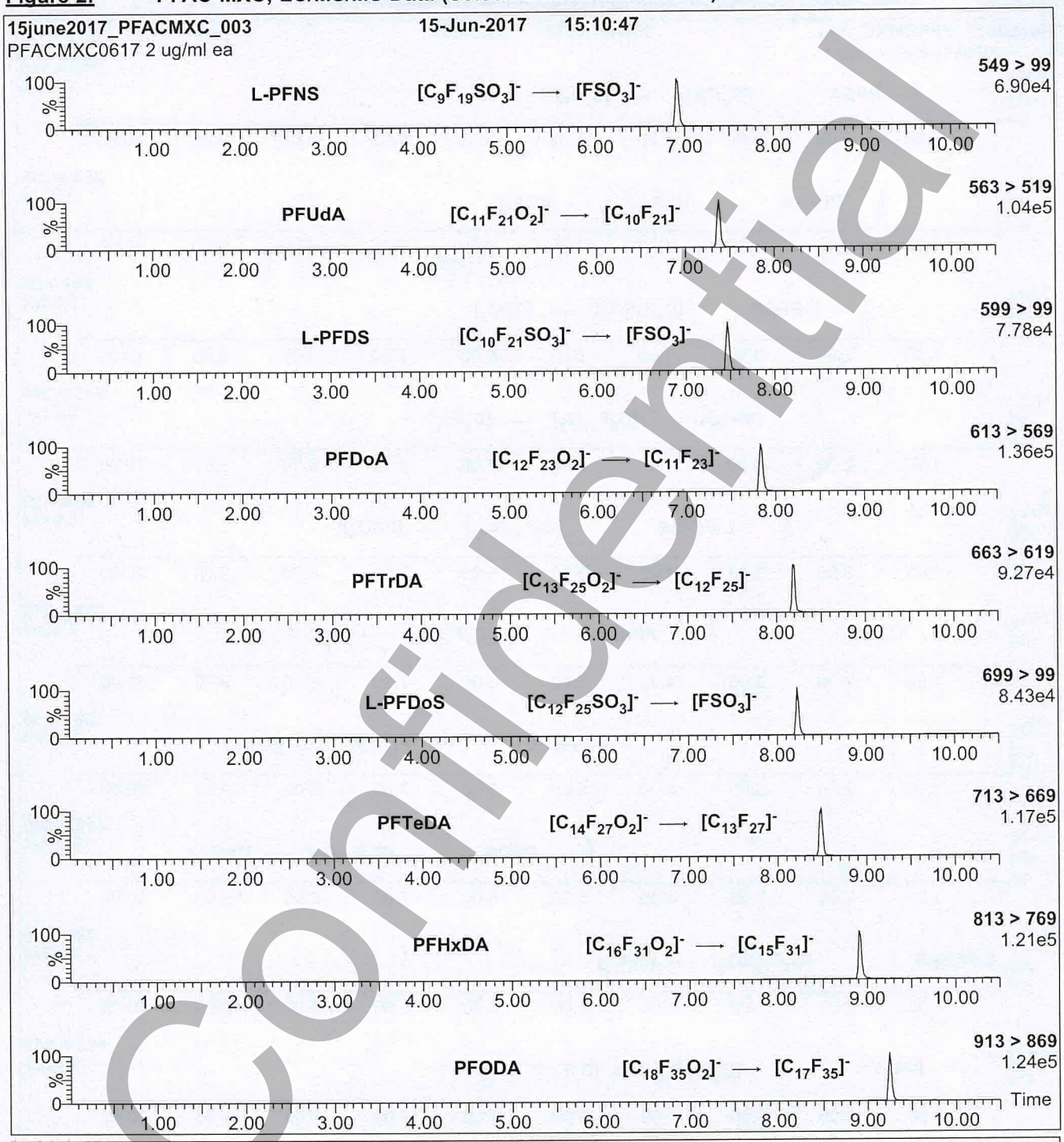
Figure 2: **PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



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Figure 2: **PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



Conditions for Figure 2:

Injection: On-column (PFAC-MXC)

Mobile phase: Same as Figure 1

Flow: 300 µl/min

MS Parameters

Collision Gas (mbar) = 3.46e-3

Collision Energy (eV) = 8-50 (variable)

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Item	Parameter	Scope of Work	ELLE SOP	Approval
1	QSM 5.3 Table B-15 PFAS Using LC/MS/MS	Extraction internal standard (EIS) recovery criteria of 50-150%	For all PFAS compounds if EIS recovery is <50%, we will check for laboratory error and correct if identified. If no laboratory error is identified, additional corrective action will be performed if EIS recovery is <10%. If EIS recovery is >10% and samples have detections above the reporting limit, no additional corrective action is performed. If EIS recovery is >10% and samples have no detections for associated native analytes, the native analyte response will be evaluated to confirm the validity of the reporting limit. Reporting limits will be proportionately increased as necessary and appropriate to ensure that reported values accurately reflect the sensitivity of the analysis.	
2	QSM 5.3 Table B-15 PFAS Using LC/MS/MS	Extraction internal standard (EIS) recovery criteria of 50-150%	For all PFAS compounds, if EIS recovery is >150%, we will check for laboratory error and correct if identified. If no laboratory error is identified, additional corrective action will be performed only when field samples have detections above the reporting limits for the associated native target analytes and EIS recovery is >200%.	
3	QSM 5.3 Table B-15 PFAS Using LC/MS/MS	Sample Preparation	If persistent matrix effects are observed for multiple samples from a given project that necessitate a high rate of additional corrective actions, these matrix effects will be mitigated prior to sample preparation and analysis, typically by processing a smaller sample mass or volume.	

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eurofins	Always check on-line for validity.	Level:
Document number: **T-PFAS-WI23588**	**Preventative and Corrective Maintenance for the API 4000 and AB Sciex 4500, 5500, 5500+ Liquid Chromatograph Mass Spectrometers (LC/MS/MS)**	**Work Instruction**
Old Reference:		
Version: **3**		Organisation level: **5-Sub-BU**
Approved by: **XL3S** Effective Date: **21-FEB-2022**	Document users: **5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_Management_Team**	Responsible: **5_EUUSLA_PFAS_Manager**

Revision Log
Reference
Purpose
Scope
Personnel Training and Qualifications
Safety Precautions and Waste Handling
Procedure

Revision Log

Revision:	03	**Effective date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Procedure	Enhancement	Updated table in A to include current requirements.

Revision:	02	**Effective date:** 26-FEB-2021
Section	**Justification**	**Changes**
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Reference	Enhancement	Added Manual for 5500/5500+
Purpose	Enhancement	Added new instruments
Procedure	Enhancement	Added new instruments

Reference

1. *AB Sciex 4500 Series of Instruments System User Guide*, AB Sciex, AB Sciex Pte. Ltd., 2013.

2. 5500 Series of Instruments, AB Sciex, AB Sciex Pte. Ltd., 2017.

3. *Turbo V Ion Source Operator Guide*, AB Sciex, AB Sciex Pte. Ltd., 2015.

4. *Instrument Front-End Cleaning Procedure For Customers*, AB Sciex, AB Sciex Pte. Ltd., 2013.

5. *Hardware Manual: API 4000 LC/MS/MS System*, AB Sciex, AB Sciex Pte. Ltd., 2010.

6. *Chemical Hygiene Plan*, Lancaster Laboratories, current version.

Purpose

Preventative and corrective maintenance are crucial in maintaining the overall performance of the API 4000, AB Sciex Triple Quad 4500, 5500, 5500+ LC/MS/MS. This SOP explains the basic principles of managing the integrity of the API 4000, AB Sciex Triple Quad 4500, 5500, 5500+ LC-MS/MS.

Scope

This document serves as a guideline for the performance of preventative and corrective maintenance on the API 4000 and AB Sciex Triple Quad 4500, 5500, 5500+ LC-MS/MS.

Routine preventative maintenance is required to maintain an LC/MS/MS system that will perform to method specifications. The performance of preventative maintenance is at the discretion and determination of the chemist. The course of maintenance is based upon experience and meeting method performance specifications. Corrective maintenance may be performed by the chemist, at the chemist's discretion, based on the observed non-conformance. If, however, it is determined that an outside contractor must be contacted to perform certain types of preventative or corrective maintenance on a system, the chemist should consult with his/her supervisor. The supervisor will then assist in determining who will contact the outside contractor to schedule a service call.

Personnel Training and Qualifications

Personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of the SOP. Each new chemist will train with an experienced chemist for the first 12 weeks depending on the individual and his or her previous experience.

During the training period, the new chemist will learn daily preventative maintenance and corrective maintenance procedures, column and source cleaning procedures. S/he is also required to read all relevant SOPs and EPA methods.

Safety Precautions and Waste Handling

Safety glasses must be worn and all necessary safety precautions taken when performing any type of preventative or corrective maintenance.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal and State laws and regulations.

Procedure

All corrective maintenance procedures, whether performed internally or by outside contractor, must be fully documented in the instrument maintenance log. Documentation must include the issue leading to the maintenance, the actions taken, and the condition of the instrument after maintenance

A. MS Maintenance Procedures

Mass Spectrometer (MS)

API 4000* and AB Sciex Triple Quad 4500, 5500, 5500+ LC-MS/MS Preventative Maintenance Schedule (MS Components)

Procedure	**Frequency**
Clean QJet*	Bi-annually
Clean Q0	Bi-annually
Mass Calibration	After cleaning QJet/0
Clean Electrode	Bi-Monthly
Clean Oriface Plate	Bi-Monthly(when venting)
Clean Curtain Plate	Bi-Monthly
Replace Rough Pump Oil	As needed (yearly)
Divert Valve	Monthly
Injection Valve	Monthly

*The API 4000 does not have a QJet. This system has a Skimmer, which is cleaned bi-annually.

1. 1. Clean Electrode

    a. Deactivate the hardware profile.
    b. Allow the Turbo V Ion source to cool for 15-20 minutes (just until it is comfortable to the touch).
    c. Remove the top fitting and separate from the peek tubing.
    d. Remove the black cap.
    e. Put the top fitting back in place and create a tight seal.
    f. Carefully unscrew the fitting and pull the electrode straight out, careful not to touch the sides of the source housing.
    g. Wipe the electrode with methanol and allow to dry.
    h. Carefully position the electrode back into the source housing.
    i. Screw the black cap on.
    j. Connect the peek tubing from the Analytical Column to the Ion Source.
    k. Connect the peek tubing that leads to the electrode.
    l. Reactivate the hardware profile.

2. Clean the Curtain Plate

    a. Deactivate the hardware profile.
    b. Allow the Turbo V Ion source to cool for 15-20 minutes (just until it is comfortable to the touch).
    c. Remove the Turbo V Ion source from the MS by unlocking the two latches on both sides and pulling straight off. (Before pulling off, disconnect the peek tubing that connects the Analytical Column to the Ion Source).
    d. Ensure that the O-rings on the back of the Ion source do not fall off.
    e. Remove the curtain plate by pulling straight off and place on a Kimwipe.
    f. Clean both sides with Milli-Q water.
    g. Clean both sides with Methanol.
    h. Use a disposable spatula to mix 1 scoop of Aluminum Oxide with Milli-Q H2O in a medicine cup. Mix together and rub onto the curtain plate to remove further discoloration.
    i. Rinse with Milli-Q and Methanol again.
    j. Allow the curtain plate to air dry.

    Note: Maintenance beyond the curtain plate will require fully venting the MS. Prior to maintenance past the curtain plate, a performance baseline should be established using negative PPG as outlined in the Mass Calibration Attachment 1; another check should be performed after the maintenance.

3. Vent the MS

a. Deactivate the hardware profile in Analyst.
b. Vent the MS by holding down the Vent button on the side of the MS (hold down the vent button until you see all of the lights flashing on the side panel).
c. Allow the MS to vent naturally (wait at least 20 minutes).
d. Turn off the MS power supply.
e. Turn off the rough pump and wait another 15-20 minutes.

4. Clean the Orifice Plate

a. Vent the MS using the above procedure.
b. Disconnect the peek tubing leading from the analytical column to the Turbo V Ion Source.
c. Remove the Turbo V Ion Source.
d. Remove the Curtain Plate.
e. Remove the Orifice Plate.
f. Clean the Orifice Plate with Milli-Q water.
g. Clean the Orifice Plate with Methanol.
h. If there are deposits or discoloration remaining, use a disposable spatula to mix 1 scoop of aluminum oxide with Milli-Q water in a medicine cup. Mix together and rub onto the curtain plate to remove any remaining discoloration.
i. Rinse with Milli-Q water and methanol again.
j. Allow the Orifice Plate to air dry.

5. Clean QJet

a. Vent the MS and remove the Orifice Plate following the above procedures. Then remove the QJet ion guide and place on a Kimwipe.
b. Remove the Q0 lens from the bottom of the QJet.
c. Place the QJet in a large beaker, and rinse thoroughly with Milli-Q water followed by Methanol.
d. Use a cotton swab to clean in between the poles of the QJet.
e. Rinse again, and allow QJet to completely air dry.
f. Clean the Q0 lens by wiping with Methanol.
g. Return the lens to the QJet.

6. Clean Q0

a. Vent the MS and remove the Orifice Plate and QJet following the above procedures.
b. Prepare the Q0 cleaning tool (this is a long plastic rod with two eyelets in the end).
c. Fold a Kimwipe in-half enough times so that it can be inserted into the top eyelet.
d. Insert the Kimwipe so that equal amounts are protruding on either end of the cleaning tool and dampen both ends with methanol.
e. Gently insert the cleaning tool ¾ of the way into the Q0, rotate two full clockwise motions, and then remove the tool from the Q0.
f. Remove the used Kimwipe and prepare another to be inserted into the bottom eyelet.
g. Repeat procedure for the bottom eyelet.
h. After cleaning, verify that no pieces of Kimwipe have been left behind in Q0. This can be done by a visual inspection of the used Kimwipes and by a visual check inside of Q0 with the help of a flashlight.

B. LC Maintenance Procedures

1. Mobile Phases

Mobile Phase solutions will need to be replaced and or topped off as needed. The current mobile phases used are 20 mM Ammonium Acetate in Milli-Q water and 20 mM Ammonium Acetate in 0.5% Water/Methanol.

Should the mobile phases run dry while the system is acquiring data, perform the following steps:

a. In Analyst, click Abort Sample and Stop Queue.
b. Replace and or top off the mobile phase that ran dry.

c. Purge the pumps on the Exion LC Autosampler (make sure the pump light is OFF and the drain is OPEN prior to selecting the purge function).
d. Let the pumps purge and check for air in the lines.
e. If needed, top off the IPA vials for both LC pumps.
f. Once the pumps have finished purging, close the drains and turn on the pumps.
g. Set the appropriate files to re-acquire in the Analyst queue and click Start Sample.

NOTE: It is important to also keep in mind the needle wash will need to be replaced as needed. The current needle wash used is 100% Acetonitrile. Should the needle wash become dry, there will be noticeable shifts in retention times.

2. ExionLC AC Column Oven

The column oven houses the Analytical Column. In the process of troubleshooting high pressure, contamination, and or peak tailing, an analyst may need to replace the Analytical Column. The current Analytical Column is a Gemini 3µM C18 LC Column (Phenomenex).

To replace the Analytical Column, perform the following steps:

a. Deactivate the hardware profile in Analyst.
b. Open the column oven.
c. Remove the top fitting from the Analytical Column. (This fitting connects the Sample Transfer Line to the Analytical Column.)
d. Hold the Analytical Column while removing the bottom fitting. (This fitting connects the Analytical Column to the Ion Source.)
e. Place the old Analytical Column off to the side (away from the Column Oven) and replace with a new column by carefully screwing the top and bottom fittings.
f. Once the new column is in place, check for leaks by pumping methanol through the system at 0.5 to 1 mL/min. (Note: Prior to pumping methanol through the system, make sure the divert valve is set to position “A” for waste. If the divert valve is set to position “B,” disconnect the peak tubing leading from the Analytical Column to the Ion Source. It is preferable to disconnect the peak tubing at the Ion Source end. For the API 4000 LC\MS\MS System that is not equipped with a divert valve, disconnecting the peak tubing as previously described is the only option to ensure methanol does not get into the Ion Source.)

    1. To manually set a flow rate, tap the button on the pump to the left of Sleep. (It looks like an orange square made up of nine dots.)
    2. With the key pad lit up in orange, select Function.
    3. Click on Function until System appears – Press Enter.
    4. Under normal operating conditions, the value to the right hand side will show “0” – change this number to “1” and press Enter. (At this point, the remote button will turn OFF on the pump.)
    5. Press CE twice to navigate quickly to the start screen.
    6. Press Function once and type in the desired flow rate.
    7. Select Enter to save the flow rate.
    8. Select Pump to begin pumping the mobile phase through the system.

g. If leaks are present, tighten fittings where appropriate.
h. Set the pump back to remote mode.

    1. Tap the button on the pump to the left side of Sleep. (It looks like an orange square made up of nine dots.)
    2. With the key pad lit up in orange, select Function.
    3. Click on Function until System appears – Press Enter.
    4. Type “1” in place of the “0” and press Enter. (At this point, the remote button will turn ON.)
    5. Press CE twice to navigate quickly to the start screen.

i. Reactivate the hardware profile and run several solvent blanks followed by CAL standards to check the peak shapes and retention times.
j. If troubleshooting a pressure/contamination issue, additional areas of the LC\MS\MS may need to be investigated.

3. Pre-Column Replacement

Under normal operation, mobile phases are passed through a pre-column prior to sample introduction. The current pre-column is the Luna 5µm C18 LC Column (Phenomenex). Over time, the pre-column can become clogged. This is indicated by an elevated pressure.

To remove the pre-column, perform the following steps:

a. Deactivate the hardware profile. (At a minimum, turn OFF both pumps to ensure the mobile phases do not leak.)
b. With a large wrench wrapped around the center to hold the pre-column in place, unscrew the top and bottom fittings from the pre-column. (Use a smaller wrench to gently twist the fittings off.)
c. Place the old pre-column off to the side and connect a new pre-column.
d. Once the new pre-column is connected, check for leaks by flushing the lines with methanol (step by step instructions in the above section "Exion AC Column Oven").
e. If leaks are present, tighten fittings where appropriate.
f. Set the pump back to remote mode.
g. Reactivate the hardware profile (if deactivated).
h. If pressure issue is not resolved, investigate additional areas of the LC/MS/MS system.

4. Exion AC Pumps

The AC Pumps are critical components in the operation of an LC\MS\MS. If there are injection issues, there are a few areas worth investigating:

a. Plunger Seals

1. Each pump is equipped with two plunger seals, one on the left and another on the right.
2. To remove a plunger seal, deactivate the hardware profile in Analyst (or at a minimum, turn OFF the pumps).
3. Gently loosen the connection to the area housing the drain with a small wrench.
4. Use a small wrench to disconnect the screw from the top of the CV-OUT. (This is a check valve with a single mark.)
5. Use a key wrench to remove the two screws from the pump head.
6. Pull the pump head straight out, careful not to snap the peek tubing connected to the CV-IN. (This is a check valve with a double or triple mark.)
7. Remove the plunger seal using the rough side of the seal remover tool.
8. Inspect the plunger seal for any abnormalities.
9. Clean the pump head with methanol.
10. Place a new plunger seal on the pump head by using the smooth side of the seal remover tool. (The plunger seal should pop into place.)
11. Perform additional maintenance on the pump head if needed before moving to the second pump head (details below).

b. PTFE Diaphragms

1. With the pump head removed, unscrew the unit holding the plunger and the diaphragm.
2. Inspect the diaphragm for any abnormalities and replace if needed. (Make sure the larger protrusion is facing towards the back.)

c. Plunger – replace as needed
d. In-Out Check Valves – replace as needed

Once all the necessary maintenance has been completed on both pump heads, check for leaks.

5. Exion AC Autosampler

The following components require maintenance:

a. Needle – replace as needed
b. Rotor seals - replace as needed

c. Sample transfer line – replace as needed (will most likely replace in the course of troubleshooting, details below)

1. Deactivate the hardware profile
2. Tap the button on the Autosampler to the left side of Sleep (it looks like an orange square made up of nine dots)
3. Press the up arrow (at this point, the following command should appear "ZHOME Enter to Start")
4. Press Enter and wait for the needle to move into the home position
5. Remove the autosampler tray
6. Take off the safety shield by removing the white screws on the corners
7. Gently slide the needle housing to the left side of the autosampler (Note: Please pay careful attention to the latch at the bottom of the autosampler tray. This latch should not be tampered with as to avoid the needle from returning to the injection port when it is not ready for use.)
8. Use a small wrench to disconnect the transfer line from the injection port (the transfer line is marked with a black stripe)

    a. Disconnect the fitting from the head of the Analytical Column
    b. Weave the transfer line from the Column Oven towards the Autosampler and remove

9. Set the old transfer line off to the side and assemble a new transfer line to put in place. (A ferrule will need to be added to the tip of the transfer line and tightened appropriately to get a good fit in the injection port – pay careful attention not to over tighten the fitting.)
10. Connect the other end of the transfer line to the head of the Analytical Column.
11. Check for leaks by flushing the system with methanol.
12. Once it has been determined there are no leaks, attach the safety shield and close the autosampler door. (At this point, the needle housing should start moving around.)
13. Press Enter to return the needle to the injection port.
14. Reactivate the hardware profile.

6. Peek Tubing

Replace the peek tubing as necessary. If the system is showing an elevated pressure, it would be helpful to cut a small portion off of the tubing connected to the Ion Source.

C. Mass Calibration - This is required after cleaning of the QJet and Q0 or annually. See attachment 1 for the instructions.

Attachment:
Attachment 1 - Mass Calibration Instructions (.pdf)

End of document

Version history

Version	Approval	Revision information	
1	10.DEC.2018		
2	12.FEB.2021		
3	07.FEB.2022		

eurofins	Always check on-line for validity. **PFAS Leaching Procedure (TCLP, SPLP) by EPA 1311-Modified and 1312-Modified in Solids and Wastes**	Level: **Work Instruction**
Document number: **T-TL-WI46585**		
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Version: **1**		Organisation level: **5-Sub-BU**
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Revision Log
Reference
Cross Reference
Scope
Basic Principles
Reference Modifications
Interferences
Safety Precautions and Waste Handling
Personnel Training and Qualifications
Sample Collection, Preservation, and Handling
Apparatus and Equipment
Reagents and Standards
Glassware Cleaning
Calibration
Procedure
Calculations
Statistical Information/Method Performance
Quality Assurance/Quality Control

Revision Log

Revision	14	**Effective Date:**	new
Section	**Justification**	**Changes**	
Whole Document	New Document		

Reference

1. *Test Methods for Evaluating Solid Wastes*, SW-846 Method 1311, July 1992.

2. Test Methods for Evaluating Solid Wastes, SW-846 Method 1312, September 1994.

3. *Chemical Hygiene Plan*, current version.

Cross Reference

Document	Document Title
T-TL-WI7143	Glassware Cleaning for Leachate Extractions
T-TL-WI7144	Leachate Blank Evaluations
T-TL-WI7145	Subsampling and Preservation of Leachates
T-TL-FRM7229	Containers, Preservation, and Departments by Analytical Method
T-TL-FRM36652	Entering Leachate Blanks in LIMS

Scope

This procedure is for a modified method for TCLP and SPLP extraction for PFAS analysis. TCLP is designed to determine the mobility of organic and inorganic nonvolatile contaminants in potentially hazardous waste. SPLP is designed to determine the mobility of waste samples under conditions that simulate rainwater percolating through a sample.

Basic Principles

For liquid and semi-solid wastes, the extract is defined as the filtrate resulting from filtration of the waste through a PROPRIETARY filter.

For solid wastes, the extraction fluid used is determined by the type of extraction. The extractions are performed by tumbling over an 18 hour period. Following the extraction, the leachate is filtered through a PROPRIETARY filter.

Reference Modifications

PFAS are not included in the parameter list for the method defined parameter of either the Toxicity Characteristic Leaching Procedure (TCLP) EPA 1311, or the Synthetic Precipitation Leaching Procedure (SPLP) EPA 1312. This extraction method is developed per client request, taking in to account sampling restrictions and PFAS-free materials.

Samples are treated as liquids if they are liquid, or semi-liquid. If a sample appears to be 100% solid, it is processed by the tumbling procedure. Therefore, preliminary percent solids are not determined for this procedure.

PROPRIETARY is used, rather than the 100g minimum aliquot defined by the methods. The same extraction fluid ratios are used.

For client-requested circum-neutral extraction, reagent water is used instead of extraction fluid for LIMS method code SPLP_CIRC_PFAS.

For non-miscible phases, the client-requested phases will be analyzed based off of project/client requirements.

Interferences

Any potential interferences are discussed in the individual analytical methods.

Safety Precautions and Waste Handling

All laboratory waste is accumulated, managed, and disposed of in accordance with all federal, state and local laws and regulations.

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Follow routine safety steps. Special care must be taken when mixing the acid solution. Wear gloves, lab coat, and safety glasses when preparing the solution and handling samples. Read all lab notes and follow instructions carefully. Avoid skin contact or breathing the vapors from any of the reagents or samples. Use the appropriate ventilation system (bench top or hood) when instructed, if the sample looks suspicious (plating waste contains cyanide), or is particularly odoriferous.

If the sample fumes or reacts in any way when the acid is added during the extraction procedure, vent the sample periodically until the reaction is no longer evident.
Discard or send for repair any glassware that is chipped, flawed, or broken.

Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding and agreeing to follow the current version of this SOP and a documented Demonstration of Capability (DOC).

The technician using this method must be trained by qualified personnel and perform these procedures at least twice in that person's presence before they are considered qualified.

Sample Collection, Preservation, and Handling

Samples must not be preserved and are stored at 0°C to 6°C, not frozen.

Samples are collected in PROPRIETARY jars for solid wastes, or PROPRIETARY for liquid wastes. PROPRIETARY of sample are required for this extraction. The holding time is 28 days from sample collection tothe beginning of tumbling, or filtration for a liquid/semi-solid waste.

Apparatus and Equipment

1. Agitation apparatus (tumbler) – This must be an EPA-approved device which is capable of rotating the extraction vessels at 30 ±2 rpm in an end-over-end manner.

2. Extraction vessel – The extraction vessel must be a jar large enough to contain the volume of extraction fluid required (within the limitation of tumbler space). The vessel must be made of Borosilicate glass, Teflon, or PROPRIETARY.

3. Filtration device – PROPRIETARY filtration device with 0.45µm pore size filters

4. Vacuum filtration system – Consisting of a vacuum flask, filter holder, and hose.

5. Beakers – Assorted sizes

6. Stirring hot plates

7. Thermometer – Capable of reading temperatures up to 70°C

8. pH meter – Orion Model 210 or equivalent – Capable of 0.01 pH unit display

9. Watch glasses

10. Graduated cylinders – Class A, assorted sizes

11. PROPRIETARY CONTENT

12. Jug for preparing extraction fluid

13. Balance – Capable of weighing to 0.01 g

14. Dispensette® Bottle-top Dispenser

15. 9.5 mm sieve

Reagents and Standards

NOTE: Reagents used are ACS grade or equivalent. Recipes of standards may be adjusted as long as equivalent ratios are maintained.

1. PROPRIETARY water – water in which an interferent is not observed at or above the reporting limit for PFAS parameters of interest, supplied by PROPRIETARY.

2. Concentrated hydrochloric acid (HCl) - stored at room temperature per manufacturer's expiration date

3. Glacial acetic acid (CH2COOH) – abbreviated as Hac in prep logbook, stored at room temperature per manufacturer's expiration date

4. 10 N sodium hydroxide (NaOH) – purchased, stored at room temperature per manufacturer's expiration date

5. Concentrated nitric acid (HNO3) - stored at room temperature per manufacturer's expiration date

6. Concentrated sulfuric acid (H2SO4) - stored at room temperature per manufacture's expiration date

7. 1 N hydrochloric acid (HCl) : This can be purchased otherwise prepare as directed below

a. Use a graduated cylinder to slowly add 83 mL of concentrated HCl to approximately 500 mL PROPRIETARY water in a 1000-mL volumetric flask.

b. Dilute the solution to volume with PROPRIETARY. Remake every 6 months.

c. Store in a glass bottle at room temperature.

8. 1 N nitric acid (HNO3): This can be purchased otherwise prepare as directed below

a. Use a graduated cylinder to slowly add 64mL of concentrated HNO3 to approximately 500mL PROPRIETARY water in a 1000mL volumetric flask.

b. Dilute the solution to volume with PROPRIETARY water.

c. Remake every 6 months.

d. Store in a glass bottle at room temperature.

9. TCLP Extraction Fluid #1

a. Use a graduated cylinder to add 57 mL of glacial acetic acid to approximately 5000 mL PROPRIETARY water in a 10 L jug.

b. Use a graduated cylinder to add 64.3 mL of 10 N NaOH.

c. Dilute with the solution to volume with PROPRIETARY water.

d. The pH of this fluid must be 4.93 ±0.05.

e. Record the preparation and the pH of the extraction fluid in the appropriate logbook.

f. This solution must be prepared daily.

g. It is acceptable to prepare this solution in other volumes as long as the ratio of acetic acid and NaOH to final volume is maintained.

10. TCLP Extraction Fluid #2

a. Use a graduated cylinder to add 57 mL of glacial acetic acid to approximately 5000 mL PROPRIETARY water in a 10 L jug.

b. Dilute the solution to volume with PROPRIETARY water.

c. The pH of this fluid must be 2.88 ±0.05.

d. Record the preparation and the pH of the extraction fluid in the appropriate logbook.

e. This solution must be prepared daily.

f. It is acceptable to prepare this solution in other volumes as long as the ratio of acetic acid to final volume is maintained.

11. SPLP stock solution (60%H2SO4/40%HNO3)

a. Fill a 100mL volumetric flask with approximately 50 mL of reagent water.

b. Add 6 mL of H2SO4

c. Add 4 mL of HNO3.

d. Bring to volume with reagent water and mix thoroughly.

e. Store at room temperature in a glass bottle for up to 6 months.

12. SPLP Intermediate
a. Fill a 1 L volumetric flask with approximately 500 mL of reagent water.
b. Add 10mL of the SPLP stock solution.
c. Bring to volume with reagent water and mix thoroughly.
d. Store at room temperature in a glass bottle for up to 6 months.

13. SPLP Extraction Fluid #1 - Soil Samples East of Mississippi
a. Prepare enough for each day of use and discard extra.
b. Determine volume needed, and prepare 2 mL of SPLP Intermediate to 1 L total volume With PROPRIETARY water. Alternate volumes are acceptable, the ratio must remain the same.

SPLP Intermediate (mL)	Final Volume (L)
1	0.5
2	1
4	2
10	5

c. Mix thoroughly

d. Determine the pH of the fluid. The pH must be 4.2 +/- 0.05. Record the preparation and pH in the appropriate logbook.

14. SPLP Extraction Fluid #2 - Soil Samples West of Mississippi
    a. Prepare enough for each day of use and discard extra.
    b. Determine volume needed, and prepare 3mL of SPLP Intermediate to 10L total volume With PROPRIETARY water. Alternative volumes are acceptable, the ratio must remain the same.

SPLP Intermediate (mL)	Final Volume (L)
1.5	5
3	10

c. Mix thoroughly

d. Determine the pH of the fluid. The pH must be 5.00 +/- 0.05. Record the preparation and pH in the appropriate logbook.

15. SPLP Extraction Fluid #3

a. PROPRIETARY water is used as extraction fluid for SPLP extractions of wastes or soils for circum-neutral extractions per client request (1311_CIRC_PFAS)

Glassware Cleaning

See *T-TL-WI7143*.

Calibration

Not applicable to this procedure

Procedure

A. Liquid and semi-liquid wastes

1. Filter the waste through the PROPRIETARY filter. The filtrate is defined as the TCLP/SPLP extract.

2. Determine and record the pH of this extract in the Initial pH column in LIMS.

3. The filtrate is considered the leachate. Enter any appropriate comments on sample matrix and appearance.

B. Solid waste samples

1. Determine if particle reduction is required.

a. Reduce the solid portion to a particle size of >/= 1cm in diameter, if necessary, using a sieve. Record "Y" in Particle Size Reduction in LIMS.

b. When a sieve is used for reducing particle size, pour the extraction fluid to be used for the batch blank through the sieve and into the blank vessel to check for cleanliness. Record "Y" in Particle Size Reduction in LIMS.

2. Weigh out PROPRIETARY of sample. Record the balance ID in Batch Information. Record the weightof the sample in LIMS.

3. Determine the extraction fluid required for the solid portion of the waste.

TCLP (1311_PFAS)

a. Weigh out 5.0 to 5.1g of the solid portion into a 150 or 250 mL beaker using a 1mm sieve if sample particle reduction is necessary.

b. Add 96.5 mL reagent water and stir for 5 minutes. Measure and record the pH. If the pH is <5.0, go to step 3 of this section and use TCLP Extraction Fluid 1.

c. If the pH is >/= 5.0, use a pipette or bottle-top dispenser to add 3.5 mL 1 N HCL to beaker, cover with a watch glass, and heat on a hot plate to 45-54 degC. The temperature must then be maintained at 45-54 degC for 10 minutes. Record the thermometer ID in the logbook.

d. Cool the slurry to room temperature. Measure the pH and record. If the pH is <5.0, use Extraction Fluid #1. If the pH is still >/= 5.0, use TCLP Extraction Fluid 2.

SPLP (1312_E_PFAS, 1312_W_PFAS)

e. SPLP Extraction Fluid #1 is for all solid samples east of the Mississippi River (1312_E_PFAS), and waste and wastewater samples (i.e. non-soils)

f. SPLP Extraction Fluid #2 is for all solid samples west of the Mississippi River (1312_W_PFAS)

SPLP (1312_CIRC_PFAS)

g. SPLP Extraction Fluid #3 is reagent water, for samples receiving circum-neutral extraction by client request.

4. Use a graduated cylinder to slowly add the appropriate extraction fluid at a volume 20X the weight of the solid. Record the Extraction Fluid ID and volume used in LIMS.

5. Close the extraction bottle tightly, and place in a tumbler (rotating 30 +/- 2rpm) for 18 +/- 2hours. Record the ID of the tumbler and the start time in LIMS. Ambient temperature must be maintained at 23 degC +/- 2 degC (69.8 degF-77.0 degF) during the extraction period.

6. Following the 18 +/- 2 hours extraction, filter the solution through a PROPRIETARY filter. The filters can be changed if necessary.

7. Measure and record the Leachate pH of the extract in LIMS.

8. Subsample into two 250mL HDPE bottles.

C. If there are non-miscible phases of liquid (i.e. cannot be combined):

1. Contact your supervisor and the PM for guidance. Follow client request (multiple analyses of the phases, combination of the phases, or analysis of one of the phases).

2. Document the action taken via a NonConformance Memo (NCM) in LIMS. Document the phase(s) supplied to the analytical department for analysis, and the volume of each phase.

Calculations

Not applicable for this procedure.

Statistical Information/Method Performance

See specific analysis method.

Quality Assurance/Quality Control

1. A new matrix batch must be prepared each day samples are leached. Batches must not be continued. Therefore, each matrix is a new batch each day.

2. An extraction fluid tumble blank (identified in LIMS as a LB) must be prepared for each extraction fluid used per day. A blank must be started for each 20 samples with the same fluid type. A sieve test must be performed on a blank if any of the samples on a batch are sieved. When filtering the blank after tumbling, if any samples associated with that blank are pressure filtered, the blank must be pressure filtered also to check for cleanliness of the apparatus.

3. Extraction of the solid phase must be initiated as soon as possible after initial filtration.

4. All instruments used in this procedure (i.e., pH meter and balance) must be calibrated according to an approved laboratory plan.

5. All quality control measures described in the appropriate analytical methods must be followed.

Attachment:
Figure 1 (.xls)

T-TL-FRM36652 Entering Leachate Blanks in LIMS
T-TL-FRM7229 Leachates - Containers, Preservation, and Departments by Analytical Method
T-TL-WI7143 Glassware Cleaning for Leachate Extractions
T-TL-WI7144 Leachate Blank Evaluations
T-TL-WI7145 Subsampling and Preservation of Leachates - ASTM D3987-12/85, EPA 1311, and EPA 1312

End of document

eurofins	Always check on-line for validity. **PFAS Leaching Procedure (TCLP, SPLP) by EPA 1311-Modified and 1312-Modified in Solids and Wastes**	Level: **Work Instruction**
Document number: **T-TL-WI46585**		
Old Reference: **NA**		
Version: **1**		Organisation level: **5-Sub-BU**
Approved by: **X6TJ** Effective Date **11-NOV-2021**	Document users: **5_EUUSLA_Leachate Preparation_All**	Responsible: **5_EUUSLA_Leachate Preparation_Manager**

Version history

Version	Approval	Revision information	
1	11.NOV.2021		

APPENDIX G

TI-SDC STANDARD OPERATING PROCEDURES

Standard Operating Procedure No. 1

Water Level Measurement

Revision:___1.0_____

Reviewed:___12/15/2021_____

Reviewer: 

Ben Headington, PMP

SOP No. 1 – Water Level Measurement

1.0 OBJECTIVE

The purpose of this document is to define the standard operating procedure (SOP) for measuring water elevations in monitoring wells included in environmental monitoring programs. This procedure describes equipment and field procedures necessary to collect water elevation measurements. The well locations and frequency of measurement are specified in project-specific work plans and QAPPs.

2.0 EQUIPMENT AND MATERIALS

The equipment and materials necessary that may be used to measure water levels include:

- Electronic water level indicator capable of producing measurements to a precision of 0.01 feet
- 5 gallon buckets or equivalent for decontamination
- Brushes for decontamination
- Water Level Measurement Form or Groundwater Sampling Form
- Field notebook
- Chemical-free paper towels or Kimwipes
- Alconox soap
- Potable water
- Garden-type spray bottle filled with deionized or distilled water
- Appropriate health and safety equipment

3.0 WATER ELEVATION MEASUREMENT PROCEDURE

3.1 DISCUSSION

Generally, water elevation measurements are used to construct potentiometric surface maps. Therefore, water level measurements at a given site should be collected within a 24 hour period. The device used to measure water levels should be adequate to attain an accuracy of 0.01 feet. Water levels should be allowed to stabilize for a minimum of 24 hours after well construction and development before measurements are taken.

3.2 MEASUREMENT PROCEDURE

This section gives the steps to follow when measuring water levels. Note that appropriate health and safety steps should be implemented and health and safety equipment should be worn during well opening, well measurement, and decontamination.

- Before any measurement is taken, the water level indicator shall be decontaminated. Decontamination procedures are discussed in SOP – Sampling Equipment Decontamination.
- Confirm that the monitoring well is labeled and the location ID is visible on the protective casing and that the ID coincides with the expected location.

- After opening the well cover, measure the depth of the static water level and the total depth of the well using an electronic water level indicator. The measuring point for all the wells shall be the top of PVC or steel well casing. The measuring point will be marked by a notch or other mark in the PVC or steel casing. If no mark is present, measure from the top of the north side of the casing.
- The static water level and the depth of the well shall be measured with the indicator, logged on the field data sheet or field notebook as feet below top of casing (ft.-TOC), and verified before the indicator is removed from the well. Note any significant changes in water level, by comparing the most recent measurement with past measurements, if appropriate. The depth of the well shall be determined by noting a loss in weight of the dropped sensor as well as an accumulation of slack in the tape. The depth recorded shall be compared to the well construction details for confirmation.
- The water level depth below the measuring point (ft.-TOC) will be subtracted from the measuring point elevation to determine the elevation of the static water level. If measuring point elevations are available at the time of water level measurement, the calculated water elevation (ft.-MSL) should be checked in the field to see that it is reasonable and the subtraction was performed correctly. If there is a significant discrepancy in the measured water level or calculated water elevation, the well should be measured again.
- All columns of field data sheets shall be completed, including time of measurement. If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). A sample field data sheet for water elevation measurement is shown (Figure 1).

3.3 DECONTAMINATION

The water level indicator must be decontaminated before use, between wells, and at the conclusion of measurements. The probe will be decontaminated according to the procedure for decontamination of sampling equipment described in SOP – Sampling Equipment Decontamination.

4.0 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets.

4.1 FIELD DATA SHEET FOR WATER LEVEL MEASUREMENTS

A field sampling data sheet for groundwater samples will be completed at each sampling location (sample attached). If items on the sheet do not apply to a specific location, the item will be labeled as not applicable (NA). The information on the data sheet includes the following:

SOP No. 1 – Water Level Measurement

- Well number
- Field book reference number
- Field personnel
- Well I.D.
- Date and time of measurements
- Sample identification number
- Water level (ft.-TOC)
- Static Water Elevation Data

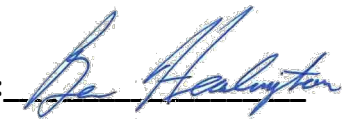
The measurement point elevation (ft.-MSL) should be filled in if it has been determined at the time of measurement. If it is not known the form will be completed at a later time when further information is available. Any irregularities or problems that may have a bearing on sampling quality should be noted in the field.

Standard Operating Procedure No. 2

Groundwater Sampling

Revision:___1.0_____

Reviewed:___12/15/2021_____

Reviewer: 

Ben Headington, PMP

SOP No. 2 – Groundwater Sampling

MONITORING WELL SAMPLING

1.0 OBJECTIVE

The purpose of this document is to define the standard operating procedure (SOP) for measuring collecting groundwater samples during environmental monitoring programs. This procedure describes equipment and field procedures necessary to collect groundwater samples using several methods. Procedures for groundwater sampling from a monitoring well are designed to obtain a sample for chemical analysis that is representative of natural aquifer conditions. Samples will be collected using disposable bailers or low-flow electric or pneumatic pumps.

2.0 METHODOLOGY

2.1 LOW-FLOW SAMPLING USING A SUBMERSIBLE PUMP

Low-flow purging is the preferred method because it results in (1) minimal loss of VOCs, (2) minimal mixing of chemically distinct zones, (3) minimal production of artificial turbidity and oxidation, and (4) minimal production of potentially contaminated purge water. The micropurging procedures described in this section are adapted from those procedures recommended by the *EPA in Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (EPA 1996)*.

Low-flow purging will be conducted using an electric submersible pump, or bladder pump, equipped with a positive-foot check valve to prevent purge water from flowing back into the well. Teflon®-lined polyethylene tubing will be used for each monitor well. The water quality parameters listed in Table 1 will be regularly measured during purging. All water quality monitoring instruments will be calibrated and measurements collected in accordance with the procedures specified in SOP – Instrument Calibration.

The following procedure will be used when purging wells using the low-flow method.

1. Decontaminate any equipment (i.e., water level indicators, pumps, and down-well probes) before placing in the well in accordance with the procedures specified in SOP – Sampling Equipment Decontamination.
2. Measure the water level in the well in accordance with the procedure described in SOP – Water Level Measurement, before beginning purging. Record the water level on the Monitor Well Sampling Form. Do not measure the total well depth before low-flow sampling so that any sediment in the bottom of the well, if present, will not be disturbed and entrained in the water column.
3. Lower the pump into the well in a controlled manner until the pump intake is situated at the approximate midpoint of the saturated screened interval, as determined from well completion logs, or midpoint of saturated screen interval (information concerning total depth of well and screened interval can be obtained from the Monitoring Well

Construction Form for each well). Do not allow the pump to touch or settle on the well bottom to prevent excess agitation and entrainment of sediment that may have accumulated in the bottom of the well.

4. Start the pump and determine the pumping rate by measuring the time required to fill a calibrated container. Adjust the pumping rate so that is does not exceed 0.5 liter (0.13 gallon) per minute in order to minimize the potential for stagnant water to be drawn into the pump intake.
5. Verify that the pumping rate is low enough by measuring the water level in the well every 3 to 5 minutes during purging. Adjust the pumping rate to maintain a drawdown of the water from the pre-sampling level at less than 0.1 meter (0.3 foot), if possible. When parameters are collected within in-line flow-through cells, the frequency of measurements shall be equal to the time required to provide complete exchange of the cell volume. If the drawdown cannot be maintained at less than 0.1 meter (0.3 foot) by reducing the pumping rate, note the condition on the Monitoring Well Sampling Form and continue to purge the well until (1) parameters and drawdown stabilize, (2) parameters stabilize and three casing volumes are removed, or (3) the well is purged dry.
6. Measure water quality parameters (as indicated in Table 1) at the start of purging and then every 3 to 5 minutes thereafter to determine when the well has been adequately purged, as discussed below.
7. Purge the well until either (1) the water quality parameters stabilize over three consecutive readings, (2) three casing volumes of water are removed, (3) the well is purged dry, (4) or the well has been pumped for at least 2 hours without drawdown. The stabilization criteria and proposed measurement methods for each of the parameters is presented in Table 1. If the well is purged dry, samples from the well can be collected when a sufficient volume of water has recharged to begin filling sample containers.
8. Collect samples as described in Sample Collection section below.
9. Following sample collection, measure the depth of the well by noting a loss in weight of the dropped sensor as well as an accumulation of slack in the tape. The depth recorded shall be compared to the well construction details for confirmation."
10. Sample containers will be labeled, and packed on ice for shipment to the analytical laboratory under appropriate chain of custody protocol and SOP – Sample Handling and Management.
11. Contain and handle all purge water removed from well in accordance with the IDW management procedures specified in SOP – IDW Management.
12. Decontaminate all sampling and drilling equipment per SOP – Sampling Equipment Decontamination.

Table 1
WATER QUALITY PARAMETER STABILIZATION CRITERIA
AND PROPOSED MEASUREMENT METHODS

Parameter	Stabilization Criteria	Measurement Method[1]
Dissolved Oxygen	± 10 percent	Water quality meter
pH	± 0.2 units	Water quality meter
Specific Conductance	± 10 percent	Water quality meter
Temperature	± 10 percent	Water quality meter
Oxidation-reduction potential (ORP)	± 10 percent (or ± 10 units)	Water quality meter
Turbidity	50 NTU (or ± 10 percent)[1]	Water quality meter

Notes:

1 When possible, dissolved oxygen and ORP should be measured with a flow-through cell or down-well probe to avoid atmospheric influences. Other parameters may be measured using a flow-through cell or alternate method (i.e., Horiba U10 or equivalent).
2 For Turbidity, three consecutive readings within 10 percent is acceptable if the 5 NTU turbidity goal cannot be reasonably achieved. For ORP, ± 10 units is acceptable if ± 10% cannot be achieved (i.e., ORP is very close to zero and therefore ± 10% of the current reading is a very small number compared with the total ORP range).

NTU Nephelometric turbidity units

2.2 SAMPLING USING A BAILER

In the event that a monitor well cannot be purged using a submersible (or equivalent) pump, the alternate method will be to purge the well using a bailer. A new Teflon® bailer, equipped with new nylon line, will be used for purging each monitor well. Water quality parameters, as indicated in Table 1, will be regularly measured during purging. All water quality monitoring instruments will be calibrated and measurements collected in accordance with the procedures specified in SOP – Equipment Calibration.

The following procedure will be used when purging wells using the bailing method:

1. Measure the water level and total well depth in accordance with the procedures specified in SOP – Water Level Measurement before beginning purging. Record the water level and total depth on the Monitor Well Sampling Form.
2. Determine the height of the water column in the well by subtracting the depth to water from the total depth of the well. Record the water column height on the Monitor Well Sampling Form.

3. Calculate the well casing volume and enter it on the form. The casing volume is calculated as:

$$V = H \times F$$

Where:

V = one casing volume (gallons)

H = height of water in well (total well depth – depth to water) (feet)

F = water volume per foot of well casing (gallons/foot)

The volume of water per foot of well casing (F) can be calculated as:

$$F = \pi (d/2)^2 \times 7.48 \text{ gallon/foot}^3$$

Where d is the inside diameter (in feet) of the well casing.

4. Calculate the total purge volume as three times the casing volume (3V). Enter this quantity on the sampling form.
5. Measure water quality (as indicated in Table 1) at the start of purging and then every casing volume thereafter to determine when the well has been adequately purged, as discussed below. Monitor the water volume purged from the well by filling a calibrated container, such as a five-gallon bucket.
6. Purge the well until (1) the water quality parameters stabilize over three consecutive readings and a minimum of three casing volumes of water have been removed from the well, or (2) the well is purged dry. The stabilization criteria and proposed measurement methods for each of the parameters are presented in Table 1. If a well is purged dry, samples from the well will be collected as described in the Sample Collection section, when a sufficient volume of water has recharged to begin filling sample containers.
7. Sample containers will be labeled, and packed on ice for shipment to the analytical laboratory under appropriate chain of custody protocol and SOP – Sample Handling and Management.
8. Contain and handle all purge water in accordance with the IDW management procedures specified in SOP – IDW Management.

2.2.1 Sample Collection

Purging and sample collection will not be conducted within 24 hours of monitoring well development. Groundwater samples will be collected by pumping water through the discharge tubing (or pouring from the bailer) directly into the sample containers. The discharge tubing will not be allowed to contact the sample container.

Before collecting groundwater samples, the sampler will don clean, nitrile gloves. Samples will be collected using a submersible (or equivalent) pump (or bailer if appropriate).

SOP No. 2 – Groundwater Sampling

In general, samples will be collected for laboratory analysis from the most volatile to the least volatile. The specific order of sample collection will be as follows:

- VOCs
- Other organic compounds
- Inorganic compounds
- Metals
- Other analyses

Required sample containers, preservation methods, volumes, and holding times are given in the QAPP. Field parameters will be measured as described in Table 1. Sampling equipment will be decontaminated in accordance with SOP – Sample Equipment Decontamination.

If dense nonaqueous phase liquids (DNAPLs) are suspected, a bailer will be lowered to the bottom of the well before purging, retrieved, and observed for the presence of DNAPLs. Disposable nylon rope will be used to lower and retrieve the bailers. A new length of nylon rope will be used for each well, and the rope will be disposed of following the sampling activities. Each bailer will be equipped with a dedicated stainless steel- or Teflon-coated leader so that the nylon rope will not contact the water in the well.

The sample will be collected from the pump using a slow, controlled pour down the side of tilted sample vial to minimize volatilization. When collecting samples for VOCs, the pump discharge rate should be kept low, preferably 0.1 to 0.3 L/min. When sampling for VOCs, the sample vial will be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it will be inverted and gently tapped to ensure no air bubbles are present in the vial. If after the initial filling bubbles are present, the vials will be discarded and the VOC sampling effort will be repeated. Refilling of vials will result in loss of preservatives. After the containers are sealed, sample degassing may cause bubbles to form. These bubbles will be left in the container. These samples will never be composited, homogenized, or filtered.

If filtered groundwater is being collected for metals analysis, a 0.45-micron filter shall be attached in-line to the water discharge line prior to sample collection.

Sample containers will be labeled, and packed on ice for shipment to the analytical laboratory under appropriate chain of custody protocol and SOP – Sample Handling and Management.

2.3 SAMPLING GROUNDWATER WELLS USING A PASSIVE DIFFUSION SAMPLER

A passive diffusion sampler (PDS) consists of low-density polyethylene (LDPE) tubing, containing laboratory-grade water, and sealed at both ends. LDPE is permeable to some types of volatile organic compounds (VOCs). Therefore, VOCs in groundwater (if present) will diffuse through the LDPE and into the laboratory-grade water until the VOC concentration within the PDS is in equilibrium with the VOC concentration in the surrounding groundwater. PDS' will be placed in the selected wells a minimum of two weeks prior to the start of the quarterly sampling event. PDS' may either be prepared in the field by the LTM contractor or may be obtained, already constructed, from an analytical laboratory.

SOP No. 2 – Groundwater Sampling

The following procedure will be used if PDS' are prepared in the field:

- Two-inch diameter flat LDPE tubing will be cut into 18 inch long pieces using a clean oil-free blade and heat-sealed on one end to form tubes.
- The tubes will be filled with ASTM water, being careful to avoid large air bubbles.
- The open ends of the tubes will be heat-sealed on a diagonal line (for ease of pouring later).
- The tubes may be encased with LDPE mesh tubing to provide abrasion resistance.
- The PDS' should be malleable enough to bend at least 90 degrees without bursting and have approximately 12 to 13 inches of ASTM water enclosed. Samplers not meeting this standard, or leaking samplers, will be discarded.
- The constructed samplers will be stored in a clean container for transport to wells for installation.

PDS' will be hung from a measured length of nylon rope or stainless steel cable sufficient to situate the middle of the sampler at the approximate midpoint of the well screen (if the water table is above the top of the well screen), or at the midpoint of the water column zone (if the water table is below the top of the well screen). A brass or stainless steel weight will be hung from the bottom of the PDS to prevent the sampler from floating above the desired sample interval. Multiple PDS' may be used if additional sample volume is required for quality control samples. The well cover will be closed and the PDS left in the well until the next scheduled sampling event, or for a minimum of two weeks before sample collection.

PDS' will be removed and the tubes cut open along the diagonal heat-seal with a clean blade. The contents of the tubes will be slowly poured into 40 mL vials to reduce sample agitation. Sample containers will be labeled, and packed on ice for shipment to the analytical laboratory under appropriate chain of custody protocol and SOP – Sample Handling and Management.

After retrieving the PDS from the well, the person(s) collecting the sample will record one measurement of field parameters by lowering the field parameter sensor with a protective sleeve down into the well so that it is at least five feet below the water surface. The person(s) will wait at least two minutes before recording each of the parameters, including: pH, ORP, temperature, dissolved oxygen, and specific conductance.

SAMPLING WITH DIRECT PUSH

1.0 OBJECTIVE

Direct push (DPT) sampling involves advancing a sampling probe to a desired depth to collect a groundwater sample. Procedures will be followed to ensure that samples collected are representative of the groundwater within a specific interval. Due to the narrow diameter of the DPT borings, direct push locations will be sampled using a portable low-flow peristaltic pump or disposable bailer.

SOP No. 2 – Groundwater Sampling

2.0 EQUIPMENT AND MATERIALS

- Portable low-flow peristaltic purge/sample pump with polyethylene and silicon tubing
- Electronic water level indicator
- Multi-parameter water quality meter
- Decontamination supplies
- Sample containers, preservatives, coolers, sample labels, and ice (as specified in the QAPP)
- Groundwater sampling forms and chain-of-custody forms
- Waste containers as specified in Work Plan
- Health and safety equipment as specified in the Site-Specific Health and Safety Plan

3.0 METHODOLOGY

1. Ensure that sample equipment is operating properly and calibrated by following the equipment manuals provided by the equipment manufacturer.
2. Ensure that all DPT and sampling equipment has been properly decontaminated (SOP – Sampling Equipment Decontamination)
3. Using the DPT drill rig, advance a sample probe by direct hydraulic pressure or by using a slide or rotary hammer, to the desired depth.
4. When the probe is at the proper depth, raise the tooling to open the sample port of the sample probe.
5. Measure the depth to water and total probe depth with a decontaminated electronic water level indicator and record on Groundwater Sampling Form (See SOP – Water Level Measurement).
6. Insert disposable polyethylene tubing through the drill tooling to the screened interval and withdraw groundwater using the peristaltic pump.
7. Collect the appropriate analytical samples including quality assurance/quality control (QA/QC) samples as specified in the QAPP, collecting VOC samples first VOC samples may be collected using a disposable bailer). If air bubbles or gaps of air within the sample line are observed, the pumping rate will be reduced and the sample line will be shielded from direct sunlight in an effort to minimize or eliminate air in the line.
8. Collect additional sample and measure and record field parameters as described in Table 1.
9. If a sufficient amount of water is not has not recharged into the boring to allow for collection of a complete set of samples, a temporary well may be set so the boring can be sampled when sufficient water has entered the boring.
10. Sample containers will be labeled, and packed on ice for shipment to the analytical laboratory under appropriate chain of custody protocol and SOP – Sample Handling and Management.
11. After the sample has been collected, remove the drill tooling or temporary well from the boring and abandon the borehole (See SOP – Borehole Abandonment).
12. Contain and handle all purge water removed from well in accordance with the IDW management procedures specified in SOP – IDW Management.

13. Decontaminate all sampling and drilling equipment per SOP – Sampling Equipment Decontamination.

Standard Operating Procedure No. 3

Sample Handling and Management

Revision:___1.0_____

Reviewed:___5/15/2020_____

Reviewer: 

Ben Headington, PMP

SOP No. 3 – Sample Handling and Management

1.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for sample management including sample handling, documentation, and analysis for environmental samples collected for chemical analyses including: sediment, soil, surface water and groundwater. This procedure is intended to be used together with the other SOPs.

2.0 EQUIPMENT AND MATERIALS

The following equipment will be used for sample management:

- Shipping forms
- Sample containers
- Ziploc bags
- Ice
- Tape (clear and strapping)
- Scissors/knife
- Cooler/ice chest
- Custody seal
- Garbage bags
- Waterproof Pens
- Chain of Custody (COC) Forms
- Sample Labels
- Logbook
- Gloves
- Preservative (if necessary)
- Packing material
- Trip blank (as necessary)
- Temperature blank

3.0 PROCEDURES FOR SAMPLE HANDLING, DOCUMENTATION, AND ANALYSIS

3.1 SAMPLE LABELING

All sample labels should be filled out with waterproof ink. Soil and water sample labels may be supplied by the laboratory. For soil and sediment samples collected in jars and sample bottles for groundwater and surface water analyses, sample labels may be completed and attached prior to sample collection. Labels may be partially completed prior to sample collection. The date and time should not be completed until the time of sample collection. At a minimum, each label shall contain the following information:

- Project/Facility Name
- Grab or composite sample
- Sampler's company affiliation
- Date and time of sample collection
- Analyses required
- Preservation used
- Sampler's initials
- Filtered (if applicable)
- Sample identification (see Section 5.2 below)

3.2 SAMPLE NOMENCLATURE SCHEME

The sample identification (ID) varies significantly with each project. At minimum the sample ID should contain enough information to be correctly associated with a specific sampling location. The sample ID shall also be recorded on the sample form for the respective location. Additionally, Quality Control/Quality Assurance (QA/QC) samples should contain a sample ID such that the laboratory would not know it is a QA/QC sample.

3.3 SAMPLE HANDLING

This section discusses proper sample containers, preservatives, and handling and shipping procedures. The QAPP also summarize the information contained in this section and also includes the sample holding times for each analysis.

3.3.1 Sample Containers

Certified, commercially clean sample containers shall be obtained from the contract analytical lab. If appropriate, the bottles shall be labeled by the laboratory to indicate the type of sample to be collected. Required preservatives shall be prepared and placed in the bottles for aqueous analyses at the laboratory prior to shipment to the site.

3.3.2 Sample Preservation

With the exception of samples that are to be hand-delivered to the laboratory during the day of sample collection, samples will be stored on ice to obtain a temperature of 4ºC in an insulated cooler immediately following sample collection. Samples delivered to the laboratory during the day of sample collection are acceptable if they have been placed on ice in an insulated cooler but have not yet reached a temperature of 4ºC. Soil and sediment samples do not require additional preservation. As noted above, sample containers for aqueous samples will be obtained from the laboratory containing the appropriate preservatives.

3.4 SAMPLE SHIPPING

Sample containers will wrapped in protective packing material (if appropriate). Samples will then be placed in a cooler with ice for shipment to the laboratory. The drain on the cooler shall be taped shut. Samples collected in glass containers will be packed in foam liners and/or bubble wrap to ensure that no breakage occurs during shipment. A temperature blank will be included in each cooler. Samples will be sent to the analytical laboratory via Federal Express or equivalent. Shipping receipts should be retained for documentation and sample tracking.

A completed chain-of-custody (COC) form for each cooler will be placed in a Ziploc bag and taped to the inside of the cooler lid. Coolers will be wrapped with packing tape at two locations to secure lids. Signed and dated custody seals shall be placed on the outside of each cooler in two places in such a manner as to allow detection of tampering (e.g., the seals must be broken to open the cooler).

3.5 HOLDING TIME REQUIREMENTS

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest, stability factors, and preservation methods. Allowable holding times for chemical analysis parameters are listed in the QAPP. Samples should be sent to the laboratory after collection in sufficient time to allow the laboratory to meet holding time requirements.

4.0 QUALITY CONTROL REQUIREMENTS

QC requirements relevant to analysis of environmental samples shall be followed during analytical activities to meet the quality objectives and criteria. The purpose of the QC program is to produce data of known and documented quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis.

4.1 QC SAMPLES

A number of QC samples will be employed to assess various data quality parameters, such as representativeness of the environmental samples, the precision of sample collection and handling procedures, the thoroughness of the field equipment decontamination procedures, and the accuracy of laboratory analysis. Types of QC samples are discussed below.

4.1.1 Matrix Spike/Matrix Spike Duplicate

Matrix spike (MS) and matrix spike duplicate (MSD) samples are prepared by spiking additional aliquots of sample with known concentrations of all project target analytes.

The sample to be used for the MS/MSD analyses shall be designated on the chain of custody and additional sample volume shall be submitted, as necessary. The MS/MSD results are used to document the bias of a method due to sample matrix. Consequently, MSs and MSDs are not used to control the analytical process. Minimum numbers of MS and one MSD samples are indicated in the project-specific QAPP, generally one for every 20 environmental samples of a

given matrix. Alternately, a laboratory may prepare and analyze a MS sample and a laboratory duplicate sample as discussed below. Analysis of a MS/MSD or MS/LD sample set to assess matrix effects on accuracy and precision is typically dependent on the analyte class (e.g., inorganic vs. organic) and the likelihood of detecting the target analyte.

4.1.2 Rinsate Blank

A rinsate blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. ASTM Type II reagent grade water obtained from the laboratory is used to prepare the rinsate blank sample. Rinsate blanks are used to assess the effectiveness of equipment decontamination procedures used to prevent cross-contamination between sampling locations. The frequency of collection for rinsate blanks is indicated in the project-specific QAPP, generally a minimum of 1 rinsate blank for every 20 environmental samples collected with a given type of sampling equipment, and only for sampling equipment which is decontaminated and reused to collect environmental samples. Rinsate blanks will be prepared in a manner identical to samples and shall be analyzed for all laboratory analyses requested for the environmental samples collected at the site using the subject equipment. Rinsate blanks are not necessary for disposable or dedicated sampling equipment.

4.1.3 Trip Blank

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled in the same manner as an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank shall accompany each cooler containing samples for VOC analysis that is sent to the laboratory.

4.1.4 Field Duplicates

A field duplicate sample is a second, discrete sample volume collected at the same location as the original sample (homogenization is not performed between the original sample and the field duplicate). Aqueous field duplicate samples are collected from successive volumes from the same sample source and device (e.g., bailers). Sediment and soil field duplicates are collected in succession from the same sample source and device. Individual analytes for the primary and duplicate groundwater samples are to be collected in order (e.g. VOC primary then VOC duplicate, etc.) so that a long period of time does not pass between collection of each analyte. Field duplicate samples are collected using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as field duplicate samples by laboratory personnel performing the analysis.

Field duplicate sample results are used to assess precision of the sample collection process and the heterogeneity of the medium sampled. The frequency of collection for field duplicates is

indicated in the project-specific QAPP, generally a minimum of one field duplicate sample from each group of 10 environmental samples of a given matrix. Specific locations for collection of field duplicate samples may be designated prior to the beginning of sample collection.

5.0 DOCUMENTATION AND TRACKING

5.1 FIELD NOTES

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages and, if applicable, on field sampling data sheets.

The information in the field logbook will include the following as a minimum. Unless information is recorded on a field sample collection form and that form is cross referenced in the logbook entry. Additional information is included in the specific SOPs regarding the appropriate data sheets.

- Project name
- Location of sample
- Sampler's signature
- Date and time of sample collection
- Sample identification numbers and sample depth (if applicable)
- Description of samples (matrix sampled), composite or grab sample
- Description of QA/QC samples (if collected)
- Sample methods or reference to the appropriate SOP
- Field observations
- Decontamination information
- Calibration information
- Personnel present
- Method of shipment
- Any deviations from SOPs
- Any information pertaining to the sample that is not noted of the sample form.

If samples are held for an extended period of time (i.e., inadvertently missed Fed-Ex pick up), field personnel will document all sample handling and custody in the field logbook.

5.2 CHAIN-OF-CUSTODY FORM

A record of each sample collected will be indicated on a COC form. Every sample in the coolers shall be covered by the COC form(s) accompanying the coolers. Coolers may contain a single COC covering only the samples in that cooler or may contain copies of the COC that covers all of the samples in all of the coolers. One cooler must contain the original COC. The COC form will

provide an accurate written record which can be used to trace the custody of all samples from the time of collection through data analyses and reporting.

The following will be specified for each sample on the COC form as a minimum:

- Sample ID
- Sample date
- Sample time
- Requested analysis
- Number of containers
- Sampler's signature or initials
- Preservation technique
- Sample type (i.e., medium)

Also recorded on the COC is the signature of the person relinquishing custody, the date and time that custody was relinquished, the name and address of the laboratory, and the name and phone number of a contact person regarding the shipment.

A sample is considered in custody if it is:

1. In one's actual possession
2. In view, after being in physical possession
3. Locked so that no one can tamper with it, after having been in physical custody
4. In a secured area

The person responsible for custody of the sample prior to delivery of the samples to the laboratory will sign the COC form, retain the last copy of the three-part COC form, document the method of shipment, and send the original and the second copy of the COC form with the sample (taped in a Ziploc bag to inner cooler lid). Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the Project Manager or Quality Assurance Manager or specified designee. Copies of the COC forms and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory may dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent to the Project Manager or Quality Assurance Manager or specified designee by the analytical laboratory to be incorporated into the central files.

Standard Operating Procedure No. 4

Sampling Equipment Decontamination

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Ben Headington, PMP

SOP No. 4 – Sampling Equipment Decontamination

1.0 OBJECTIVE

Decontamination is performed as a quality assurance measure and safety precaution. It helps prevent cross-contamination among samples and helps maintain a clean working environment for the safety of field personnel.

2.0 EQUIPMENT AND MATERIALS

- Cleaning liquids such as soap or detergent solutions (Alconox or equivalent), potable water
- Ultra-filtered deionized water
- Laboratory-grade deionized water
- Cleaning brushes
- Cleaning containers, such as plastic buckets or tubs
- Pump sprayers for dispensing rinse waters
- A high-pressure hot water sprayer for cleaning large equipment (e.g., drill rods)
- Waste containers
- Health and safety equipment as outlined in the Site-Specific Health and Safety Plan

3.0 METHODOLOGY

Small, reusable equipment is decontaminated primarily by rinsing with liquids that include soap or detergent solutions, potable water, and distilled water. Steam cleaning may he used whenever visible contamination exists on large machinery or vehicles. Following decontamination, if the equipment is not to be reused immediately, it should be stored and protected from recontamination.

The drill rig and used equipment will be decontaminated prior to arrival at Site. It will be the driller's responsibility to ensure this practice is implemented. Prior to the start of intrusive activities, the rig will be inspected upon arrival and decontaminated prior to leaving the Site.

3.1 PRE-SAMPLING DECONTAMINATION ACTIVITIES

1. Don the appropriate personal protective equipment, including nitrile gloves, as specified in the Site-Specific Health and Safety Plan and as required for the specific work area.
2. Assemble containers and equipment for decontamination.
3. Decontaminate new equipment or equipment not previously decontaminated before use. Disposable equipment, including polyethylene tubing and bailers, do not require decontamination prior to use.
4. Rinse equipment not previously decontaminated and appropriately protect from recontamination before the next use.

SOP No. 4 – Sampling Equipment Decontamination

3.2 DECONTAMINATING SAMPLING EQUIPMENT

1. Remove solid particles from the equipment or material by brushing and rinsing with potable water. This will remove gross contamination.
2. Disassemble sampling equipment (bladder pump, if applicable) and discard used bladder.
3. Place equipment into a phosphate-free detergent solution (Alconox or similar laboratory detergent).
4. Wash equipment with a brush and a phosphate-free detergent solution (Alconox or similar laboratory detergent).
5. Rinse equipment thoroughly with potable water.
6. Triple rinse the equipment with distilled water.
    a. Ultrafiltered deionized water will be used for collection of equipment rinsate blanks inorganic analysis
    b. Laboratory-grade deionized water will be used for collection of equipment rinsate blanks organic analyses.
7. Unless the equipment is going to be used immediately protect it from recontamination before the next use.

3.3 DECONTAMINATING LARGE EQUIPMENT

Drilling equipment (rigs, drill rods, augers, rods, bits, casing, screen. etc.), downhole logging equipment, and other large pieces of field equipment may be high-pressure steam-cleaned before and after use. Steam cleaning will be performed at an appropriate decontamination area specified by the field supervisor. The decontamination area shall be capable of containing decontamination fluids and solids. The decontamination fluids shall be managed in accordance with SOP – IDW Management.

Additionally, the drilling subcontractor has the responsibility of making the drilling rig free of leaks (i.e., hydraulic fluid, oil, gas. etc.) that could contaminate the boreholes. Grease may be sparingly used on rod shoulders to ease rod breaking upon completion of a borehole. Rod joints should be wiped with a clean cloth to minimize the amount of grease on the exterior of the rod.

4.0 COMMENTS

Decontamination is critical for maintaining the integrity of the sampling program. Check equipment carefully prior to sampling, and if there is any doubt about the effectiveness of the decontamination, repeat the decontamination process as an extra precaution. Decontamination fluids will be containerized and disposed of following the procedures provided SOP – IDW Management. Decontamination procedures shall be documented in the field log book.

Standard Operating Procedure No. 5

Soil Sampling for Chemical Analysis

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Reviewer: 

Ben Headington, PMP

SOP No. 5 – Soil Sampling for Chemical Analysis

1.0 OBJECTIVE

Soil samples will be collected for field screening and chemical analysis to help characterize the source areas and to determine the nature and extent of contamination in soil. Soil samples will be collected during direct push activities and monitoring well drilling.

2.0 EQUIPMENT AND MATERIALS

- Appropriate number and types of sample containers (to include 5-gram Terra Core sample kits)
- Stainless steel T-handle
- Precleaned stainless steel sampling utensils (See SOP – Sampling Equipment Decontamination)
- Sample coolers and ice.
- Appropriate field documentation forms and labels and an indelible ink pen.
- Sampling equipment (splitTTspoons samplers).
- Decontamination equipment.
- Waste containers.
- Health and safety equipment, as specified in the Health and Safety Plan.

3.0 METHODOLOGY

Soil samples collected by direct push or split spoon methods will be collected as follows (See SOP No. 7 – Drilling and Lithologic Logging):

a) Retrieve sampler from borehole and remove drive shoe and head assembly. Open the sampler carefully to avoid disturbing the sample.

b) Once the sampler has been opened, the length of the sample will be screened with a photoionization detector (PID), and the reading will be recorded on the drilling log.

c) The upper portion of soil in the sampler potentially represents material that has fallen from above or has been scraped from the sides of the auger hole; therefore, this portion is not representative of the sampling interval and should be discarded.

d) Samples for volatile organic compound (VOC) analysis will be collected first (using a Terra Core sampler) for the desired interval to minimize the potential for volatilization.

e) Following lithologic logging, remaining soil within desired sample interval will be homogenized prior to dispensing into remaining sample jars for other analyses. Wipe residual soil from jar threads.

f) Complete the sample labels in accordance with SOP – Sample Handling and Management and place them on the jars.

g) Place protective packing on the sample jar.

h) Decontaminate sampling equipment in accordance with SOP – Sampling Equipment

Decontamination.

i) Collect and manage wastes as specified the waste management plan.

4.0 COMMENTS

For sampling at the Former Stewart AFB, all surface soil samples will be collected from 0-1ft bgs. Subsurface soil samples will be collected from 1-5 ft bgs, 5-10 ft bgs, 10-15 ft bgs, etc. at each borehole within the vadose zone and to the depth that groundwater is encountered. Based on historical water levels measured at the Site it is estimated on average that two subsurface soil samples will be collected from each boring; however, it is possible the more or less subsurface samples will end up being collected during the sampling activities based on the depth of groundwater. VOC samples within each subsurface soil sampling interval will be collected from the approximate mid-point of the interval. If during subsurface soil sampling, visible or field instrument-detected contamination is present, VOC sample(s) will also be collected from the interval that the impacts are observed/measured to assist in defining potential source areas and inform the characterization of the nature and spatial extent of contamination.

All other analyses (i.e., non-VOCs) will be performed on a composite sample consisting of soil across the entire 4 or 5-ft subsurface interval. If waste material is observed in any soil borings at the depth that groundwater is encountered, the borings will be advanced into the saturated zone until the bottom of the waste material is determined.

Following standard practice, the soil samples for VOC analysis will be collected before any logging or other sample handling is conducted. Due to the nature of VOCs, it is critical to collect these samples as quickly as possible and to immediately place them in a cooler with ice. VOC soil samples are collected via Terra Core sampling kits. The procedure for using a Terra Core sampler is as follows:

- Uncap each vial – one at a time to ensure you recap the correct vial.
- With the Terra Core sampler, collect 5 grams of soil (see Step 1).
    - a. Push the sampler into the soil with the center section (the plunger) flush with the top of the sampler.
    - b. Pull the sampler out of the soil
    - c. Turn the plunger at a 90-degree angled. Slowly and at a slight angle to avoid splashing: Extrude the soil from the sampler into the vial by pushing the plunger down (see Step 2).

- Place the cap on the vial making sure that there is a good seal Replace the vial into the foam container
- Note the identification number on the vial. This ID number must be written on the chain of custody.
- Record the vial identification number for the vial(s) and the sampling information (location, sampling time, and specific analyses) for each sample on the chain of custody. Please fill out the chain of custody completely.

The Terra Core samplers for VOC soil samples should be pre-chilled in a cooler with ice prior to

filling This practice will further reduce the potential for volatilization during sample collection. Ship over-night the Terra Core samples to the lab the same day they are collected to ensure the 48-hr hold time is met. A copy of the Terra Core instructions is included in this SOP. It may be necessary to advance an additional boring for the purpose of lithologic logging.

4.1 LITHOLOGIC LOGGING AND GEOTECHNICAL ANALYSIS

Lithologic logging will be performed to define the subsurface geology. Selected samples will be collected to send to the laboratory for quantitative geotechnical analysis. See SOP – Borehole Logging for further information.

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Overview



- The TCEQ Remediation Division issued an updated guidance for the soil sample collection method SW-846 5035A that will go into effect January 1, 2016.

- All soil samples collected for Volatiles analysis by SW-846 8260 GC/MS collected for the compliance with any of the following 30 TAC Chapters:

  - Chapter 334, subchapters D and F (Underground and Aboveground Storage Tanks)
  - Chapter 335 Subchapter S (Risk Reduction Standards) and
  - Chapter 350 (Texas Risk Reduction Program TRRP)

- Due to the high potential for calcium carbonate in Texas soil, TCEQ recommends the samples to be collected using no preservative (i.e. DI Water) and to be stored in the freezer upon receipt at the laboratory.

Key Tips

- Holding time: 48 Hours holding time to freeze at the laboratory
- Standard 14 day holding time after samples are frozen
- Sample should weigh ± 0.5 grams
- Make sure to tighten all caps!
- DO NOT label pre-weighed vials
- Collected moisture in the separate container provided

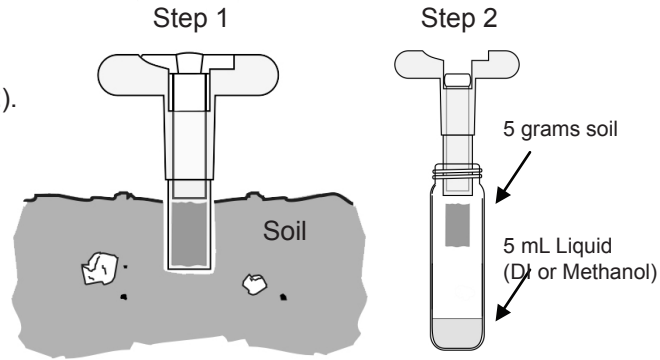
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Sampling Kit

1. 2 x 40mL vials with 5mL DI water and a stir bar
2. 1 x 40mL vial with 5mL methanol (Blue cap)
3. 1 Terracore 5 g sampling device
4. One moisture container

Sampling Instructions

1. Uncap each vial – one at a time to ensure you recap the correct vial.
2. With the Terra Core sampler, collect 5 grams of soil (see Step 1).
   a. Push the sampler into the soil with the center section (the plunger) flush with the top of the sampler.
   b. Pull the sampler out of the soil
   c. Turn the plunger at a 90 degree angle
   d. Slowly and at a slight angle to avoid splashing: Extrude the soil from the sampler into the vial by pushing the plunger down (see Step 2).
3. Place the cap on the vial making sure that there is a good seal Replace the vial into the foam container
4. Note the identification number on the vial. This ID number must be written on the chain of custody.
5. Record the vial identification number for the vial(s) and the sampling information (location, sampling time, and specific analyses) for each sample on the chain of custody. Please fill out the chain of custody completely.



Standard Operating Procedure No. 6

IDW Management

Revision:___2.0_____

Reviewed:___9/27/2021_____

Reviewer: 

Ben Headington, PMP

SOP No. 6 – IDW Management

1.0 OBJECTIVE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used for the handling, management, and disposal of investigation derived waste (IDW) encountered or generated during environmental investigation activities. This SOP gives descriptions of equipment, field development procedures, field data collection, and personnel responsibilities.

2.0 EQUIPMENT AND MATERIALS

The following equipment and materials may be needed for IDW management:

Personal protective equipment (PPE) as outlined in the HSP

- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags (minimum 0.55 mil), potable water, distilled water and/or deionized water)
- Department of Transportation (DOT)-rated 55-gallon drums or other approved containers for containing soil cuttings, decontamination water, and formation water
- Drum/bung wrench and drum funnel
- Heavy equipment forklift or vehicle with drum grappler (as necessary)
- Laboratory-supplied sample containers
- Photoionization detector (PID) or flame ionization detector (FID)
- Wood pallets (as necessary)
- Non-porous (e.g.. stainless steel) shovels
- Polyethylene tanks (as necessary)
- Field notebook and waterproof and permanent marking pens

3.0 PROCEDURES

It is anticipated that both non-liquid and liquid IDW will be generated or encountered during field activities. IDW generated during the field investigation is expected to include:

- Soil cuttings and other soil wastes generated during sampling
- Well development and purged water
- Wash and rinse waste from decontamination activities
- Used PPE and other non-soil solid wastes

3.1 SOIL IDW

- Soil cuttings generated during drilling and soil sampling will be placed into DOT-rated 55-gallon drums, or appropriately sized containers at the point of generation pending further analysis. Soil cuttings generated inside the limits of an area of

concern (AOC) at the Site will be containerized and remain inside the AOC or origin pending further analysis.

- Mixing of the cuttings from several borings or sampling locations with an AOC is permissible in order to fill the drums.
- When drums or containers are full, or daily activities are completed, the drum lids and rings will be fastened.
- Drums will be stored on pallets at the designated IDW accumulation area inside each AOC. Drums will be segregated to separate soil from liquid IDW.
- Drums will be sealed and labeled with permanent markings (using paint pens or drum labels) with the following information:
    - Source: the boring(s), well, or site identification number
    - Matrix (e.g., soil, water)
    - Sample interval
    - Fill date
    - Drum identification number
    - Contractor
    - Point of contact with phone number
    - Labeled "Contents Pending Analysis"
- If large volumes of soil IDW will be generated, soil IDW will be transferred from the drums into roll-off bins (lined and covered) located within the designated IDW accumulation area.
- If no associated investigation sample results exist, a composite soil sample will be collected from the soil IDW drums by collecting a drive or hand auger sample from each of the drums. The sample material from all of the drums will be composited into a single sample that will be used to characterize and dispose of the IDW.

3.2 LIQUID IDW

- Well development, purge, abandonment, and decontamination water will be contained in DOT-rated drums, or in appropriately sized watertight containers, at the point of generation.
- When drums or tanks are full, or daily activities are completed, the containers will be sealed: for example, drum lids and rings will he fastened.
- Drums will be stored on pallets at the designated IDW accumulation area inside each AOC. Drums will be segregated to separate soil from liquid IDW.
- Drums will be sealed and labeled with permanent markings (using paint pens or drum labels) with the following information:
    - Source: the boring(s), well, or site identification number
    - Matrix (e.g., soil, water)
    - Sample interval
    - Fill date
    - Drum identification number
    - Contractor
    - Point of contact with phone number

    - Labeled "Contents Pending Analysis"
- If large volumes of water will be generated, the water will be transferred into an appropriately-sized polyethylene tank.
- If no associated investigation sample results exist, a composite water sample will be collected from the water IDW drums. The sample will be used to characterize and dispose of the IDW.

3.3 PPE AND DISPOSABLE INVESTIGATION EQUIPMENT

- The plan for managing used PPE and other non-soil solid waste generated during field activities (e.g., sample handling) will be segregated separately and placed into dedicated heavy duty plastic bags or containers (e.g. drums)
- Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic bags or containers, if warranted.
- Decontamination procedures consist of brushing off, or using small amounts of water to scrub off, gross potential contamination.

3.4 DISPOSAL OF IDW

IDW will be disposed of in accordance with federal, state, and local regulations. If soil IDW is determined to be non-hazardous, it will be returned to the AOC it originated. Otherwise, if the soil is determined to be hazardous, it will be properly disposed of offsite by a certified waste-handling contractor at a licensed facility.

If wastewater is determined to be non-hazardous, it will be returned to the AOC it originated. Otherwise, if the liquid waste is determined to be hazardous, it will be properly disposed of offsite by a certified waste-handling contractor at a licensed facility.

Soil and liquid IDW will be analyzed for PFAS as per the requirements of the disposal facility receiving the waste, since Site media will not be analyzed for PFAS because it is not a chemical believed to be associated with Department of Defense activities at the Former Stewart FUDS property. PFAS results will be compared to applicable project screening levels (PSLs) in Worksheets #15-24 and 15-25 in the UFP-QAPP. If the results are below PSLs, then the associated soil or groundwater IDW will be disposed of onsite with respect to PFAS. If the results are above PSLs, then the associated soil or groundwater IDW will be transported and disposed of at a certified offsite facility.

4.0 DOCUMENTATION

Project staff are responsible for thoroughly documenting IDW handling and disposal activities. Personnel will be responsible for documenting the collection, transportation, labeling (if applicable), and staging or disposition of IDW. A Waste Inventory Tracking Form is to be completed if necessary. Documentation should include the following:

- Project Name
- Names of personnel

- Site location
- Type of activities
- Date waste generated
- Boring, well, or site number(s)
- Matrix
- Type of container(s)
- Estimated volume
- Disposition of contents
- Comments (field evidence of contamination (e.g., PID reading, odors)
- Any variance to procedures described in this SOP

Standard Operating Procedure No. 7

Drilling and Lithologic Logging

Revision:___1.0_____

Reviewed:___12/15/2021_____

Reviewer: 

Ben Headington, PMP

SOP No. 7 – Drilling and Lithologic Logging

OBJECTIVE

Drilling and lithologic logging will be performed to define the subsurface geology. Selected samples will be collected to send to the laboratory for quantitative geotechnical analysis. Soils will be described using the Unified Soils Classification System (American Society for Testing and Materials [ASTM] Designation D 2488-09a: Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]). This SOP serves as a supplement to the site-wide and investigation area specific workplans and field sampling plans (FSPs), and is intended to be used in conjunction with the other SOPs.

EQUIPMENT AND MATERIALS

- Monitoring equipment and personal protective equipment (PPE) as outlined in the site-specific HSP
- Air or fluid rotary drill rig with appropriate sized drill rods and downhole bits/casing systems for drilling in bedrock and unconsolidated materials. Hollow-stem auger (HSA) drill rig with appropriately sized augers and drill rods for drilling in unconsolidated materials (optional). Direct Push Technology (DPT) rig with appropriate drill rods.
- High pressure, hot water washer for decontamination
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Sampling equipment for HSA rig (e.g., stainless steel 2-inch outer diameter split spoon sampler)
- Re-closable plastic bags for archiving samples
- 55-gallon drums or other approved containers for containing soil cuttings
- Other materials and equipment may be needed based on field conditions.

DRILLING PROCEDURES

Prior to drilling, borings will be numbered and the site cleared for utilities. Boring locations may be adjusted in the field due to the presence of underground utilities, overhead power lines, or other structures, or if access problems are encountered. Drilling locations will be approved by the Site Manager prior to initiating drilling activities.

Health and safety equipment specified in the site-specific HSP will be donned before proceeding with subsurface drilling activities. The HSP will specify action levels for various contaminants and the field monitoring required to measure ambient conditions.

All drill cuttings will be placed in labeled drums and moved to a central secured location for storage. Any water generated during drilling will be contained in labeled drums or tanks. Handling of investigation derived wastes (IDW) will be as specified in SOP - IDW Management.

Downhole equipment will be steam-cleaned prior to proceeding to the drill site and between subsequent boreholes using the procedures presented in SOP - Decontamination of Sampling Equipment. Samplers will be decontaminated at the drill site between each sample interval.

All work areas around borings will be restored to a physical condition equivalent to that of pre-drilling, as near as practical. This will include drill cuttings removal and rut repair.

At the direction of the field geologist, potable water may be introduced into boreholes. If it is necessary to introduce an alternate drilling fluid into boreholes to lift cuttings during bedrock drilling, Material Safety Data Sheets (MSDS) for any products will be supplied for review and approval.

SOP No. 7 – Drilling and Lithologic Logging

For air or fluid rotary drilling, a shale-shaker and de-sanding sanding system may be used to maintain the density and viscosity of the drilling fluid. Sand content will be minimized to the extent possible to enhance recovery of cuttings.

The rig shall be free of leaks that could contaminate the boreholes (i.e., hydraulic fluid, oil, fuel, etc.). Pipe lubricants that are used should not introduce contaminants into the borehole. Lubricants that are environmentally acceptable include Green Stuff®, King Stuff®, vegetable oil, Crisco™, and some Teflon™-based lubricants. Lubricants that are not acceptable include petroleum-based and most metal-based lubricants. The Site Manager will pre-approve lubricants that will be used.

AIR/FLUID ROTARY DRILLING

The procedures below address drilling of boreholes using a, air-rotary or fluid-rotary drill rig. Rotary drilling may be conducted to install bedrock monitoring wells and injection points. Samples of drill cuttings will be collected for visual logging purposes at five-foot intervals. Samples may also be collected for testing. Drilling and sampling procedures using a rotary drill rig are as follows:

Remove stones, vegetation, etc., from the sampling location surface.

Use an appropriate drill bit to provide for a minimum 2-inch annulus around the groundwater monitoring well casing.

Avoid over-pressurizing during air rotary drilling, as this can fracture the soil and create new pathways.

Sampling of drill cuttings will be performed at five-foot intervals to the total depth of the borehole. Samples will be collected directly from the cyclone and placed in quart-sized baggies and labeled with the boring number and depth.

Screen the sampled material using the instruments specified in the HSP.

Log the sample as described below.

Follow sample handling procedures for collecting samples as described in SOP - Sample Management.

Discard the unused samples and handle the waste as described in SOP - IDW Management.

HOLLOW-STEM AUGER DRILLING

The procedures below address drilling of boreholes and collection of subsurface soil samples using a HSA rig. HSA drilling may be conducted to install shallow monitoring wells in unconsolidated materials. Subsurface soil samples may be collected in some boreholes for laboratory chemical analysis at specific intervals as outlined in the project Work Plans. For boreholes where samples are not collected for chemical analysis, samples will be collected at five-foot intervals during drilling and placed in plastic bags. HSA drilling and samples procedures are as follows:

Remove stones, vegetation, etc., from the sampling location surface.

Use the appropriate sized augers to provide for a minimum 2-inch annulus around the groundwater monitoring well casing.

If split-spoon sampling is used, collect a sample by driving the spilt-spoon sampler using a 140-pound hammer with a 30-inch drop. Record Standard Penetration Test blow counts for each 6-inch interval driven (for the first 18 inches).

If a continuous sampling device is used, collect a sample by lowering the sample barrel through the augers and connecting the center rods to the drive head such that the barrel tip is slightly ahead of the HSA cutting bit.

Bring the sampler to the surface and open the sampler.

Screen the sampled material using the instruments specified in the HSP.

Log the sample in accordance with the Borehole Logging procedures listed below. Repeat the process until the total depth of the borehole is reached.

DIRECT PUSH TECHNOLOGY (DPT)

The procedures below address the advancement of boreholes using a Direct Push Technology (DPT) rig. The DPT rig consists of a hydraulically-operated hammer device mounted on the back of a van, a pickup truck or a skid that advances small-diameter hollow rods and sampler to the desired sampling depth. DPT is typically used to collect subsurface soil samples and to install shallow monitoring wells in unconsolidated materials.

Before conducting the DPT probing, underground utilities and structures must be demarcated on the ground surface. A subcontractor will be used to locate and mark the utility lines. The selected sampling location shall be a safe distance from the demarcated utility. In some cases, records regarding utility locations may not exist. In any event, a good practice is to slowly push the probe rods the first few feet (rather than hammering) to ensure that no utilities are present.

DPT drilling and samples procedures are as follows:

- Review APP and SSHP and Work Plan before initiating sampling activity.
- Don the appropriate personal protective clothing as indicated in the SSPH.
- Locate sampling location(s) in accordance with the Work Plan and document pertinent information.
- Use clean (decontaminated) sampling tools to obtain sample material from each specified sample location.
- Carefully remove stones, vegetation, debris, etc. from the ground surface in the sampling location area. Clear the sample location using a new and/or appropriately decontaminated tool as described to expose a fresh sampling surface.
- If the sampling site is in an asphalt-covered area, drill a hole using the rotary function and a specially designed (1.5-inch or 2.0-inch diameter) carbide-tipped drill bit. Otherwise, the area needs to be cleared of heavy underbrush and immediate overhead obstructions.
- Thread the drive cap onto the top of the probe rod and advance the sampler.
- Advance the push rod using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth.
- Move the probe unit back from the top of the probe rods and remove the drive cap.

BOREHOLE ABANDONMENT

Borehole abandonment may be necessary in some cases. The following procedures will be used to abandon boreholes:

SOP No. 7 – Drilling and Lithologic Logging

All downhole equipment will be removed from the borehole. Equipment will be decontaminated in accordance with SOP - Decontamination of Sampling Equipment.

Boreholes will be abandoned in accordance with SOP 11 Borehole and Well Abandonment and *Part 5, Subpart 5-2 of the Compilation of the Rules and Regulations of the State of New York*. Boreholes will be grouted using bentonite pellets or cement-bentonite grout. If used, the grout mix will be in the proportions of one sack of Portland cement (94 pounds), 2 to 5 pounds of powdered bentonite, and approximately 7 to 9 gallons of water. The bentonite will be well mixed with the water prior to adding the cement.

Grouting will be performed by placing a tremie pipe to the bottom of the borehole and pumping grout through the tremie pipe until undiluted grout flows from the ground surface.

Twenty-four hours after grouting, the borehole will be checked for settlement and topped off to the ground surface with grout.

Details concerning the abandonment process will be recorded on the boring log and in the field logbook.

Lithologic Logging

The following materials and equipment may be needed:

- Munsell soil color chart
- Hand lens
- Putty knife or spatula
- Dropper with 10% hydrochloric acid (HCl) for calcium carbonate test
- Drilling forms
- Sampling device (e.g., core barrel, split-spoon, Macrocore ™)
- Camera
- Waste containers as specified in the IDW Management Plan
- Health and safety equipment, as specified in the Site-Specific Health and Safety Plan

PROCEDURES

A "site geologist" (geologist, hydrogeologist or geotechnical engineer) experienced in borehole drilling and soil sampling will be present at each operating drill rig. This site geologist will be responsible for logging samples, monitoring drilling operations, and preparing field boring logs.

- Boring log information will be recorded on a Boring Log Form. Depth information will be recorded to the nearest 0.1 foot. An appropriate scale will be used on the boring log form (e.g., a scale of 1 inch on the log form equaling 1 foot of boring).
- Measure entire sample core length and record the recovery on the drilling log. Mark lithologic changes on the drilling form. Lithologies will be logged directly from cores/cuttings and indirectly interpolated using professional judgment, drill cuttings, drill action, etc., between sampling intervals.
- Descriptions of intact unconsolidated soil samples will include parameters listed in Table 1. Material will be described in the following order:
    - Material type (i.e., sand [sandstone], silt [siltstone], clay [claystone], etc.)
    - Color (Munsell color chart will be used)

  - Grain size, sorting, rounding, and composition of the material (for sand or gravel)
  - Types and amounts of secondary constituents
  - Other pertinent characteristics (plasticity, hardness, bedding, etc.)
  - Moisture content
  - USCS code (for unconsolidated material)
- Unconsolidated materials will be classified in accordance with the USCS (equivalent to ASTM D 2488-09a, "Description and Identification of Soil [Visual Manual Procedure]"; An Engineering Description of Soils Visual-Manual Procedure, NYDOT, 2015); Attachment B and USEPA Manual 625/12-91/002 "Description and Sampling of Contaminated Soils"). Soil classifications will be made in the field at the time of sampling by the site geologist (Table 1).
- In the field, visual estimates of the volume of secondary soil constituents will be reported by such terms as "trace" (<5 percent), "few" (5-10 percent), "little" (15-25 percent) "some30-45 percent), and "mostly" (50-100 percent) or by an estimated percentage.
- Consolidated material (e.g., igneous and metamorphic rocks) will be described by parameters listed in Table 2 and described in the Geotechnical Engineering Bureau's Rock Core Evaluation Manual (NYDOT, 2015), Tennisen (1983), ASTM D5434-97, "Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock", and ASTM C294-86(1991), "Standard Descriptive Nomenclature for Constituents of Natural Mineral Aggregates". Material will be logged using drill cuttings and/or rock core. Material will be described in the following order:
  - Rock Type
  - Color (Munsell color chart will be used)
  - Grain size and shape
  - Texture (stratification. foliation)
  - Mineral composition
  - Weathering and alteration
  - Strength
  - Other relevant notes
- Drill cuttings will be described in terms of the appropriate parameters, to the extent practical. "Classification" will be minimally described for this material, along with a description of drilling actions for the corresponding depth. Notations will be made on the log that these descriptions are based on observations of material other than formal samples (e.g., from cuttings).
- The drilling equipment used will be described on each log. Information such as drill rod size, bit size and type, and rig manufacturer and model will be recorded.
- All special problems encountered during drilling and their resolution will be recorded on the log. This would include sudden tool drops, unrecovered tools in the borehole, and lost casing.
- The dates for the start and completion of borings will be recorded on the log.
- Stratigraphic/lithologic changes will be identified on the boring log with a solid line at the measured borehole depths at which changes occur. Gradational transitions and changes identified from cuttings or methods other than direct observation and measurement will be identified by a horizontal dashed line at the appropriate scale depth based on the best judgment of the logger.
- Photographs of soil core intervals will be taken to better document presence of lithological changes and/or contamination.

- Logs will show borehole and sample diameters and depths at which drilling or sampling methods or equipment change.
- Logs will show total depth of penetration and sampling. The bottom of the hole will be clearly identified on the log.
- Logs will identify the depth at which water is first encountered, the depth of water at the completion of drilling, and the stabilized depth to water. The absence of water in borings will also be indicated. Stabilized water-level data will include time allowed for levels to stabilize.
- Logs will include other information relevant to a particular investigation, but not limited to:
    - Odors
    - Field screening or test results (e.g., organic vapors)
    - Any observed evidence of contamination in samples and cuttings
- Special abbreviations used on a log will be defined either in the log where used, or in a general legend.

DOCUMENTATION

Project staff are responsible for documenting sampling activities. A field boring log form will be completed summarizing field activities. Photo-documentation of the logging and sampling process for each interval including sample identification and scale will be collected during the field activities. Field notes will also be kept during drilling and logging activities. The following information will be recorded in a bound field log book:

- Names of personnel
- Weather conditions
- Date and time of drilling and sampling
- Location and sample station number
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Boring log information
- Other applicable information

SOP No. 7 – Drilling and Lithologic Logging

DECONTAMINATION

All tools and sampling equipment (e.g., spatula, drive sampler,etc.) will be decontaminated between sample locations and between individual samples. Decontamination will be conducted in accordance with SOP – Sampling Equipment Decontamination.

- Names of personnel
- Weather conditions
- Date and time of drilling and sampling
- Location and sample station number
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Boring log information
- Other applicable information

TABLE 1

DESCRIPTION OF UNCONSOLIDATED SOIL

Parameter	Example
Formation, (if named and if known)	Alluvium
Unified Soil Classification System	Sandy Clay
Secondary Components and Estimated Quantities either by percentages or by descriptive percentage ranges (Note: terms used to indicate ranges should be described on the log or in a general legend)	sand: fine, with trace of med.
Color	gray
Consistency (cohesive soil). Use relative term	very soft, soft, medium, stiff, very stiff, hard
Density (non-cohesive soil). Use relative term	loose, medium, dense, very dense
Moisture Content. (Use relative term. Do not express as a percentage unless a value has been measured)	dry, damp, moist, wet, saturated
Texture/Fabric/Bedding	no apparent bedding, numerous vertical iron-stained tight fractures
Grain Angularity	rounded sand grains
Sorting (sands)	poorly sorted
Structure	Slickensides, stratification
Grain or fragment size	coarse
Note – Geologic Interpretation, “Till”, "Fill", "Top of Natural Ground", and "Top of Bedrock" where appropriate	

TABLE 2

DESCRIPTION OF CONSOLIDATED SOIL

Parameter	Example
Rock Type	Sedimentary
Color	green
Mineralogy, Grain Size, & Texture	Clay, fine grained
Bedding	Thin-bedded
Fractures	Slightly fractured
Structure	Laminated
Size Range of Pieces	Fragments,
Hardness	Soft rock
Weathering	Highly weathered
Note – Geologic Interpretation, “Till”, "Fill", "Top of Natural Ground", and "Top of Bedrock" where appropriate	

Standard Operating Procedure No. 8

Piezometer, Monitoring Well, and Injection Point Construction

Revision:___1.0_____

Reviewed:___5/15/2020_____

SOP No. 8 – PIEZOMETER, MONITORING WELL, AND INJECTION POINT CONSTRUCTION

The following procedures describe construction of monitoring wells, piezometers, and injection points.

MONITORING WELL CONSTRUCTION

Objective

Monitoring wells will be installed to collect representative samples of the unconfined groundwater, to measure the groundwater surface elevation, and to conduct various types of aquifer testing. Monitoring wells will be constructed in a manner that complies with applicable federal, state, and local regulations. This SOP to be used in association with SOP – Lithologic Logging.

Equipment and Materials Needed

- Drill tooling (supplied by subcontractor). Drilling techniques will be selected based on the site-specific geology and judgment of the onsite geologist and drilling foreman.
- Well materials (supplied by subcontractor).
- Washed silica grade filter sand of an appropriate gradation
- Grout mixing and pumping equipment with a tremie system
- Sodium bentonite pellets
- Cement-bentonite grout
- Locking steel protective casing and guard posts or flush boxes
- Concrete
- Indelible pen
- Monitoring well construction diagrams
- Weighted measuring tape
- Electronic water level indicator
- Waste containers as specified in SOP – IDW Management
- Safety equipment as specified in the Site-Specific Health and Safety Plan

Methodology

Monitoring wells will be constructed in open boreholes or through the hollow stem augers or surface casing, depending on the stability of the borehole and materials encountered during drilling.

The annular space will be filled with a filter pack (adjacent to the well screen), a bentonite seal, and casing grout between the well string and the borehole wall. As the annular space is being filled, the well string will be centered and suspended such that it does not rest on the bottom of the hole.

Measurements made during filling of the annular space will be performed to the nearest 0.1 foot below ground surface (bgs) and will consist of the following:

- Total depth of borehole at the completion of drilling
- Total depth of the open borehole before the start of well construction
- Lengths of the end cap, screen sections, riser blank sections, and stickup of well above ground surface
- The depth to the top of the filter pack, top of the bentonite seal, and the top of the grout.

Casing and Screen Requirements

The casing requirements will be as follows:

- All casing will be new, unused, and/or decontaminated according to the specifications of SOP - Sampling Equipment Decontamination
- All PVC will conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System).
- The casing will be straight and plumb.

Well screen requirements include:

- All requirements for casing, except for strength requirements, apply to well screens.
- The screen material shall be new, non-contaminating, non-clogging, continuous slot design.
- Screen slot openings shall be 0.010 inches unless otherwise specified based on site-specific aquifer properties.
- The bottom of the screen will be capped with a threaded cap.

Filter Pack

The purpose of the well filter pack is to provide lateral support for the well screen, increase yield by improving the hydraulic conductivity in the immediate vicinity of the well, and retain the formation to prevent natural materials from entering the well. The filter pack material will be clean, inert, and well rounded, and will contain less than 2 percent flat particles. The filter pack will consist of 10/20 or 20/40 mix or equivalent of clean silica sand and will be placed from the bottom of the hole to at least 2 feet, but not more than 4 feet, above the top of the well screen. The size of the filter pack material used will be selected as appropriate for the well screen slot size installed so that no more than 10% of the filter pack material is smaller than the slot size.

For auger boreholes, the filter pack will be placed in the hole by pouring the sand through the augers and slowly raising the augers out of the hole. For bedrock monitoring wells installed in open boreholes (by rotary drilling), the screen and riser casing will be suspended above the bottom of the borehole as the filter pack is poured directly into the borehole. The volume of the filter pack placed in the well will be recorded.

Well Seal

The materials used to seal the annulus between the borehole wall and casing must prevent potential contaminant migration from ground surface or intermediate zones, isolate a discrete monitoring zone, preserve confining conditions, prevent intrusion of the overlying grout into the filter pack, and prevent cross-contamination between strata. The bentonite seal will consist of at least 3 feet, but not more than 5 feet, of bentonite pellets between the filter pack and the casing grout. If the bentonite seal is placed above the water table, then the bentonite will be hydrated using potable water.

Annulus Backfill/Grout

The annular space above the filter pack and seal will be grouted with a bentonite/cement mixture. Grouting is used to minimize the vertical migration of water to the screened interval and to increase the stability and integrity of the well casing.

The cement/bentonite grout mixture shall consist of 95 to 97 percent Type V or Type II-V Portland Cement and 3 to 5 percent bentonite powder by weight (equivalent to one 94-pound bag of cement and between 3 and 5 pounds of bentonite). Approximately 8.5 gallons of water shall be used for each cement/bentonite batch. The grout mixture shall be prepared by thoroughly mixing the bentonite powder with water first and then mixing in the cement.

The casing grout requirements are as follows:

- The annular grout will extend from the top of the bentonite seal to approximately 3 feet below ground surface (bgs).
- Grout shall be placed in the well annulus using a tremie pipe located within approximately 10 feet of the top of the bentonite seal and the tremie pipe will be pulled up as the annular space is filled.
- Pumping will continue until undiluted grout has been returned to the surface.
- After grouting, the well shall not be disturbed or be developed for a minimum of 24 hours. Additional grout will be added if settling occurs.

Surface Casing

After the grout has hardened for at least 24 hours, place the protective casing or flush box in the borehole and support it at the appropriate height (3 feet above the ground surface for a stick-up completion or flush with the ground surface for a flush completion).

For aboveground completions, build a form approximately six (6) inches deep and two (2) feet square around the well completion. Pour concrete into the form and smooth the concrete so that it slopes gently away from the well completion.

If necessary, set four 4-inch-diameter protective posts at the corners of the pad. These posts will be set in postholes at least 18 inches deep and will stick up four (4) feet. Concrete will be poured into the posts and the holes. Bring the concrete no higher than 2 to 3 inches below ground level in the post holes, so the soil can be filled in over the top.

Mark the water level measuring point on the north side of the PVC casing and write the well identification number on the well cap with an indelible marker. Lock the well cap.

The well completion will be a permanent feature that will be visible and obvious. Make sure that completions are neat and the site graded to previous conditions. If well riser needs to be cut to achieve the proper height for the stick up, it should be cut with a hack saw before installation, or with a pipe cutter after installation so that the cut is even and level.

PIEZOMETER CONSTRUCTION

Piezometers will be installed and completed in the same manner as the unconfined monitoring wells except there will be no grout or surface completion. Bentonite will be placed to within one (1) foot of ground surface and soil will be used to fill in up to bring the area back to grade. Piezometers may be constructed one or one and one-half-inch diameter schedule 40 PVC.

INJECTION POINT CONSTRUCTION

Injection points will be installed to allow remediation treatment chemicals to be injected into groundwater. Injection points can be installed by several drilling methods, including direct-push, hollow-stem auger, and rotary drilling methods. Injection points are short-term features (e.g., may only be utilized 1-2 times) and will be abandoned after the remedy is complete.

Equipment and Materials Needed

- Drill tooling (supplied by subcontractor). Drilling techniques will be selected based on the site-specific geology and judgment of the onsite geologist and drilling foreman. The borehole will be of sufficient diameter to achieve a seal that will confine the injectate to the targeted interval.
- Grout mixing and pumping equipment with a tremie system
- Well materials (supplied by subcontractor)
- Grout basket and pre-packed bentonite seal above the slotted portion of the screen.
- Sodium bentonite pellets
- Cement-bentonite grout
- Injection well construction forms
- Weighted measuring tape
- Electronic water level indicator
- Waste containers as specified in SOP – IDW Management
- Safety equipment as specified in the Site-Specific Health and Safety Plan

Methodology

Injection points will be constructed in open boreholes or through the hollow stem augers or surface casing, depending on the stability of the borehole and materials encountered during drilling.

The annular space in the screened area of the casing will be left open to maximize contact with the affected portions of the saturated zone. A grout basket and a bentonite seal will be placed

above of the screen, and cement-bentonite grout will be placed above the seal to focus injected materials into the target interval and prevent injectate from rising up the borehole annulus.

Injection points casing will be new, unused, and/or decontaminated according to the specifications of SOP - Sampling Equipment Decontamination. The well seal will be constructed of either a grout basket that will expand to the maximum dimensions of the borehole to prevent bentonite pellets from entering the screened internal and/or pre-packed bentonite placed on the well pipe. The bentonite seal will consist of at least 3 feet, but not more than 5 feet, of bentonite pellets. If the bentonite seal is placed above the water table, then the bentonite will be hydrated using potable water.

The annular space above the seal will be grouted with a bentonite/cement mixture. Grout will be mixed as specified in "Monitoring Well Construction" above.

Standard Operating Procedure No. 9

Monitoring Well Development

Revision:___2.0_____

Reviewed:___1/28/2022_____

Reviewer: 

Ben Headington, PMP

SOP No. 9 – Monitoring Well Development

1.0 OBJECTIVE

Monitoring wells installed during the remedial investigation will be developed to:

- Remove fine-grained native soil material that may have collected in the well casing during construction
- Grade the filter pack from formation to casing
- Allow for accurate chemical measurements to be made during well sampling
- Reduce potential cross contamination within the borehole

During well development, water quality parameters will be measured and pumping rates will be documented, the latter of which can be used to select sample purge rates and pumping test rates during future field activities.

2.0 EQUIPMENT AND MATERIALS

- Copies of well drilling and installation records, including lithologic logs for the well to be developed
- Electronic water level meter
- Water quality meter(s) to measure pH, temperature, electrical conductivity and turbidity and appropriate calibration standards
- Bailer and appropriate pumping equipment
- Well development log
- Decontamination equipment
- Waste management equipment
- Health and safety equipment as specified in the Site-Specific Health and Safety Plan

3.0 METHODOLOGY

1. Begin developing no sooner than 72 hours after a well has been constructed (Ohio EPA, 2009).
2. Prior to the start of development activities, clean well development equipment following proper decontamination procedures in SOP – Sampling Equipment Decontamination.
3. Before developing a well, measure the total well depth and the depth to the top of the water table (see SOP – Water Level Measurement), and record the measurements in the well development log.

4. Alternately surge and bail the well until minimal fines are produced and the purged water begins to clear.
5. Take water quality measurements for pH, temperature, specific conductivity, and turbidity frequently once the water clears, at least every half-hour; take measurements more frequently as visual observations or water quality measurements indicate that the consistency of the water is changing.
6. Turbidity will be measured during well development (see SOP – Field Parameter Measurements), with the goal being 50 nephelometric units (NTU). If 10 wetted casing volumes of water have been purged from the well, and the turbidity has not reached 50 NTU but is between 50 and 500 NTU, the well development will be considered complete.
7. Contain and handle purge water according to specifications in SOP – IDW Handling.
8. If a pump is used instead of a bailer, install a development pump (2- to 5-gallons per minute [gpm] capacity submersible pump).
9. Purge water from the well, using the pump, at a rate approximately equal to or greater than the anticipated purging/sampling rate.
10. Continue development until a minimum of five wetted casing volumes have been removed. Continue purging and monitor the pH, temperature, specific conductivity, and turbidity. Stop purging once parameters stabilized to within 10% of the previous two readings or 10 wetted casing volumes have been removed.
11. Record measurements on the well development log.
12. Continue to contain the purge water according to methods outlined in SOP – IDW Management.
13. When development is complete, remove and decontaminate the purge pump and measure and record a final total well depth and top of the water table depth.

4.0 COMMENTS

Wells at the site are expected to produce sufficient volumes of water to allow for standard development. However, slow producing wells may need to be developed using an alternative procedure. If, during the initial phases of development, a well is bailed dry, development should be performed by bailing the well, allowing it to recover to at least 90% of the initial water level, and repeating the bailing.

5.0 REFERENCES

Ohio EPA, 2009. *Technical Guidance Manual for Ground Water Investigations, Chapter 8, Monitoring Well Development, Maintenance, and Redevelopment*. Division of Drinking and Ground Waters. February.

Standard Operating Procedure No. 10

Surface Water/Sediment Sampling for Chemical Analysis

Revision:___1.0_____

Reviewed:___12/15/2021_____

SOP No. 10 – Surface Water/Sediment Sampling for Chemical Analysis

1.0 OBJECTIVE

Surface water and sediment samples will be collected for chemical analysis to help characterize overland migration and potential groundwater discharge to surface water from source areas, and to determine the nature and extent of contamination in intermittent or perennial water bodies.

2.0 EQUIPMENT AND MATERIALS

- Peristaltic pump and dedicated polyethylene tubing
- Water quality meter
- Ponar sampler and trowel
- Stainless-steel rod (USGS wading rod)
- Voss 0.45-micron filters
- Appropriate number and types of sample containers
- Pre-cleaned stainless steel sampling utensils (See SOP – Sampling Equipment Decontamination)
- Sample coolers and ice.
- Appropriate field documentation forms and labels and an indelible ink pen.
- Decontamination equipment.
- Waste containers.
- Health and safety equipment, as specified in the Health and Safety Plan.
- Field notebook

3.0 METHODOLOGY

Surface water and sediment samples will be collected as follows:

a) The order of sample collection should be downstream to upstream.

b) Care should be taken not to disturb stream bottoms resulting in sediment suspension.

c) Care should be taken to ensure the collection of sediment fines during sample collection.

d) Prior to sample collection, water quality parameters we be collected using a peristaltic pump with dedicated tubing and a calibrated water quality meter.

e) Water samples shall be collected by setting the tubing at the appropriate depth below the water surface and slowly filling the sample containers using a pump rate of approximately 150 ml/min. If flow is too strong, use a stainless-steel rod similar to a USGS wading rod to keep sample tubing in place and positioned in a vertical orientation.

f) Samples bottles for volatile organic compound (VOC) analysis will be collected first to minimize the potential for volatilization. Vials should be filled with zero headspace, again taking care not to lose preservative.

g) Collect samples for all non-VOC water then sediment (location-specific) analyses next using a Ponar sampler from 0 to 6 inches before working your way upstream to additional sample locations as designated.

h) Collect filtered samples for metals. Connect Voss 0.45-micron filter to the end of sample tubing. Filter does not require to be pre-rinsed. Filter can accommodate up to 1 liter of turbid water.

i) Complete the sample labels in accordance with SOP – Sample Handling and Management and place them on the jars.

j) Recorded field observations should include description of each sample location, depth to water, estimated flow rate, and photo-documentation.

k) Place protective packing on the sample jar.

l) If dedicated materials are not used, decontaminate sampling equipment in accordance with SOP – Sampling Equipment Decontamination.

m) Collect and manage wastes as specified the waste management plan.

Standard Operating Procedure No. 11

Well and Borehole Abandonment

Revision:___1.0_____

Reviewed:___12/15/2021_____

1.0 OBJECTIVE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to seal and abandon boreholes created during the field investigation. This SOP serves as a supplement to Nebraska water well regulations (178 NAC 12). Personnel overseeing and performing borehole abandonment will have knowledge and experience in working with drill rigs and sealing and abandoning environmental boreholes.

2.0 EQUIPMENT AND MATERIALS

The following equipment and materials may be needed for borehole abandonment:

- Personal protective equipment (PPE) as outlined in the HSP
- Drill rig equipped with a hoist (for removal of well/piezometer casing and screen)
- Grouting mixing and pumping equipment
- Grouting materials and equipment (potable water, bentonite powder, bentonite chips, cement for grouting [portland type II or IV], large tank for mixing grout, trash pump for mixing grout, plastic or steel tremie pipe)
- Borehole Abandonment Form

Other materials and equipment may be needed based on field conditions.

3.0 METHODOLOGY

Abandonment is the procedure by which a borehole is permanently sealed in place, or a monitoring well or piezometer is sealed in place or removed. The objective of abandonment is to eliminate the potential vertical pathway to the subsurface associated with boreholes or unneeded wells. Abandonment will be performed for the following:

- Following drilling and sampling of investigation boreholes.
- To remove wells or piezometers that are no longer needed.

3.1 BOREHOLE ABANDONMENT

Investigation boreholes drilled for collection of subsurface material samples will be abandoned immediately following sampling and/or data collection. Prior to any intrusive drilling associated with abandonment, utility clearance will have been accomplished according to SOP – Staking, Utility Clearance, and Permitting.

The following steps will be performed to abandon a borehole:

- All boreholes to be abandoned will be grouted with a cement/bentonite grout.
- Grout will be injected into the borehole using a tremie pipe as the hollow-stem augers are pulled. Measurements will be taken of the grout level during the process to verify that the grout level does not fall below the bottom of the augers, thus ensuring a continuous seal is injected into the borehole.

- The cement-bentonite grout mixture will consist of the following in accordance with the State's Water Well Standards. The amount of bentonite shall not exceed 5 pounds bentonite per cubic foot (94 pounds) of Portland cement. The volume of water used will not exceed 6.5 gallons per 94 pound bag of cement.
- During grouting, water present in the borehole will be displaced up the borehole. Displaced borehole water cannot be discharged to the ground surface. Displaced water will be pumped from the borehole as grouting progresses and contained in drums or other approved water-tight containers for handling as investigation derived waste (IDW). IDW management is addressed in SOP -IDW Management.
- Twenty-four hours after grouting, the borehole will be checked for grout settlement and will be topped off to the ground surface with grout, if necessary.
- Any excess grout will be placed in drums for disposal in accordance with SOP -IDW Management.

3.2 MONITORING WELL AND PIEZOMETER ABANDONMENT

Monitoring wells or piezometers that are no longer needed may also be abandoned The preferred method of abandonment is to remove the surface completion (i.e., protective casing, traffic posts, and surface seal), pull or drill out the well or piezometer casing and screen, drill out the annular seal and filter pack material, and seal the borehole. State or local regulations may require alternate methods in specific circumstances.

In most cases it may not be feasible to remove the well casing. Wells that are not pulled or drilled out, will be sealed by injecting grout under pressure into the well casing. Well casings may be split prior to grouting.

If the well or piezometer cannot be pulled or drilled out, the well or piezometer will be sealed in place by injecting grout under pressure into the well casing. The PVC well casing may be split using a down-hole casing splitter prior to grouting.

All well/piezometer casing and annular materials will be handled as IDW as addressed in SOP – IDW Management.

4.0 DOCUMENTATION

The rig geologist or other responsible person will document all borehole or well/piezometer abandonment procedures on a Borehole Abandonment Form and in the field logbook.

The following information will be documented:

- Borehole or well/piezometer designation
- RFI contractor and personnel names
- Abandonment subcontractor and personnel names
- Dates of abandonment
- Measured diameters and depths of boreholes and wells/piezometers prior to initiating abandonment activities

- Detailed record of abandonment procedures
- Volume of water produced and contained during abandonment
- Grout composition and quantity used
- Casing reused or left in place
- IDW generated

Upon completion of well decommissioning activities, a Water Well Abandonment and Decommissioning Report shall be filed with the New York State Department of Environmental Conservation and submitted to:

New York State Department of Environmental Conservation Division of Water
Bureau of Water Resources Management
625 Broadway, Albany, NY 12233-3508

A copy of the form can be obtained at
https://www.dec.ny.gov/docs/water_pdf/welldecommissform.pdf

Standard Operating Procedure No. 13

Soil Boring and Monitoring Well Survey

Revision:___1.0_____

Reviewed:___12/15/2021_____

Reviewer: 

Bob Janosy, PG

SOP No. 13 – Soil Boring and Monitoring Well Survey

1.0 OBJECTIVE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to facilitate a land survey. Personnel overseeing and performing the well survey will have knowledge and experience in working with all applicable equipment. All locations shall be staked to facilitate surveying.

2.0 EQUIPMENT AND MATERIALS

The following equipment and materials may be needed for surveying:

- Personal protective equipment (PPE) as outlined in the HSP
- Survey Equipment

Other materials and equipment may be needed based on field conditions.

3.0 METHODOLOGY

All sampling locations shall be staked to facilitate subsequent surveying. The Contractor shall perform all surveys required for this project and shall supply this office with the original or a legible reproducible copy of the surveys and field books. The surveys shall at least conform to the requirements stated in the following paragraphs.

3.1 MONITORING WELLS

Coordinates and elevations shall be established for each monitoring well. The horizontal coordinates shall be to the closest one foot and referenced to the State Plane Coordinate System. If the State Plane Coordinate System is not available, an existing local grid system shall be used.

Depending on the time of year and amount of the Site being under tree cover, either a total station and/or digital level will be used. A ground horizontal elevation to the closest 0.1- foot and an elevation for the top of the well riser to the closest 0.01-foot shall be achieved at each well. These elevations shall be referenced to Mean Sea Level, specifically to the North American Vertical Datum (NAVD) of 1988. If the 1988 Datum is not available, the National Geodetic Vertical Datum (NGVD) of 1929 shall be used. All positions and coordinates of all permanent points within the control traverse shall be shown. If not stated in the Site Specific Scope of Services, the Contractor shall coordinate with the USACE.

3.2 SOIL BORINGS, SAMPLE POINTS, SURVEY LOCATIONS

All soil boring/sampling locations shall be located horizontally as described in Section 3.1 above.

4.0 DOCUMENTATION

The location, identification, coordinates, and elevations of the wells and monuments shall be

plotted on maps with a scale large enough to show their locations with reference to other

structures at the individual sites. A tabulated list of the monitoring wells and monuments, copies of all field books, and all computations sheets shall be prepared and submitted to the USACE- COR. The tabulations shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations.

Standard Operating Procedure No. 14

Soil Gas Sampling for Chemical Analysis

Revision:___2.0_____

Reviewed:___12/15/2021_____

Reviewer: 

Bob Janosy, PG

SOP No. 14 – Soil Gas Sampling for Chemical Analysis

1.0 OBJECTIVE

Soil vapor samples will be collected for chemical analysis to help characterize the source areas and to determine the nature and extent of contamination in soil and soil vapor. Soil vapor samples will be collected during drilling activities.

2.0 EQUIPMENT AND MATERIALS

Subatmospheric Pressure (Time-Integrated) Sampling Equipment

- Vacuum pump - for use in conducting purging process.
- Sampling inlet line - stainless steel tubing to connect the sampler to the sample inlet.
- Sample canister - leak-free stainless steel pressure vessels of desired volume with valve and Summa passivated interior surfaces.
- Particulate matter filter - 2-µm sintered stainless steel in-line filter.
- Teflon tubing – dedicated tubing for downhole sampling.
- Tedlar bag
- Chromatographic grade stainless steel tubing and fittings - for interconnections. All materials in contact with sample, analyte, and support gases should be chromatographic grade stainless steel.
- Helium gas (for leak testing)
- ION Science GasCheck G Helium Detector
- Fixed orifice, capillary, or adjustable micro-metering valve - used in lieu of the electronic flow controller/vacuum pump for grab samples or short duration time-integrated samples. Precleaned stainless steel sampling utensils
- Sample coolers for the shipment of gas canisters.
- Appropriate field documentation forms and labels and an indelible ink pen.
- Decontamination equipment.
- Health and safety equipment, as specified in the Health and Safety Plan.

Pressurized Sampling Equipment

- VOC canister sampler - whole air sampler capable of filling an initially evacuated canister by action of the flow controlled pump from vacuum to near atmospheric pressure. Sampling inlet line - stainless steel tubing to connect the sampler to the sample inlet.
- Sampling inlet line - stainless steel tubing to connect the sampler to the sample inlet.
- Sample canister - leak-free stainless steel pressure vessels of desired volume with valve and Summa passivated interior surfaces.
- Particulate matter filter - 2-µm sintered stainless steel in-line filter.
- Chromatographic grade stainless steel tubing and fittings for interconnections. All materials in contact with sample, analyte, and support gases should be chromatographic grade stainless steel.

3.0 METHODOLOGY

SOP No. 14 – Soil Gas Sampling for Chemical Analysis

Soil borings will be conducted prior to soil gas sampling to help inform locations and depths of soil gas sampling. Soil gas sampling locations will be 3-5 feet away from the respective soil boring (instead of 1-2 feet), and soil gas sampling will happen not less than 48 hours after completing work at each respective soil boring. Soil gas samples will be collected from the same approximate depth as a VOC sample collected from the respective soil boring.

Soil gas sampling shall not be performed within 48 hours of a rain event and/or an event producing more than 0.5 inches of rain. Sampler should review lithology on boring logs to determine appropriate orifice for tight or loose soils. In addition, the sampler should determine from boring logs the depth to groundwater and the presence of soil moisture (capillary fringe) to ensure soil gas sampling is conducted at depths above these zones.

3.1 PURGING

Prior to sampling, to ensure stagnant or ambient air is removed from the sampling system and to assure samples collected are representative of subsurface conditions, a purge test should be conducted. The purge volume test is conducted by collecting and analyzing a sample for target compounds after the removal of appropriate purge volumes. The following purge procedure is recommended:

- The purge test location should be selected as near as possible to the anticipated or confirmed contaminant source, and in an area where soil gas concentrations are expected to be greatest based on lithology (e.g., coarse-grained sediments).

- Calculate the volume of the sampling system by summing the volume of the probe screened interval (including filter pack void space, accounting for porosity of sand pack), the volume of tubing from the probe tip to the ground surface, and the volume of above ground tubing connecting the soil probe to the sample collection device.

- Purge the monitoring point until at least three volumes of the full sampling system have been evacuated.

- The purging or sampling flow rate should be attainable in the lithology adjacent to the soil gas probe. To evaluate lithologic conditions adjacent to the soil gas probe (e.g., where no-flow or low-flow conditions), a vacuum gauge or similar device should be used between the soil gas sample tubing and the soil gas extraction devices (e.g., vacuum pump, summa canister).

- A recommended purging or sampling at rates between 100 to 200 milliliters per minute (ml/min) to limit stripping, prevent ambient air from diluting the soil gas samples, and to reduce the variability of purging rates. The low flow purge rate increases the likelihood that representative samples may be collected. The purge/sample rate may be modified based on conditions encountered in individual soil gas probes.

- The purge test data (e.g., calculated purge volume, rate and duration of each purge step) should be documented.

- If the soil matrix is such that purging as recommended above is not possible due to low or no flow conditions (i.e., gas will not flow or flow is severely restricted), the probe should be advanced deeper to look for zones of higher permeability. If the deeper probe does not encounter a higher permeability zone and low or no flow conditions persist, the probe should be abandoned and a new probe advanced elsewhere on the site.

3.2 LEAK TEST

- Leakage during soil gas sampling may dilute samples with ambient air and produce results that underestimate actual site concentrations or contaminate the sample with external contaminants. Leak tests should be conducted to determine whether leakage is present (e.g., the leak check compound is detected and confirmed in the test sample after its application).

- Leak tests should be conducted at every soil gas probe.

- For each sample, use a hand pump to vacuum test the sampling equipment after assembly.

- Select a leak check compound that is not known or suspected to be site related or otherwise associated with the site or nearby properties. Common gas-phase tracers include helium (most preferred, laboratory grade, if available), pentane, isopropanol, isobutene, propane, and butane. 1,1-difluoroethane is also a common tracer which is sprayed on the ground around the sample point, prior to collecting the soil gas sample. Avoid tracer compounds, such as isopropyl alcohol, that could cause elevated detection limits for target compounds if present in the sample at elevated concentrations. Confirm with the analytical laboratory that the selected tracer compound will not interfere with the analysis for target compounds. Detection limit interference issues may be less important if an on-site lab is used for sample analysis.

- The shroud can be as simple as an inverted bucket or cardboard box or similar container designed to minimize exchange of gas between the inside of the shroud and ambient air. For helium (as a tracer gas), use an intermittent or continuous injection of tracer gas into the shroud to maintain a tracer gas concentration of approximately 1% to 10% by volume. Collect and analyze an air sample from inside the shroud to verify the concentration of leak tracer.

- Evaluate leakage in the field by collecting a soil gas sample into a Tedlar bag and analyzing the contents of the bag for the tracer. Helium can be analyzed in this way in the field using the ION Science GasCheck G helium detector. Helium will also be analyzed in summa

canisters in conjunction with the analysis of other target compounds. Use of a field analyzed leak tracer allows for leakage issues to be addressed immediately.

- Low concentrations of leak tracer compound may be detected in soil gas samples even in the absence of significant sample leakage. However, if leak tracer compound is detected greater than 10%, the cause of the leak should be evaluated, determined, and corrected through confirmation sampling. If leakage is confirmed and the problem cannot be corrected, the soil gas probe should be properly decommissioned. A replacement probe should be installed at least five (5) feet from the original probe decommissioned due to confirmed leakage.

3.3 SOIL GAS SAMPLING

Sub-atmospheric Pressure Sampling Using a Fixed Orifice, Capillary, or Adjustable Micrometering Valve:

- Prior to sample collection, the appropriate information is completed on the Canister Sampling Field Data Sheet.
- Sampler to review lithology on boring logs to determine appropriate orifice for tight or loose soils.
- A canister, which is evacuated to 0.05 mm Hg and fitted with a flow restricting device, is opened to the atmosphere containing the VOCs to be sampled.
- A whole air sample is drawn into the system through a stainless steel inlet tube by a direct drive blower motor assembly.
- A small portion of this whole air sample is pulled from the inlet tube by a specially modified inert vacuum pump in conjunction with a mass flow controller.
- The initially evacuated canister is filled by action of the flow controlled pump to near atmospheric pressure.
- The canister should not be completely filled to atmospheric pressure in order to demonstrate that no leakage occurred during transport to the laboratory.
- A digital time-program is used to pre-select sample duration and start and stop times.
- Upon sample completion at the location, the appropriate information is recorded on the Canister Sampling Field Data Sheet.

3.4 QA/QC SAMPLING

- The collection of at least one field duplicate per sampling event or one per ten samples, whichever is greater, is required.
- Duplicate samples should be collected in separate sample containers, using the same procedures and at the same location and depth as the original sample.
- Duplicate samples will be collected simultaneous to collection of the primary sample using a sampling tee. The sampling tee connections will be leak-tested to ensure there is no short-circuiting to the atmosphere.
- At least one equipment blank must be collected per sampling event or per 25 samples, whichever is greater. Items subject to equipment blank testing are push rods, probe tips,

and pressure gauges. The most common method of collecting an equipment blank is to pour distilled water over a recently decontaminated piece of equipment and collect the water in a container that is appropriate for the analytical method that will be used, which, at a soil gas site, will usually be VOCs.

4.0 DOCUMENTATION

Recorded field observations on field logs should include:

- Project name
- Date and time
- Weather conditions
- Description of each sample location
- Sample equipment
- Depth to groundwater
- Estimated flow rate
- Initial and final pressures
- Initial and final purge times
- Purge volume and number of purge volumes removed
- Leak test check details

Recorded field observations on Sample ID tags and COCs should include:

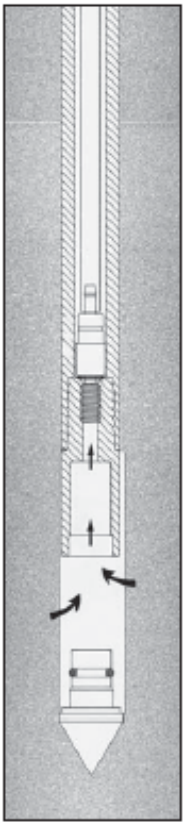
- Date and time
- Project name
- Sample ID
- Analyses requested

Photo-documentation is also recommended.

Soil Gas Sampling – PRT System Operation

from Geoprobe Systems®

www.geoprobe.com
1-800-436-7762



Soil Gas Sampling using the Post-Run Tubing (PRT) System.

Soil Gas Sampling — PRT System Operation

Basics

Using the Post-Run Tubing System, one can drive probe rods to the desired sampling depth, then insert and seal an internal tubing for soil gas sampling. The usual Geoprobe probe rods and driving accessories and the following tools are required:

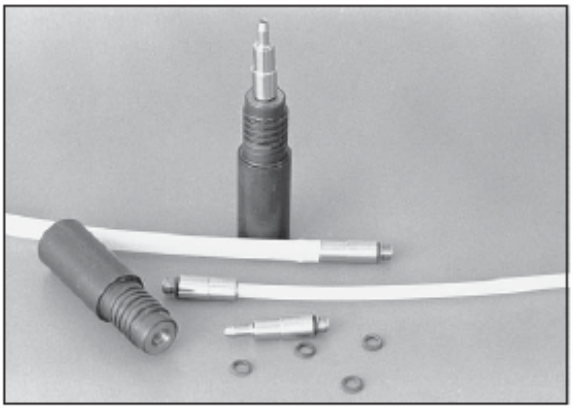
- PRT Expendable Point Holder
- PRT Adapter
- Selected PRT Tubing

Preparation

1. Clean all parts prior to use. Install O-rings on the PRT Expendable Point Holder and the PRT adapter.
2. Inspect the probe rods and clear them of all obstructions.
3. TEST FIT the adapter with the PRT fitting on the expendable point holder to assure that the threads are compatible and fit together smoothly.

   NOTE: PRT fittings are left-hand threaded.
4. Push the adapter into the end of the selected tubing. Tape may be used on the outside of the adapter and tubing to prevent the tubing from spinning freely around the adapter during connection – especially when using Teflon tubing **(Figure 1)**.

   REMEMBER: The sample will not contact the outside of the tubing or adapter.



PRT SYSTEM PARTS
PRT Expendable Point Holder, PRT Adapters, Tubing, and O-rings.

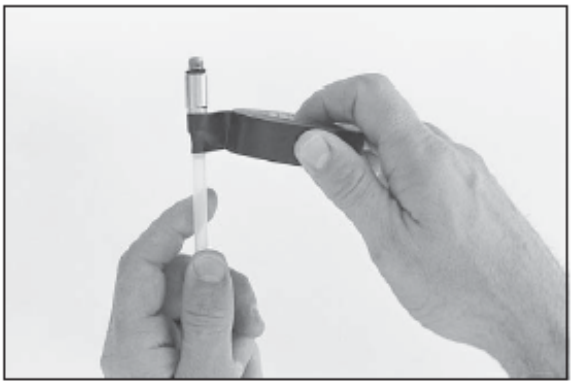


Figure 1. Securing adapter to tubing with tape. NOTE: Tape does not contact soil gas sample.



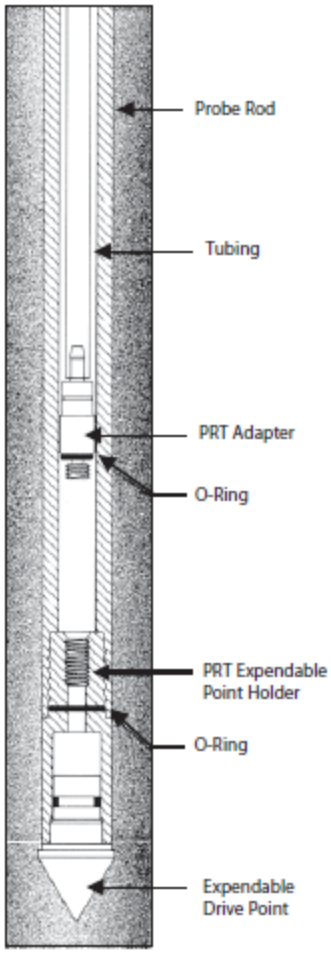
Figure 2. Insertion of tubing and PRT adapter.



Figure 3. Engaging threads by rotating tubing.

SOP No. 14 – Soil Gas Sampling for Chemical Analysis

Soil Gas Sampling — PRT System Operation



A cross section of probe rods driven to depth and then retracted to allow for soil gas sampling. The PRT adapter and tubing are now fed through the rods and rotated to form a vacuum-tight connection at the point holder. The result is a continuous run of tubing from the sample level to the surface.

Probing

Drive the PRT tip configuration into the ground. Connect probe rods as necessary to reach the desired depth. After depth has been reached, disengage the expendable point by pulling up on the probe rods. Remove the pull cap from the top probe rod, and position the Geoprobe unit to allow room to work.

Connection

1. Insert the adapter end of the tubing down the inside diameter of the probe rods **(Figure 2)**.
2. Feed the tubing down the rod bore until it hits bottom on the expendable point holder. Allow about 2 ft. (610 mm) of tubing to extend out of the hole before cutting it.
3. Grasp the excess tubing and apply some downward pressure while turning it in a counterclockwise motion to engage the adapter threads with the expendable point holder **(Figure 3)**.
4. Pull up lightly on the tubing to test engagement of the threads. (Failure of adapter to thread could mean that intrusion of soil may have occurred during driving of probe rods or disengagement of drive point.)

SOP No. 14 – Soil Gas Sampling for Chemical Analysis

Soil Gas Sampling — PRT System Operation

Sampling

1. Connect the outer end of the tubing to the Silicone Tubing Adapter and vacuum hose (or other sampling apparatus).
2. Follow the appropriate sampling procedure for collecting a soil gas sample **(Figure 1)**.

Removal

1. After collecting a sample, disconnect the tubing from the vacuum hose or sampling system.
2. Pull up firmly on the tubing until it releases from the adapter at the bottom of the hole. (Taped tubing requires a stronger pull.)
3. Remove the tubing from the probe rods. Dispose of polyethylene tubing or decontaminate Teflon tubing as protocol dictates.
4. Retrieve the probe rods from the ground and recover the expendable point holder with the attached PRT adapter.
5. Inspect the O-ring at the base of the PRT adapter to verify that proper sealing was achieved during sampling. The O-ring should be compressed. This seal can be tested by capping the open end of the point holder applying vacuum to the PRT adapter.
6. Prepare for the next sample.



Figure 1. Taking a soil gas sample for direct injection into a GC with the PRT system.

Geoprobe® Systems

D.4

TI-SDC JOINT VENTURE

Soil Gas Sampling Field Data Sheet

SUMMA AIR SAMPLING WORK SHEET

Contract No: _____ Site: _____
Date: _____ Weather: _____
Sampler:_____

Sample #					
Location					
SUMMA Size					
SUMMA ID					
Orifice Used					
Analysis/Method					
Time (Start)					
Time (Stop)					
Total Time					
SUMMA WENT TO AMBIENT	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO
Initial Canister Pressure					
Final Canister Pressure					
Flow Rate (Pre)					
Flow Rate (Post)					
Flow Rate (Average)					
Purged Volume					
Number of Purged Volumes Removed					
MET Station On-site? Y / N					

General Comments:

TI-SDC JOINT VENTURE

Soil Gas Sampling Field Data Sheet

SUMMA AIR SAMPLING WORK SHEET

Contract No: _____ Site: _____
Date: _____ Weather: _____
Sampler:_____

Sample #					
Tracer Gas Monitoring	Time Hg	Time Hg	Time Hg	Time Hg	Time Hg

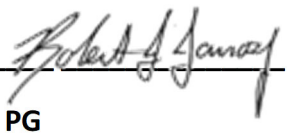
General Comments:

Standard Operating Procedure No. 15

Field Instrumentation Calibration

Revision:___ _____

Reviewed_12/15/2021_____

Reviewer: 

Bob Janosy, PG

SOP No. 15 – Instrumentation Calibration

1.0 OBJECTIVE

This procedure will be used as a field reference guide for the calibration of field instruments for a Horiba U-52 and an Oakton T-100 water quality meters. Water temperature, conductivity, pH, dissolved oxygen, and oxidation reduction potential will be recorded using the Horiba U-52 Water Quality Meter. Turbidity will be recorded using an Oakton T-100 turbidity meter. A MiniRae 3000 PID will be used for measuring organic vapors. A MGD-2002 (or similar) helium detector will be used during tracer gas leak testing during the soil gas sampling effort.

2.0 EQUIPMENT AND MATERIALS

- Horiba U-52 Water Quality Meter
- Oakton T-100
- MiniRae 3000 PID
- MGD-2002 (or similar) Helium Detector
- Tedlar BagCalibration standards
- 100 ppm isobutylene Span gas
- Deionized water
- Calibration sheets

3.0 METHODOLOGY

Horiba U-52 Calibration

To obtain correct measurement values, the sensors need to be calibrated using standard solution before measurement. You can select simultaneous auto calibration of the pH, COND and TURB sensors in pH4 standard solution and DO and DEP sensors simultaneously in air, or manual calibration of individual measurement parameters.

- Wait at least 20 minutes after turning the power ON before calibrating the DO sensor.
- Make the DO and COND compensation settings before calibration since these settings are applied during calibration.
- Select only the desired parameters for calibration and calibrate just those parameters
- Use about 200 mL of standard solution in the calibration cup.

Auto calibration:

The following parameters are calibrated (at 25°C):
pH: Set to 4.01 (zero-point calibration); the span is adjusted to the factory default value.
COND: 0.449 S/m (4.49 mS/cm, span calibration); zero point is adjusted to the factory default.
TURB: 0 NTU (zero-point calibration); the span is adjusted to the factory default value.
DO: 8.92 mg/L (span calibration); the zero point is adjusted to the factory default value.
DEP: 0 m (zero-point calibration); the zero point is adjusted to the factory default value.

If the air temperature changes, the readout value may not be stable. Ensure that the ambient air

temperature is the same temperature as the calibration solution, because the internal probe temperature sensor and external temperature sensor (in the calibration solution) are used for the auto calibration. Allow the probe and standard solution to equilibrate for 1 hour if a thermometer is not available to verify that these temperatures are the same.

Do not hold the probe while performing the auto calibration. Body temperature may elevate the internal temperature sensor measurement creating DO calibration error.

1. Remove the sensor guard and wash the sensor probe 2 or 3 times with deionized water.

2. Remove the transparent calibration cup.

3. Fill the transparent calibration cup to the line with pH 4 standard solution.

4. Press the control unit's CAL key to set the calibration mode.

5. Press the down (V) key to move the cursor to "Auto Calibration", then press the ENTER key.

6. Immerse the sensor probe in the transparent calibration cup. Check that the pH sensor, ORP sensor, reference electrode, COND sensor, TURB sensor and temperature sensor are submerged in the pH 4 standard solution and check that there are no air bubbles on the sensor.

7. With the sensor probe still in the transparent calibration cup, place the transparent calibration cup into the black calibration cup.

8. When all the sensor values have stabilized, press the ENTER key to start calibration.

Note - Do not remove the sensor probe from the calibration solution. U-53 turbidity data will display "----" until the calibration is completed.

Calibration is finished when the message "Cal complete. MEAS to measure." appears.

Press the MEAS key to set the measurement screen, then start measurement.

Manual calibration

The procedures below describe how to calibrate each sensor individually.

Temperature (TEMP) calibration

1. Fill a bucket or similar container with water of a known temperature, and insert the sensor probe in it. Wait 5 minutes before starting calibration to allow the sensor probe temperature to stabilize.

2. Press the control unit's CAL key to set the calibration mode.

3. Press the down (V) key to move the cursor to "Manual Calibration", then press ENTER key.

4. In the parameter selection screen, move the cursor to "Temp", then press the ENTER key.

5. Press the up (U) and down (V) keys to set the calibration value - the temperature of the water containing the submerged sensor probe.

6. Check that “Measurement value” has stabilized, then press the ENTER key to start calibration.

Calibration is finished when the message “Cal complete. CNT to measure.” appears.

pH calibration

You can select one calibration point (zero-point calibration) or two calibration points (zero-point calibration and span calibration). Carry out two calibration procedures to ensure good measurement precision throughout all measurement ranges.

1. Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 7 standard solution.

2. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.

3. Press the control unit’s CAL key to set the calibration mode.

4. Press the down (V) key to move the cursor to "Manual Calibration", then press ENTER key.

5. In the parameter selection screen, move the cursor to "pH", then press the ENTER key.

6. Set the number of calibration points, then press the ENTER key.

7. Press the up (U) and down (V) keys to set the pH value of the pH 7 standard solution containing the submerged sensor probe at the measurement temperature

8. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

9. Press the ENTER key to start the span calibration procedure when the message "Cal complete. Press ENT to Span cal." appears.

10. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 4 or pH 9 standard solution.

11. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.

12. Press the up (U) and down (V) keys to set the pH value of the pH 4 or pH 9 standard solution containing the submerged sensor probe at the measurement temperature.

13. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

14. Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter

ORP calibration

If the prepared ORP standard solution is left in open air for one hour or more, the solution may be transformed. For this reason ORP standard solution cannot be stored. Calibrate within one hour of preparing the solution. When measuring sample with low concentrations of oxidants and reductants after conducting an operational check using a standard substance, the measured values may not stabilize or the results of measurement might not be repeatable. If this is the case, start the measurement after immersing the sensors in the sample water sufficiently.

When alkaline ion water is left for 5 minutes, its ORP undergoes changes significantly. Always measure alkaline ion water promptly.

1. Fill a clean beaker with one bag of ORP standard powder No. 160-22 or No. 160-51. Add 250 mL of deionized water and agitate the solution thoroughly (there will be some excess quinhydrone (a black powder) that floats on the surface when agitating the solution). Fill the transparent calibration cup to the reference line with this standard solution.

2. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.

3. Press the control unit's CAL key to set the calibration mode.

4. Press the down (V) key to move the cursor to "Manual Calibration", press the ENTER key.

5. In the parameter selection screen, move the cursor to ORP, then press the ENTER key.

6. Press the up (U) and down (V) keys to set the mV value of the ORP standard solution containing the submerged sensor probe at the measurement temperature.

7. Check that "Measurement value" has stabilized, then press ENTER key to start calibration.

8. Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.

Conductivity (COND) calibration

To support a wide range of sample concentrations, electrical conductivity is divided into three measurement ranges: 0.0 mS/m - 99.9 mS/m, 0.090 mS/m - 0.999 S/m, and 0.9 S/m - 9.99 mS/m.

When manually calibrating conductivity, you can select two calibration points (one zero-point calibration point and a span calibration point for one of the three measurement ranges) or four calibration points (one zero-point calibration point and span calibration points for all three

measurement ranges). Carry out the four calibration points to ensure good measurement precision throughout all measurement ranges.

Make the compensation setting before calibration since this setting is applied during calibration.

1. Prepare the standard solution. Dry Potassium chloride (KCl) powder (high-grade commercially available) at 105°C for two hours, and leave it to cool in a desiccator.

2. Consult the following table and weigh potassium chloride (KCl), then prepare three standard potassium chloride (KCl) solutions following the procedure below.

3. Dissolve the weighed Potassium Chloride (KCl) in deionized water.

4. Put the dissolved Potassium Chloride (KCl) into a 1 L measuring flask, and fill to the 1 L mark with deionized water.

5. Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).

6. Press the control unit's CAL key to set the calibration mode.

7. Press the down (V) key to move the cursor to "Manual Calibration", then press ENTER key.

8. In the parameter selection screen, move the cursor to "Cond", then press ENTER key.

9. Set the number of calibration points, then press the ENTER key.The instructions below assume that four calibration points have been set.

10. Press the up (U) and down (V) keys to set "Cond" value to 0.0 mS/m (0.000 mS/cm).

11. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

12. When the message "Cal complete. Press ENT to Span cal." appears, press ENTER key to start the first span calibration procedure.

13. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 71.8 mS/m (0.718 mS/cm) standard solution.

14. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.

15. Press the up (U) and down (V) keys to set the "Cond" value to 71.8 mS/m (0.718 mS/cm). Calibration range = 0 mS/m to 99.9 mS/m (0 mS/cm to 0.999 mS/cm)

16. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

17. When the message "Cal complete. Press ENT to Span cal." appears, press ENTER key to start the next span calibration procedure.

18. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 0.667 S/m (6.67 mS/cm) standard solution.

19. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.

20. Press the up (U) and down (V) keys to set the "Cond" value to 0.667 S/m (6.67 mS/cm). Calibration range = 0.100 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)

21. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

22. When the message "Cal complete. Press ENT to Span cal." appears, press ENTER key to start the next span calibration procedure.

23. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 5.87 S/m (58.7 mS/cm) standard solution.

24. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.

25. Press the up (U) and down (V) keys to set the "Cond" value to 5.87 S/m (58.7 mS/ cm). Calibration range = 1.00 S/m to 10.00 S/m (10.0 mS/cm to 100.0 mS/cm)

26. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

27. Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.

Dissolved oxygen (DO) calibration

You can select one calibration procedure (span calibration) or two calibration procedures (zeropoint calibration and span calibration). Carry out the two calibration procedures to ensure good measurement precision throughout all measurement ranges.

It is necessary to prepare new solution before calibration of the Dissolved Oxygen (DO) sensor.

The calibration cup (included) cannot be used to manually calibrate the DO sensor. Use a suitable bottle in which the DO sensor and the temperature sensor can be immersed.

Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.

Make the compensation setting before calibration since the setting is applied during calibration. The DO sensor is affected by flow. When performing span calibration with saturated

dissolved oxygen water, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) or agitate the saturated dissolved oxygen water.

1. Prepare the standard solution. Add about 50 g of sodium sulfite to 1000 mL of water (either deionized water or tap water) and stir the mixture to dissolve the sodium sulfite in it. Pour 1 to 2 liters of water into a suitable flask (either deionized water or tap water). Using a air pump, feed air into the water and aerate the solution until oxygen is saturated.

2. First, calibrate the zero point. Press the control unit's CAL key to set the calibration mode.

3. Press the down (V) key to move the cursor to "Manual Calibration", then press ENTER key.

4. In the parameter selection screen, move the cursor to DO or DO%, then press ENTER key.

5. Set the number of calibration procedures, then press the ENTER key. The instructions below assume that two calibration points have been set.

6. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the bottle.

7. Press the up (U) and down (V) keys to set the DO value to 0.00 mg/L or 0.0%.

8. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

9. When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the span calibration procedure.

10. Wash the sensor probe 2 or 3 times with deionized water to remove any dirt, then submerge the sensor probe in the container filled with the span solution.

11. Press the up (U) and down (V) keys to set the DO value to the saturated dissolved oxygen value (mg/L) of the water at that temperature or the dissolved oxygen saturation ratio.

12. Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.

13. Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.

Oakton T-100 Calibration

Turbidity Calibration

1. Place TN-100/ T-100 turbidimeter on a flat and level surface.

2. Insert the CAL 1 standard (800 NTU) into the sample well, aligning the mark on the vial with the mark on the meter.

3. Press down vial until it snaps fully into the instrument.

4. Cover the vial using the light shield cap.

5. Press ON/OFF key to switch the on the meter. The meter goes to measurement mode after the power-up sequence.

6. Select the calibration function of the instrument by pressing the CAL key once. The "CAL" annunciator blinks momentarily and the meter prompt for the first calibration standard "CAL 1 800 NTU".

7. Press READ/ENTER key.

8. The "CAL 1 800 NTU" annunciator blinks for about 12 seconds while the instrument performs calibration of CAL 1 point. When the instrument has completed calibration for this point, it prompts you to insert the next calibration standard into the sample well "CAL 2 100 NTU".

9. Repeat the calibration for CAL 2, CAL 3 & CAL 4 calibration standards.

10. After you successfully calibrate the CAL 4 standard (0.02 NTU), the display shows "STbY".

11. The meter is now ready for measurement.

Post Use Calibration Check (End of Day Check)

After the initial calibration is performed (beginning-of-day), the instrument's calibration may drift during the measurement period. As a result, the amount of drift that occurred during the collection the measurements needs to be determined at the end-of-day. This will be performed by placing the instrument in measurement mode (not calibration mode) and placing the probe in one or more of the standards used during the initial calibration. For the Horiba U-52, all the parameters except for turbidity will be measured using the calibration standards. The Oakton T-100 turbidity meter post-verification check will be performed using one of the 4 calibration standards.

The post use measurement value (end-of-day) will be compared to the initial calibration value (beginning-of-day). This difference in value will be compared to the drift criteria or post calibration criteria described in the quality assurance project plan or the post-calibration criteria below.

- Dissolved Oxygen: < 0.5 mg/L for the 0 mg/L solution, but not a negative value
- Specific Conductance ±5% of standard or ± 10 µS/cm (whichever is greater)
- pH ± 0.3 pH unit with pH 7 buffer
- ORP ± 10 mv
- Turbidity ± 5% of standard

PID Calibration (MiniRae 3000 Portable VOC Monitor)

SOP No. 15 – Instrumentation Calibration

1. Allow the temperature of the unit to equilibrate to its surroundings. This could take up to 15 minutes depending on the difference between the temperature of the environment where the detector was stored prior to use and the temperature on site. Note: The range of operating temperatures for this instrument is -4°F to 122°F.

2. Attach probe tip and hydrophobic (water trap) filter by screwing it to the detector inlet. Ensure that the probe tube, filter, and detector inlet fittings are tight. Note: Do not operate the MiniRae 3000 without a water trap filter installed. Operating without it could cause the pump to strain and/or be damaged, and could prevent the sample from reaching the unit. The filter should be replaced when clogged, visibly dirty, and after high measurements.

3. Turn on the detector by depressing the Φ (MODE) button.

4. Allow the instrument to "warm up" prior to calibrating, by allowing it to run for ~5 minutes. During this time the unit will display its setting during the warm up sequence. When it has finished its warm up, readings will be in parts per million (ppm).

5. Test the pump by blocking the pump flow. The alarm should sound and the pump icon should flash. Push the Y/+ button to the clear the alarm. Note: Do not use a unit that does not pass the pump test.

6. Fill the Tedlar® Sampling Bag with the calibration reference standard.

Span Gas Calibration

1. Select the "Span Calib" and press the Y/+ button.

2. The screen will read; C. Gas = Isobutylene, Span = 100 ppm, Change? Note: If the span value on the screen is different from the isobutylene in the Tedlar® Sampling Bag, adjust it now.

3. If the gas is 100 ppm isobutylene-in-air, press the N/- button.

4. Open and connect a FULL Tedlar® Sampling Bag of 100 ppm isobutylene-in-air standard to the probe tip and then press the Y/+ button.

5. The screen will read, "Calibrating…." with a 30 second countdown.

6. When the span calibration is finished, the screen will read; "Span 1 is done Reading=100.0 ppm". Note: The reading should range between 95 and 105 (within 5% of the calibration standard). If it differs from this, recalibrate. If after two attempts, the detector cannot be recalibrated to fall within this range, the instrument should be taken out of service and replaced with a properly functioning unit. All calibration information should be documented on the attached PID/FID Daily Calibration Field Sheet.

7. The unit is now ready for use. Refer to section V. and VI. for guidance relative to field screening of environmental media and air quality monitoring.

SOP No. 15 – Instrumentation Calibration

Post Use Calibration Check

Complete an end-of-the-day calibration check. While the instrument is in the run mode, connect the probe tip to a FULL Tedlar® Sampling Bag of 100 ppm isobutylene-in-air standard. NOTE: Use a fresh bag of calibration gas for the calibration check. A bag filled in the morning may not be accurate in the afternoon, especially if the bag was exposed to sunlight. Record this measurement on the attached PID/FID Daily Calibration Field Sheet. If the measurement does not between 95 and 105 ppm, the field data will need to be qualified. For multiple days of field use, if the instrument fails the end-of-the-day check on two consecutive days, the unit should be replaced.

ION Science GasCheck G Helium Detector

- Select ‘Calibration’ screen and use UP/DOWN keys to move the check to the desired Custom Cal symbol.

Press ‘Esc’ key to exit into the main menu'Custom Calibration' can only be selected and use after the instrument has been calibrated by the user, to do this move the 'tick / check' under the 'Custom Cal' symbol and press the ENTER key.

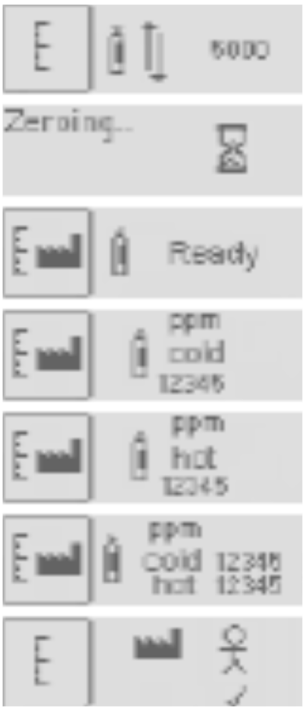
The GasCheck G requires either 5000 ppm Helium concentration or a 0.0005cc/sec (5 E-4 cc/sec) leak rate as a reference. The GasCheck G automatically selects the type of Calibration media based on which units the instrument already has selected.

If the GasCheck G is used to detect leaks measured using 'ppm or mg/m3' units then the instrument must be calibrated using a 5,000 ppm Helium concentration.

If the GasCheck G is used to detect leaks measured using 'cc/sec' units then the instrument must be calibrated using a 0.0005 cc/sec (5 E-4) Helium leak.

SOP No. 15 – Instrumentation Calibration

Calibration procedure using 'ppm' units



1. Fill an empty (uncontaminated) sample bag with 5,000 ppm Helium gas before starting the calibration procedure. Also remove the outer grey probe from the GasCheck G.

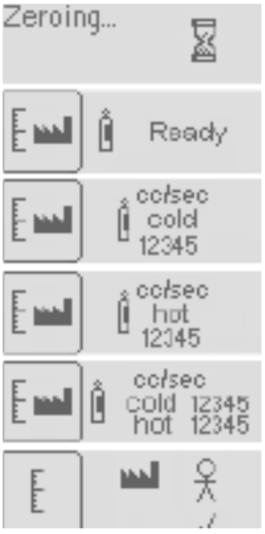
2. Select the 'Custom Cal' symbol from the instruments menu. An option appears allowing the adjustment of the 'ppm' value to ensure the instrument matches the gas concentration being used. Use the UP and DOWN keys to adjust between 4,900 and 5,100 ppm.

3. Ensure the instrument is in clean air and then press the ENTER key, the instrument will Zero, this will take a few seconds but once complete a 'Ready' message will appear.

4. Insert the instruments probe fully into the sample bag containing the gas and press the ENTER key. The instrument will automatically sequence through the cold and hot stages of calibration but when finished gives a summary of values.

5. Press the ENTER key to return back to the calibration option screen. Press the ESC key to start using the instrument or press the ENTER key to calibrate again.

Calibration procedure using 'cc/sec' units



1. Follow the instructions of the CalCheck unit, the pointer of the pressure gauge must be resting over the green segment.

2. Select the 'Custom Cal' symbol from the instruments menu.

3. Ensure the instrument is in clean air and then press the ENTER key, the instrument will Zero, this will take a few seconds but once complete a 'Ready' message will appear.

4. Insert the instruments probe into the CalChecks outlet and press the ENTER key. The instrument will automatically sequence through the cold and hot stages of calibration but when finished gives a summary of values.

5. Pressing the ENTER key will return back to the calibration option screen. Press the ESC key to start using the instrument or press the ENTER key to recalibrate again.

Horiba U-52 Calibration Log

TIDEWATER INC

Project/Site Name: _____

Date: _____

Project No: _____

By: _____

Date	Stabilization (Y/N)	Auto Cal (Y/N)	Temp (°C)	pH	ORP (mV)	Conductivity (mS/cm)	Turbidity (NTU)	DO (mg/L)	Notes

Turbidity Meter Calibration Log

TIDEWATER INC

Project/Site Name: _____ Date: _____

Project No: _____ By: _____

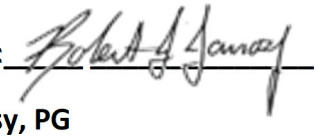
Instrument/Serial Number	Pre-Cal AM: .02 NTU	Post-Cal AM: .02 NTU	Pre-Cal AM: 20 NTU	Post-Cal AM: 20 NTU	Pre-Cal PM: .02 NTU	Post-Cal PM: .02 NTU	Pre-Cal PM: 20 NTU	Post-Cal PM: 20 NTU	Date / Time
Oakton T-100 2813533									
Oakton T-100 2568473									
Oakton T-100 2813533									
Oakton T-100 2568473									
Oakton T-100 2813533									
Oakton T-100 2568473									
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Oakton T-100 2568473									
Oakton T-100 2813533									
Oakton T-100 2568473									

Standard Operating Procedure No. 16

Multi-Gas Meter Operation

Revision:___ _____

Reviewed:___12/15/2021_____

Reviewer: 

Bob Janosy, PG

SOP No. 16 – Multi-Gas Meter Operation

1.0 OBJECTIVE

The purpose of this document is to describe the use of the Eagle 2 field portable multi-gas detectors.

2.0 EQUIPMENT AND MATERIALS

- Eagle II Multi-gas Meter
- Calibration Gas

3.0 METHODOLOGY

There are three operational modes in Normal Mode: Measuring Mode, Display Mode, and Calibration Mode. While in Normal Mode, the unit is normally operating in Measuring Mode.

This section explains how to start up the EAGLE 2, get it ready for operation, and turn it off.
The EAGLE 2 may be used with a sample hose or with the probe installed directly to the inlet fitting.

1. Connect the sample hose or probe to the EAGLE 2's quick connect inlet fitting.
2. If using a sample hose, connect the probe to the sample hose's quick connect fitting.
3. Press and briefly hold down the POWER ENTER RESET button. Release the button when you hear a beep.
4. The LCD will show the following screen for about ten seconds.
5. The Battery Voltage Screen appears for a few seconds.
6. The Active Gases Screen appears for a few seconds indicating which channels are active and their target gas.
7. The gas alarm setpoints are displayed by three screens in sequence: the Low Alarm Screen, High Alarm Screen, and STEL/TWA Alarm Screen. Each screen remains on the LCD for three seconds.
8. After the alarm screens, a Calibration Screen reminder is displayed prompting user to calibrate instrument if necessary.
10. The Date/Time Screen appears for a few seconds.
11. If a sensor failure occurred during start up, a screen indicating which sensor failed appears and the buzzer sounds a pulsing tone twice per second.
13. The Measuring Mode Screen is displayed indicating the unit is ready for measurements. The Normal Operation Screen appears displaying the current gas reading for each target gas.

Calibration Mode

This section describes the EAGLE 2 in Calibration Mode. In Calibration Mode, you can move through a menu of screens to do the following:
• Perform a span adjustment on all channels simultaneously using auto calibration
• Perform a span adjustment on one channel at a time using single calibration

SOP No. 16 – Multi-Gas Meter Operation

• Perform a fresh air (zero) adjustment

NOTE: BEFORE EACH DAY'S USAGE, SENSITIVITY IN THE %LEL RANGE MUST BE TESTED ON A KNOWN CONCENTRATION OF THE COMBUSTIBLE TARGET GAS, METHANE, EQUIVALENT TO 25 - 50% OF FULL SCALE CONCENTRATION (the %LEL full scale is 100 %LEL). ACCURACY MUST BE WITHIN -0 to + 20% OF ACTUAL. ACCURACY MAY BE CORRECTED BY FOLLOWING THE CALIBRATION INSTRUCTIONS FOR THE COMBUSTIBLE CHANNEL BELOW.

If the combustible channel passes the above response test and does not require calibration, the unit should still be calibrated periodically. The optimum frequency of calibration depends heavily on how the EAGLE 2 is used. For example, instruments used daily may need to be calibrated weekly or monthly, while instruments that are used only a few times a year may need to be calibrated before each use. Typical calibration frequencies range from monthly to quarterly. Make sure to perform the combustible channel response test as described above and make sure to develop a calibration schedule tailored to your application that takes this test and required calibration resulting from this test into account.

Calibration Supplies and Equipment

• Calibration Gas. Known calibrating samples of the gases being detected. The combustible and toxic gas samples should have concentrations between 10 and 50% of the full scale value.
• A demand-flow regulator to provide adequate sample gas flow
• Non-absorbent tubing
WARNING: If you are using a calibration kit that includes a gas bag and a fixed flow regulator or dispensing valve, do not apply gas directly to the EAGLE 2 with the regulator or dispensing valve or damage to the pump will result.

To calibrate the %LEL, oxygen, CO, and H2S sensors at the same time, automatically, with no need for a zero-oxygen source, you can use the auto calibration feature with a 4-gas cylinder. If the H2S channel is not active, then a 3-gas cylinder may be used for auto calibration. This chapter includes instructions for auto calibration.

To enter Calibration Mode, do the following:
1. Find a fresh-air environment. This is an environment free of toxic or combustible gases and of normal oxygen content (20.9%).
2. While in Measuring Mode, press and hold the RANGE ▼ SHIFT button, then press the DISPLAY ADJUST NO button and release both buttons.
3. The Calibration Mode Screen displays with the cursor next to AUTO CALIBRATION.

Calibrating Using the Auto Calibration Method

This method allows you to calibrate the CH4 (%LEL sensor), oxygen, H2S, and CO sensors simultaneously. It is designed for use with the RKI 4-gas calibration cylinder and is the quickest and easiest method to calibrate the EAGLE 2.

SOP No. 16 – Multi-Gas Meter Operation

Setting the Fresh Air Reading
1. While in the Calibration Mode Screen, move the cursor to the PERFORM AIR ADJUST menu item by using the RANGE ▼ SHIFT button.
2. Press and release the POWER ENTER RESET button. The following screen appears.
3. Press and release the AIR ▲ YES button to continue.
If you do not want to continue, press the DISPLAY ADJUST NO button and the unit will return to the Calibration Mode Screen.
4. The EAGLE 2 will indicate that it is adjusting the zero reading for a few seconds, then indicate that the operation is complete before returning to the Calibration Mode Screen.

Post Use Calibration Check (End of Day Check)

After the initial calibration is performed (beginning-of-day), the instrument's calibration will be checked at the end of the day through a post-verification check. This will be performed by placing the instrument in measurement mode and placing the probe into a Tedlar bag with the span gas.

The post use measurement value (end-of-day) will be compared to the initial calibration value (beginning-of-day). The initial and post values will be compared and recorded on the calibration sheet. The verification measurement process will be conducted on the methane span gas and compared to the criteria below.

- Methane (CH4) - 15% Volume

APPENDIX H

FIELD FORMS

TI-SDC JOINT VENTURE

Former Stewart AFB Groundwater Gauging Log

Weather:

Personnel:

Measuring Point: Top of Casing (TOC)
Measuring Point Description: Black Mark

Well ID	Date	Time	PID (ppm)	DTB (ft)	DTP (ft)	DTW (ft)	NOTES

CONTRACTOR/SUPERINTENDENT DATE

TI-SDC JOINT VENTURE

Former Stewart AFB
Well Development / Purge Log

Location: Newburgh & New Windsor, NY	Well No.:	Date:	Contract No.: W912WJ-19-D-0006	Page 1 of 1

Equipment:

Personnel:

Date and Time Pump Dropped:

Total Well Depth: TOC Screen Interval:: to

Static Water Level: TOC Depth to Product:

Water Column: Product Layer:

Weather:

Well Condition:

Pump Type:

Purge Start Time: HRS

Purge Stop Time: HRS

Pump Rate: mL/min

Total volume Purged:

Well Casing Diameter: 2-inch

Minimal Purge Sampling ☐ Low Flow Method ☐

Criteria used to stop purging / development: Dry Well ☐ Parameter Stabilization ☐

Time	Water Depth (ft btoc)	Temp. (°C) +/- 10%	PH (units) +/- 0.2	ORP (mV) +/- 10	Conductivity (mS/cm) +/- 10%	Turbidity (NTU) +/- 10%	Dissolved Oxygen (mg/L) +/- 10%	Salinity	Comments

Field Team Leader Signature _____

Environmental Analysis Request/Chain of Custody

eurofins | Lancaster Laboratories Environmental

Acct. # _____ Group # _____ Sample # _____

Client:	
Project Name/#:	Site ID #:
Project Manager:	P.O. #:
Sampler:	PWSID #:
Phone #:	Quote #:
State where samples were collected: ____	For Compliance: Yes ☐ No ☐

Sample Identification	Collection Date	Collection Time	Grab	Composite	Matrix: Soil	Tissue	Sediment	Water: Potable	Ground	NPDES	Surface	Other:	Total # of Containers	Analyses Requested / Preservation and Filtration Codes	Remarks

For Lab Use Only

SF #: _____

SCR #: _____

Preservation Codes

H = HCl T = Thiosulfate

N = HNO_3 B = NaOH

S = H_2SO_4 P = H_3PO_4

F = Field Filtered O = Other

Turnaround Time Requested (TAT) (please check): Standard ☐ Rush ☐

(Rush TAT is subject to laboratory approval and surcharges.)

Date results are needed:

Rush results requested by (please check): E-Mail ☐ Phone ☐

E-mail Address:

Phone:

Data Package Options (please check if required)

Type I (Validation/non-CLP) ☐ MA MCP ☐

Type III (Reduced non-CLP) ☐ CT RCP ☐

Type VI (Raw Data Only) ☐ TX TRRP-13 ☐

NJ DKQP ☐ NYSDEC Category ☐ A or ☐ B

EDD Required? Yes ☐ No ☐ If yes, format: _____

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Relinquished by Commercial Carrier:

UPS _____ FedEx _____ Other _____

Temperature upon receipt _____ °C

eurofins | Air Toxics

Analysis Request /Canister Chain of Custody

For Laboratory Use Only

PID: _____ Workorder #: _____

180 Blue Ravine Rd. Suite B, Folsom, CA 95630
Phone (800) 985-5955; Fax (916) 351-8279

Click links below to view:
Canister Sampling Guide
Helium Shroud Video

Client: _____ PID: _____
Project Name: _____
Project Manager: _____ P.O.# _____
Sampler: _____
Site Name:

Special Instructions/Notes:

Turnaround Time (Rush surcharges may apply)

Select TAT from drop down box

Lab ID	Sample Identification	Can #	Flow Controller #	Start Sampling Information		Stop Sampling Information		Canister Vacuum/Pressure		Lab Use Only		Requested Analyses			
				Date	Time	Date	Time	Initial (in Hg)	Final (in Hg)	Receipt	Final (psig) Gas: N_2 / He				

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time

Lab Use Only

Shipper Name:	Custody Seals Intact?	Yes	No	None	

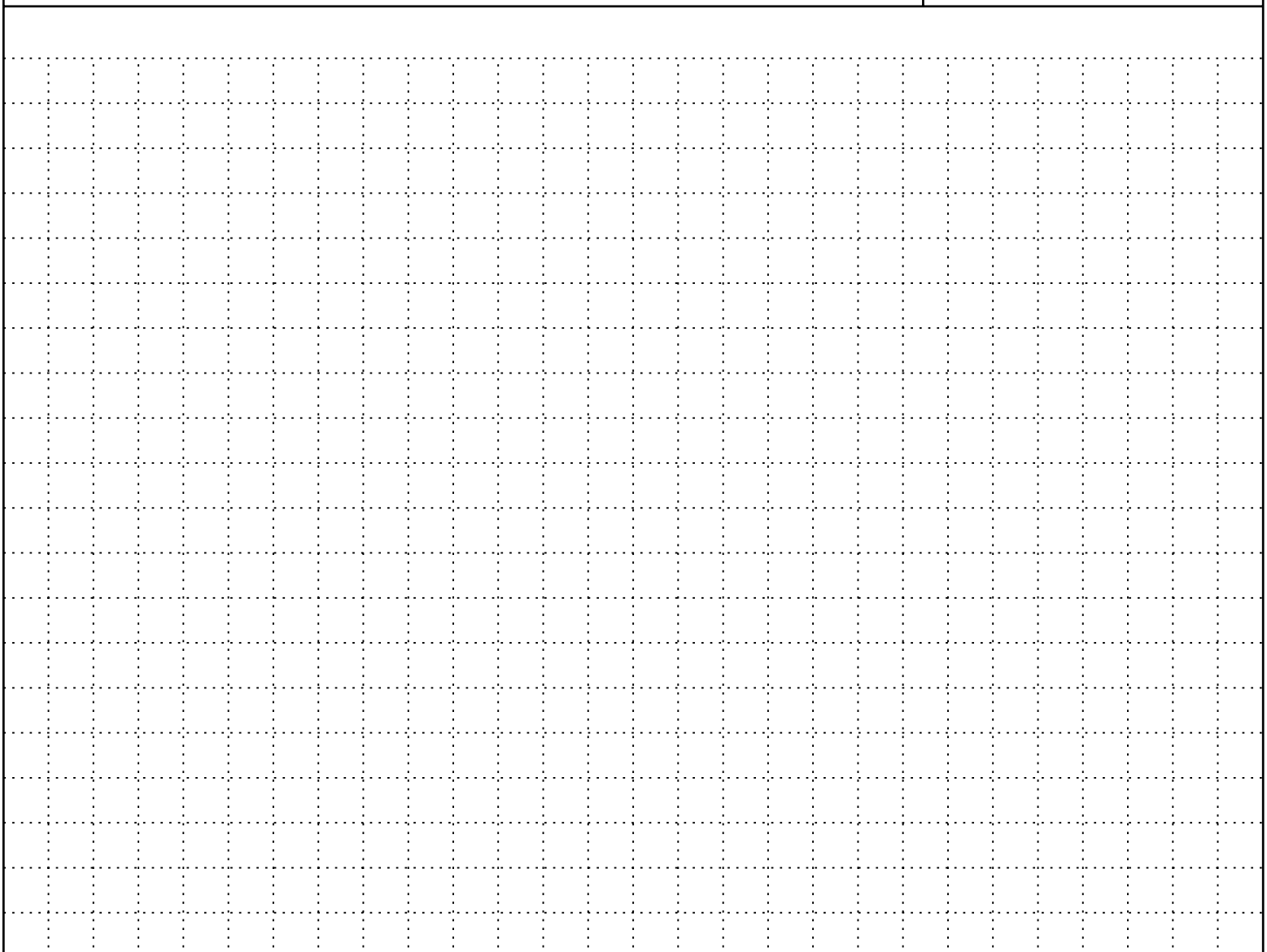
Sample Transportation Notice: Relinquishing signature on this document indicates that samples are shipped in compliance with all applicable local, State, Federal, and international laws, regulations, and ordinances of any kind. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Eurofins Air Toxics against any claim, demand, or action, of any kind, related to the collection, handling, of shipping of samples. D.O.T Hotline (800) 467-4922

HTRW DRILLING LOG

DISTRICT		HOLE NUMBER
1. COMPANY NAME	2. DRILL SUBCONTRACTOR	SHEET SHEETS OF
3. PROJECT	4. LOCATION	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED	11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOLAL CORE RECOVERY %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR		

LOCATION SKETCH/COMMENTS | SCALE



PROJECT	HOLE NO.

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER	
PROJECT	INSPECTOR
SHEET	SHEETS OF

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)

PROJECT	HOLE NO.

Monitoring Well Construction Log Form

Project Name: _____ **Well No.** _____

Project Location: _____ **Project No.** _____

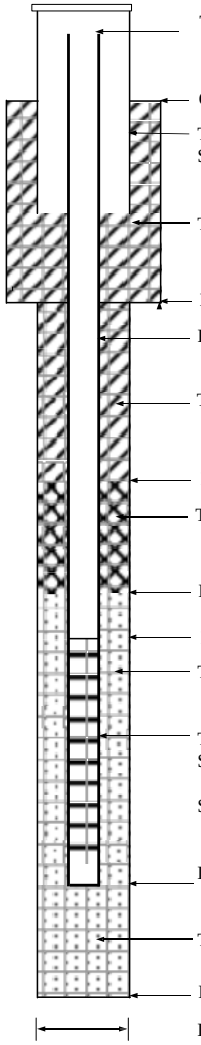
Installed By: _____ **Observed By:** _____ **Date of Well Completion** _____

Method of Installation: _____

Well Type (circle one): **Single Cased** **Double Cased**

Coordinates: **Northing** _____ **Survey Datums:** _____

Easting _____



	feet bgs	Elevation (feet MSL)
Top of Casing		_____
Ground Elevation		_____
Type of surface casing _____ Surface Casing ID _____		
Type of surface seal _____		
Depth of surface seal	_____/	_____
I.D./Type of riser pipe _____		
Type of grout _____		
Depth to top of seal	_____/	_____
Type of seal _____		
Depth to top of filter pack	_____/	_____
Depth to top of screen	_____/	_____
Type of filter pack _____		
Type of screen _____ Screen ID _____		
Screen slot size _____		
Depth to bottom of well	_____/	_____
Type of backfill _____		
Depth to bottom of boring	_____/	_____
Diameter of boring _____		

Diagram Not To Scale

Notes:
bgs = Below ground surface
MSL = Mean sea level
NA = Not applicable
ID = Inside diameter

TI-SDC JOINT VENTURE

Canister Sampling Field Data Sheet

SUMMA AIR SAMPLING WORK SHEET

Contract No: _____ Site: _____
Date: _____ Weather: _____
Sampler:_____

Sample #					
Location					
SUMMA ID					
Orifice Used					
Analysis/Method					
Time (Start)					
Time (Stop)					
Total Time					
SUMMA WENT TO AMBIENT	YES/NO	YES/NO	YES/NO	YES/NO	YES/NO
Pressure Gauge					
Pressure Gauge					
Flow Rate (Pre)					
Flow Rate (Post)					
Flow Rate (Average)					
MET Station On-site? Y / N					
General Comments:					

APPENDIX I

SITE SAFETY AND HEALTH PLAN/ACCIDENT PREVENTION PLAN

FINAL ACCIDENT PREVENTION PLAN AND SITE SAFETY AND HEALTH PLAN

REMEDIAL INVESTIGATION ACTIVITIES

AT THE
FORMER STEWART AIR FORCE BASE,
NEWBURGH AND NEW WINDSOR, NEW YORK

CONTRACT NO. W912WJ-19-D-0006
DELIVERY ORDER NO. W913WJ19F0135
FUDS PROJECT NO. C02NY0704

Prepared for:



U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Prepared by:

TI-SDC JV
3401 Carlins Park Drive, Ste. B
Baltimore, MD 21215-7854

September 2022

a. SIGNATURE PAGE

This Accident Prevention Plan (APP) was developed by Tidewater, Inc and Sustainable Design Consortium, Inc. Joint Venture (TI-SDC) for activities at the Former Stewart Air Force Base, located in Newburgh and New Windsor, New York. The signatures below indicate approval of the plan and agreement to following the procedures described therein.

(1) Prepared by:

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09/30/2022
Date

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Safety and Health Manager / Plan Approver
TI-SDC JV
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09/30/2022
Date

TABLE OF CONTENTS:

a. SIGNATURE PAGE ii
b. BACKGROUND INFORMATION 1
(1) Contractor 1
(2) Contract Number 1
(3) Project Name 1
(4) Brief Project Description, Description of Work to be performed, and Location 1
Project Description 1
Project Locations 1
(5) Major phases of work anticipated 1
(6) Activity Hazard Analysis 3
c. STATEMENT OF SAFETY AND HEALTH POLICY 5
Safety and Health Policy Statement 5
d. RESPONSIBILITIES AND LINES OF AUTHORITY 6
(1) Employer's Ultimate Responsibility for Implementation of the SOH Program 6
(2) Key Personnel 7
(3) Competent and/or Qualified Persons Training 8
(4) Competent and/or Qualified Persons and Proof of Competency 8
(5) TI-SDC's Risk Management Process 8
(6) Pre-Task Safety and Health Analysis 8
(7) No Work Shall Be Performed Without Designated Competent Person on Site 9
(8) Policies and Procedures Regarding Non-Compliance with Safety Requirements 9
(9) Lines of Authority 9
(10) Procedures for Holding Managers and Supervisors Accountable for Safety 10
e. SUBCONTRACTORS AND SUPPLIERS 11
(1) Identification of Subcontractors and Suppliers 11
(2) Safety Responsibilities of Subcontractors and Suppliers 11
f. TRAINING 11
(1) New Hire SOH Orientation Training at the Time of Initial Hire 11
(2) Mandatory Training and Certifications that are Applicable to This Project 12

(3) Periodic Safety and Health Training for Supervisors and Employees 12
(4) Requirements for Emergency Response Training 12
g. SAFETY AND HEALTH INSPECTIONS 13
(1) Safety Inspections 13
(2) External Inspections/Certifications 13
h. MISHAP REPORTING and INVESTIGATION 13
(1) Exposure Data 13
(2) Mishap Investigations, Reports, and Documentation 13
(3) Mishap Notification 14
i. OCCUPATIONAL RISK AND COMPLIANCE PLANS 15
(1) Fatigue Management Plans (01.A.20) 15
(2) Emergency Response Plans 15
Plan Procedures (01.E.01) 15
Responsibilities of the Emergency Coordinator (EC) 16
Obtaining Emergency Services 16
Communications 16
Emergency Contacts and Notifications 16
Emergency Medical Treatments and First Aid 17
Operations Shutdown 19
Procedures for Plan Review and Amendment 19
Spill Plans 19
Notification of Spills and Discharges 19
Required Equipment 19
Spill Control 19
Firefighting Plan (01.E.01) 20
Emergency Services Information (01.E.05) 20
(3) Site Sanitation /Housekeeping Plan (02.B) 20
Housekeeping 20
Restrooms 20
Drinking Water 21

Waste Disposal 21
(4) Medical Support (03.A) 21
On-Site Medical Support 21
Off-Site Medical Arrangements 21
First Aid/CPR 22
(5) Blood-Borne Pathogen Program (03.A.05) 22
(6) Exposure Control Plan (03.A.05) 22
(7) Automatic External Defibrillator (AED) Program (03.B.04) 22
(8) Site Layout Plan (04.A) 22
(9) Access and Haul Road Plan (04.B) 22
(10) Hearing Conservation Program (05.C) 22
(11) Respiratory Protection Plan (05.G) 22
(12) Health Hazard Control (06.A) 23
Personal Protective Equipment 23
(13) Hazard Communication Program (06.B.01) 24
Hazardous or Toxic Agent Labeling 25
Safety Data Sheets (SDSs) 25
Employee Information and Training 25
Personnel Protective Equipment 25
(14) Process Safety Management Program (06.B.04) 25
(15) Lead Compliance and Abatement Plan (06.C.02) 25
(16) Asbestos Abatement Plan (06.C.03) 26
(17) Radiation Safety Program (06.F) 26
(18) Abrasive Blasting Plan (06.I) 26
(19) Heat/Cold Stress Monitoring Plan (06.J) 26
Heat Stress Monitoring Plan (HSMP) (06.J.01) 26
Cold Stress Monitoring Plan (CSMP) (06.J.04) 27
(20) Indoor Air Quality Management (06.L) 27
(21) Mold Remediation Plan (06.L.04) 27
(22) Chromium (VI) Exposure Evaluation (06.M) 27

(23) Crystalline Silica Monitoring Plan (06.N.02) 27
(24) Lighting Plan for Night Operations (07.A.06) 28
(25) Traffic Control Plan (08.C.05) 28
(26) Fire Prevention Plan (09.A.01) 28
Fueling Area or Stations 28
Fire Protection and Control 28
(27) Wild Land Fire Management Plan (09.L) 29
(28) Arc Flash Hazard Analysis (11.B) 30
(29) Assured Equipment Grounding Control Program (AEGCP) (11.D.05, App. E) 30
(30) Hazardous Energy Control Program and Procedures (12.A.01) 30
(31) Standard Pre-Lift Plan –Load Handling Equipment (16.A.03) 30
(32) Critical Lift Plan – Load Handling Equipment (16.H) 30
(33) Naval Architectural Analysis –Load Handling Equipment (Floating) (16.L) 30
(34) Floating Plant Inspection and Certification (19.A.01) 30
(35) Severe Weather Plan for Marine Activities (19.A.03) 30
(36) Emergency Plan for Marine Activities (19.A.04) 30
(37) Man Overboard/Abandon Ship Procedures (19.A.04) 30
(38) Float Plan for Launches, Motorboats, and Skiffs (19.F.04) 30
(39) Fall Protection & Prevention Plan (21.D) 30
(40) Demolition/Renovation Plan (23.A) 31
(41) Safe Practices for Rope Access Work Plan (24.H) 31
(42) Excavation/Trenching Plan (25.A.01) 31
(44) Compressed Air Work Plan for Underground Construction (26.I.01) 31
(45) Erection and Removal Plans for Formwork and Shoring (27.C) 31
(46) PreCast Concrete Plan (27.D.01) 31
(47) Lift-Slab Plans (27.E) 31
(48) Masonry Bracing Plan (27.F.01) 31
(49) Steel Erection Plan (28.B) 31
(50) Explosives Safety Site Plan (29.A) 31
(51) Blasting Safety Plan (29.A, 26.J) 31

(52) Dive Operations Plan (30.A.14) 32
(53) Safe Practices Manual for Diving Activities (30.A.15) 32
(54) Emergency Management Plan for Diving (30.A.18) 32
(55) Tree Felling and Maintenance Program (31.A.01) 32
(56) Aircraft/Airfield Construction Safety & Phasing Plan (32.A.02) 32
(57) Aircraft/Airfield Safety Plan Compliance Document (32.A.02) 32
(58) Site Safety and Health Plan for HTRW Work (33.B) 32
(59) Confined Space Entry Procedures (34.A.05) 32
(60) Confined Space Program (34.A.06) 32
j. RISK MANAGEMENT PROCESS 32

Appendix A - Site Safety and Health Plan (SSHP)
Appendix B - Activity Hazard Analyses (AHAs)
Appendix C - Site Safety Health Officer Qualifications
Appendix D - Safety Meeting Form
Appendix E - Accident Investigation and Reporting Form ENG 3394

ACRONYMS/ABBREVIATIONS:

ACGIH	American Conference of Industrial Hygienists
ASTM	American Society for Testing and Materials
ACGIH	American Conference of Industrial Hygienists
AED	Automatic External Defibrillator
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
AOC	Areas of Concern
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
COC	Chemical of Concern
COR	Contractor Officer Representative
CP	competent person
CPR	Cardio Pulmonary Resuscitation
CSMP	Cold Stress Monitoring Plan
CSP	Certified Site Professional
DPT	Direct Push Technology
DQCR	daily quality control reports
EC	Emergency Coordinator
FUDS	Formerly Used Defense Site
GFCI	Ground Fault Circuit Interrupter
HAZWOPE	OSHA Hazardous Waste and Emergency Response
R HSMP	Heat Stress Monitoring Plan
IAQ	Indoor Air Quality
ISEA	International Safety Equipment Association
IDW	Investigative Derived Waste
LHE	Load Handling Equipment
OSHA	Occupational Safety and Health Administration
PANYNJ PM	Port Authority of New York and New Jersey
PPE	Project Manager
QC	Personal Protection Equipment
SOH	Quality Control
SOW	Safety and Occupational Health
SDSs	Scope of Work
SHM	Safety Data Sheets
SSHP	Safety and Health Manager
SSHO	Site-specific Safety and Health Plan
TI-SDC	Site Safety and Health Officer
UFP-QAPP	Tidewater, Inc – Sustainable Design Consortium Joint Venture
	Uniform Federal Policy-Quality Assurance Project Plan

USACE	United States Army Corps of Engineers
WBGT	Wet Bulb Globe Temperature

b. BACKGROUND INFORMATION

(1) Contractor

The Prime Contractor for this project is the Tidewater, Inc. - Sustainable Design Consortium, Inc. Joint Venture (TI-SDC).

(2) Contract Number

United States Army Corp of Engineers (USACE) New England District Contract No. W912WJ-19-D-0006, Delivery Order No. W913WJ19F0135, Formerly Used Defense Site (FUDS), No C02NY0704.

(3) Project Name

The project involves conducting Remedial Investigation activities at the Former Stewart Air Force Base (AFB) located in Newburgh and New Windsor, New York.

(4) Brief Project Description, Description of Work to be performed, and Location

Project Description

TI-SDC has prepared this Accident Prevention Plan (APP) and Site Safety Health Plan (SSHP) for Remedial Investigation activities at Former Stewart AFB. The SSHP is included in Appendix A. The current project, described in the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP), involves implementing investigation activities at two areas of concern (AOCs) as detailed further below at Former Stewart AFB. The remedial investigation involves conducting a ground penetrating radar survey, collecting surface water and sediment samples, advancing soil borings to collect soil samples, and collecting groundwater samples from existing groundwater monitoring wells or newly installed wells.

Project Locations

The former Stewart Air Force Base (AFB), now Stewart International Airport is located in Orange County, New York in the southwest portion of the State, approximately 2.5 miles west of Newburgh, New York and 35 miles northwest of New York City. The site is currently owned by the New York State Department of Transportation (NYSDOT). The property is leased and the airport operated by the Port Authority of New York and New Jersey (PANYNJ). In 1930, the original tract of land was donated by Samuel L. Stewart to the City of Newburgh for use as a municipal airport. Prior to this, the land use was primarily agricultural. According to NAE sources, Parcel C02NY070401 was reportedly used as a landfill. A site location map is presented in Figure 1. A detailed summary of the site history and previous investigations are provided in the UFP-QAPP.

(5) Major phases of work anticipated

The current project involves implementing site investigation activities at the Former Southern Landfill (AOC 2, Areas A through D, totaling approximately 70.2 acres) and the "Half-Acre" Landfill (AOC 3, totaling approximately 1.4 acres) at the Former Stewart AFB. The work at Former Stewart AFB will be implemented in accordance with the UFP-QAPP and conducted in three phases.

Phase 1: Preliminary Site Preparation and Data Collection:
Data collected during this initial phase will help guide a more comprehensive sampling event to be performed during Phase 2:

- Perform site preparation activities to include vegetation removal at proposed sampling locations and staging areas for field project equipment and materials.
- Perform a potable well survey to identify off-site drinking water supply wells that are at risk for impacts from site groundwater.
- Conduct a site reconnaissance to identify the location of existing monitoring wells and other site features, such as outfalls and seeps. Assess the condition of the existing monitoring wells to determine if they are suitable for gauging and sampling.
- Perform a wetland delineation for AOC 2 and AOC 3. Assessment criteria will include: hydrology, hydric soils, and vegetation. Areas where assessment criteria are met will then be delineated.
- Install up to 15 piezometers and gauge water levels for the purpose of updating the groundwater surface map and flow direction for the site.
- Verify the integrity of existing monitoring wells and their construction relative to the water table and observed free-phase product (if any). Pending usability, these wells will be incorporated into the overall groundwater sampling program. If the integrity of the wells is compromised, then the existing wells will be abandoned properly.
- Conduct a geophysical survey to locate potential buried containerized waste and metallic debris. The area for the geophysical survey shall encompass the Former AOC 2 and AOC 3.

Phase 2: Comprehensive Sampling.
Investigation samples will be collected to focus sampling locations for the third phase and consists of surface water, sediment, surface and subsurface soil, and groundwater samples.

- Collect up to 20 co-located surface water and sediment samples in identified seep and drainage areas at AOC 2 and AOC 3. Discrete (grab) samples of sediment will be collected from a depth of 0 to 6 inches bgs, using a Petit Ponar grab sampler, or equivalent. Surface water samples will be obtained using a long-handled dip sampler. Surface water will be collected from 2 ft above the bottom of the surface water body unless the depth is less than 2 ft; then the sample will be collected with as little bottom disturbance as possible.
- Collect discrete (grab) surface soil samples at up to 50 locations throughout AOC 2 and 10 locations within AOC 3. Surface soil will be collected manually using a stainless-steel hand trowel or stainless-steel hand auger, at a depth of approximately 0 to 12 inches bgs.
- Conduct up to 25 soil borings to an average depth of 30 feet at AOC 2 and 5 soil borings at AOC 3. The soil borings will be drilled using a Direct Push Technology (DPT) rig with core barrel lined with acetate sleeves for sample collection.
- If deemed suitable for sampling, sample groundwater from the 10 existing wells within AOC 2.

Phase 3: Focused Groundwater Sampling and Background Study.
Groundwater Investigation and Grab Sampling:

- A DPT groundwater investigation will be conducted during the third phase of the investigation along transects at AOC 2 and AOC 3. Up to 60 discrete grab groundwater samples will be collected at average depths of 25-30 feet using a groundwater profiler (such as a Waterloo Sampler or Geoprobe® Screen Point Tool).
- If additional permanent wells are deemed necessary, they will be installed and sampled during a subsequent phase of investigation.
- Background Study: Identify uncontaminated areas outside the influence of the Site, with similar physical conditions. Select an upgradient area for performance of a background DPT investigation.

(6) Activity Hazard Analysis

The Activity Hazard Analysis and control measures for the tasks planned are provided in Appendix B. Work phases that require an activity hazard analysis (AHA) include the following:

1. Mobilization and Demobilization
2. Vegetation Clearing
3. Surveying (to include Land, Utility, Geophysical, Wetland Delineation)
4. Direct Push Technology (DPT)
5. Soil and Groundwater Sampling
6. Equipment Decontamination
7. Investigation Derived Waste (IDW) Management and Disposal

Anticipated Physical Hazards
Tools and Equipment: Hazards present while using tools and equipment are generally associated with improper tool handling and inadequate maintenance. Management of these hazards requires rigorous maintenance of tools and equipment and effective training of employees in the proper use of these tools. Electrically powered tools have inherent physical hazards. Most equipment will create vibrations during operation. Proper safety procedures will be implemented during their operation.

Large power tools and equipment should be lifted properly to prevent back injuries. Safety glasses with side shields, ear protection, and safety-toed boots will be worn while operating powered tools or equipment.

Electrical cords must comply with EM 385-1-1, Section 11 and will be listed by UL or other nationally recognized testing laboratory and shall have unbroken insulation and should not be exposed to water or other liquids. A ground fault circuit interrupter (GFCI) outlet or cord must be used at all times. All electrical equipment must be inspected and color coded as per

the Assured Grounding and Bonding Program (EM 385-1-1: Section 11 and Appendix F) if GFCIs cannot be used as stated above.

Slips, Trips, and Falls: All sites present slip and trip hazards. Since the areas contain a wetland, this Site will have wet muddy areas and uneven terrain that pose slip hazards. Employees should be cognizant of slip hazards and avoid walking over muddy/marshy surfaces whenever possible. Good housekeeping principals will apply.

Cold/Heat Stress: Cold/Heat stress (frostbite, hypothermia/heat exhaustion, and heat stroke) may be a hazard depending on the weather conditions encountered at the time of scheduled activities. Workers should dress appropriately and remain aware of changing weather conditions while at the Site. Cold stress will be more of a factor during this project due to the time frame and location of this project.

Exposure to sun, even in the winter, for short or long periods can result in minor to severe sun burn. Chronic exposure to the sun can cause cancer (melanoma lesions). When possible, stay out of direct sunlight by seeking shade. Wear and reapply liberal amounts of sunscreen to protect skin, especially the face, from direct sunlight. Sun/safety glasses that are polarized with ultraviolet light protection should also be used.

Biological Hazards: Potential biological hazards associated with working at the site include snakes, insects, and poison ivy. While no specific biological hazards have been identified or communicated by the host, TI-SDC employees and their subcontractors will be instructed to maintain awareness for biological hazards in their surroundings, especially when initially entering the work site. If any such hazards become known during the course of the project, the Site Safety Health Officer (SSHO) will make the appropriate changes in this APP and communicate the dangers/concerns to the workers. Workers will exercise caution when traversing the site to avoid insects, snakes, and poison ivy. No significant populations of any of the referenced potential biohazards have been identified at the work site.

Serious and/or threatening chemical and physical hazards frequently overshadow any potential exposure to biological hazards. However, specific biological hazards can cause injury and even death. Therefore, when appropriate, such hazards will be identified and evaluated in conjunction with all other actual or potential hazards associated with an operation, and steps taken to control exposure. Procedures as prescribed in the First Aid Book will be properly implemented. Paramedics will be summoned for workers exhibiting symptoms of allergic reaction to a biological hazard.

Hazardous or Toxic Agent Inventory

The following chemicals may be brought onto the Site during the Site work:

- Gasoline and Diesel: Gasoline and Diesel will be used for site vehicles and only filled at offsite filling stations.
- Cleaning agents: Liquids, specifically Liquinox, will be used as part of the decontamination process for equipment during soil and groundwater sampling activities.

- Portland cement (American Society for Testing and Materials [ASTM] C150) and bentonite will be used as part of the well construction process.

Hazardous or Toxic Agent Labeling
Proper hazard labeling will be applied to containers containing hazardous substances brought on-site.

Safety Data Sheets (SDSs)
Copies of SDSs (formerly known as Material Safety Data Sheets) for the above listed chemicals will be kept on-site, at the point of storage during the field activities. The SDSs will be reviewed during the initial tailgate safety meeting with all site personnel. The handling and storage requirements outlined on the SDSs will be followed for each chemical.

c. STATEMENT OF SAFETY AND HEALTH POLICY

Safety and Health Policy Statement

It is the policy of the TI-SDC Team to provide a healthy and safe environment for all of its employees. We do this by fostering a strong safety culture, integrating safety into every aspect of work planning and execution. Incidents resulting in injury, illness, or property damage are preventable and safety takes precedence over short-term gains. The TI-SDC Team has established a health and safety program and management system to prevent accidents and enable managers to provide employees with direction on health and safety issues. Each employee is responsible through personal example to establish a climate in which everyone shares a concern for their own safety and that of their fellow workers.

The TI-SDC Team constantly improves its safety goals by auditing past projects and adding lessons learned to new projects. The TI-SDC Team records all accidents and injuries and near misses to determine areas of improvement on future projects. All recorded incidents and accidents are reviewed by the Safety and Health Manager (SHM) to determine if adjustments need to be made to the company health and safety program.

The primary objective of this project is to remain accident and injury free throughout the duration of work. All work will be conducted in full compliance with standards of the Occupational Safety and Health Administration (OSHA), the USACE Safety and Health Requirements Manual EM-385-1-1 where appropriate, and applicable local, state and federal regulations.

The TI-SDC Team has established procedures that provide direction on health and safety issues for all employees. These procedures are periodically evaluated to ensure that they are kept up to date.

The TI-SDC Team disciplinary program provides procedures and guidance for addressing problem performance. Disciplinary actions for misconduct or unsatisfactory health and safety performance include verbal and written warnings and suspension without pay. A serious violation of safety or health rules or engaging in conduct that creates a safety or health hazard may be considered a serious offense and may result in immediate termination.

This APP was developed in compliance with USACE EM 385-1-1, 30 Nov 14; APPENDIX A: MINIMUM BASIC OUTLINE FOR ACCIDENT PREVENTION PLAN.

For this project, TI-SDC has adopted Tidewater's written health and safety plans and programs.

d. RESPONSIBILITIES AND LINES OF AUTHORITY

(1) Employer's Ultimate Responsibility for Implementation of the SOH Program

The TI-SDC Team bears the ultimate corporate responsibility for the implementation of the Safety and Occupational Health (SOH) Program.

Overall personnel responsibility for the TI-SDC Team health and safety programs and policies lies with the SHM. Specific responsibilities of the SHM towards health and safety efforts include:

- Ensuring resources are available to implement the program
- Reviewing and approving all policy update(s)
- Develops, implements, and manages corporate safety and health program
- Provides current safety guidelines and procedures
- Develops checklist and ensures frequent project safety audits
- Oversees medical surveillance, respiratory protection and Health & Safety training programs for all applicable corporate employees
- Assesses incident reports
- Coordinates and conducts safety training efforts
- Approves all project health and safety plans
- Interacts with OSHA and/or state regulatory officials as required.

The Project Manager (PM) has the ultimate responsibility for implementing the TI-SDC Team's SOH Program at the project level. Specific responsibilities of the PM include:

- Read and review the Construction Safety Standards and become knowledgeable of local, state and federal regulations
- Is responsible to see that an analysis is made of the plans and specifications and a study made of the site to determine the exposure to accidents which may develop
- Require that subcontractors comply with safety requirements
- Be responsible when visiting the job site to report to the Superintendent all unsafe acts and conditions observed
- Review all accident reports
- See that all site safety record keeping is maintained by field management
- If a temporary office is established at the job site, provide the job site with the necessary safety forms, posters, reports, regulations and literature
- Conduct a minimum of one safety inspection of the job site and file a written report.

The SSHO is responsible for the implementation of the company SOH Program. Specific responsibilities of the SSHO include:

- Make available all necessary personal protective equipment, job safety materials, fire extinguishers and first aid equipment

- Instruct the site employees that safe practices are to be followed and safe conditions maintained throughout the job
- Provide new employee safety and health orientation for all workers on the project
- Inform the workers they are not to take chances - rather they are to follow proper and safe procedures at all times
- Instruct workers regarding their safety responsibilities and job safety requirements
- Require that all subcontractors adhere to all safety regulations
- Review all accidents with site personnel and ensure that lessons learned are shared and discussed
- Hold weekly safety meetings and require subcontractors to hold daily "Tailgate Safety Meetings"
- Train all members of your crew on hazardous/toxic chemicals which are new to the job before they are exposed to them
- Make sure that appropriate hazard warning labels are present on all containers containing hazardous/toxic chemicals or substances
- Obtain copies of subcontractors' accident reports and perform a proper incident investigation report
- Inspect the job site for health and safety hazards on a daily basis during tailgate meeting.
- Identify and assign other competent persons for work activities as needed.

(2) Key Personnel

Position	Name	Phone Number
PM	Keith Fields	614-778-2618 cell
SSHO	Robert Janosy	614-593-5541 cell
Alternate SSHO	Greg Headington	614-374-2722 cell
SHM	David McCall	740-504-9714 cell

PM: The PM has overall responsibility for completion of the project in accordance with contract and regulatory requirements. The PM is responsible for planning and oversight of the project activities and acts as an interface between the field staff and corporate office. The PM has ultimate responsibility for the implementation of the project tasks and the safety and health of project workers. The PM is responsible for development of work plans, field implementation, and laboratory analyses. The PM is also responsible for the completion of site operations in accordance with the approved plans and field work orders. The PM is responsible for the preparation of submittals, coordination of schedules, cost tracking, and serves as the primary contact with the Client. The TI-SDC Team PM is Keith Fields, Tidewater Inc., 3761 Attucks Drive Powell, OH 43065; 614-778-2618 (cell); eith fields@tideh2o.net.

SSHO: The SSHO has the authority to ensure compliance with the site safety and health requirements, local, state and federal regulations and all aspects of the SOH Program including; activity hazard analyses, air monitoring, use of personal protective equipment (PPE), decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, and spill containment program. The SSHO has full authorization to stop work and demand corrective action based on the non-compliance with the level of safety required by the plans. The SSHO is also responsible for preparation and maintenance of records by performing a daily safety and health inspection and documenting the inspection results on the daily log or tailgate meeting form. The TI-SDC Team SSHO is Robert Janosy, SDC, 3761 Attucks Drive Powell, OH 43065; 614-593-5541 (cell); bob.janosy@tideh2o.net. The alternate SSHO is Greg Headington, SDC, 3761 Attucks Drive Powell, OH 43065; 614-374-2722 (cell); greg.headington@tideh2o.net.

Safety and Health Manager: The SHM is responsible for the development, implementation, and oversight of the APP and overall management of the health and safety program for the project. The SHM provides assistance to the SSHO. The SHM coordinates any modification to the APP with the SSHO. The SHM is responsible for the evaluation of air monitoring data and recommending engineering controls, work practices, and PPE. The SHM reviews accident reports and results of daily inspections. The SHM for this scope of work is David McCall, Tidewater, 3761 Attucks Drive, Powell, OH 43065, 740-504-9714; david.mccall@tideh2o.net.

(3) Competent and/or Qualified Persons Training

The SSHO has the 30-Hour OSHA Safety in Construction certification. Both the SSHO and alternate SSHO are certified in Cardiopulmonary Resuscitation (CPR)/First Aid.

(4) Competent and/or Qualified Persons and Proof of Competency

The TI-SDC Team has identified the following competent person (CP)(s) to serve on the Project Sites:

- Robert Janosy – CP and SSHO
- Greg Headington – CP and Alternate SSHO

The SSHO and alternate SSHO are also certified in First Aid and CPR. Resumes for Mr. Robert Janosy and Mr. Greg Headington are located in Appendix C.

Other CP for specific work activities may be identified and assigned at a later date. Qualifications will be submitted at that time.

(5) TI-SDC's Risk Management Process

The TI-SDC Team will use approved AHAs as part of a total risk management process.

(6) Pre-Task Safety and Health Analysis

The TI-SDC Team performs a safety and health analysis prior to the performance of each task. This analysis is documented on the project AHAs, which are located in Appendix B of this APP.

The TI-SDC Team requires the following analysis prior to performing each project task:

- Task description
- Hazard identification
- Risk and likelihood of occurrence
- Engineering controls
- Environmental monitoring for the hazards
- Personal protective equipment
- Training requirements
- Documentation on Activity Hazard Analysis form.

(7) No Work Shall Be Performed Without Designated Competent Person on Site

It is the TI-SDC Team's policy that no work shall be performed unless the designated competent person is present on the job site. The Competent Person applies to the SSHO and alternate SSHO, another other as identified.

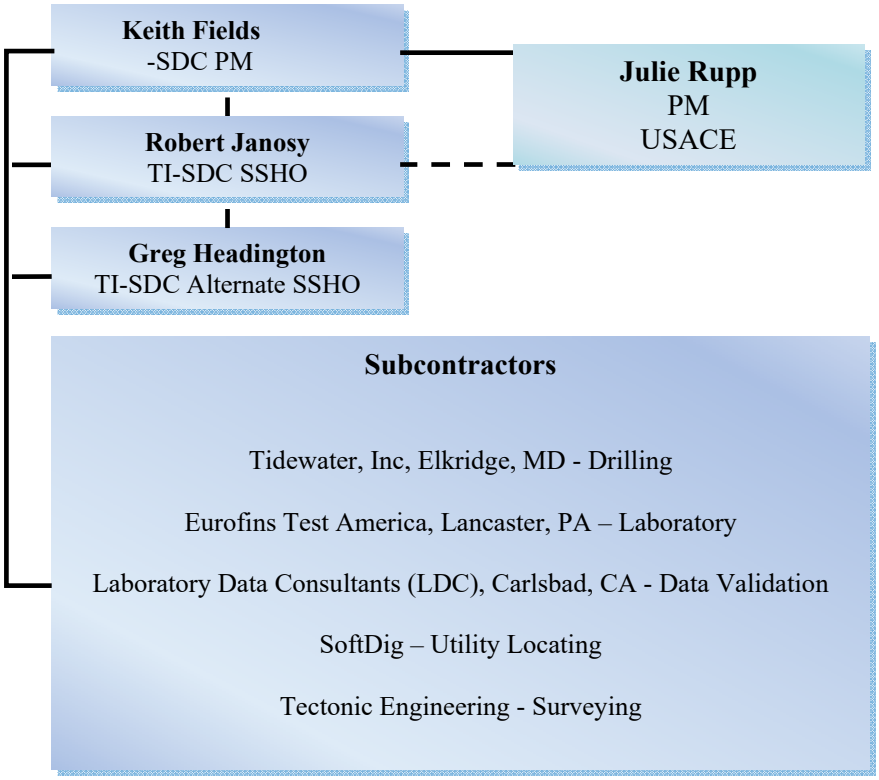
(8) Policies and Procedures Regarding Non-Compliance with Safety Requirements

The PM, SSHO, or designated competent person shall stop work activities for non-compliance with this APP or the SSHS plan, or if site conditions become unsafe. Site work activities can resume only after the issue has been resolved. In most instances, the resolution occurs at the site level. The ultimate responsibility for resolution of conflicts lies with the PM.

The PM, SSHO or designated competent person shall also suspend participation of an individual project team member from site activities for violation of any provision of this APP.

(9) Lines of Authority

The TI-SDC Team's organizational approach shown in below provides a single point of contact and accountability to USACE providing effective and efficient program management with minimal government oversight. Our PM will be supported at a program-level by quality control (QC), and contracts management, to ensure resources are available and committed to contract and task order requirements.



(10) Procedures for Holding Managers and Supervisors Accountable for Safety

The TI-SDC Team's policy is that managers and supervisors are ultimately accountable for safety at the job site. They are responsible for ensuring that all personnel adhere to the requirements stipulated in this APP.

Safety performance will be evaluated as part of each manager's and supervisor's annual performance review. Poor safety performance will result in reduced merit compensation for the manager or supervisor.

e. SUBCONTRACTORS AND SUPPLIERS

(1) Identification of Subcontractors and Suppliers

An initial list of subcontractors is provided below. This list will change and be updated periodically.

Subcontractor	Service Provided
Eurofins Test America	Laboratory
LDC	Data Validation
TBD	IDW Waste Management and Disposal
TBD	Vegetation Removal/Restoration

The TI-SDC Team requires its subcontractors and suppliers to work in a responsible and safe manner. Subcontractor and suppliers are required to adhere to the guidelines and provisions contained in this APP and OSHA 29 Code of Federal Regulations (CFR) 1926 when performing activities at the project sites.

(2) Safety Responsibilities of Subcontractors and Suppliers

All subcontractors are required to provide their own Safety and Health Plan; it will be reviewed by the PM and SSHO. (If no plan submitted, the subcontractor will follow TI-SDC Safety and Health Plan.) Subcontractor's Safety and Health Plan will only be accepted if they are equal to or exceed the requirements of the TI-SDC Team's SOH Program. If a subcontractor submits a Safety and Health Plan and it is approved by the PM and SSHO, it will be attached to the SOH Program as an Appendix with concurrence of the SHM.

Subcontractors First Violation of a Rule or Regulation
A subcontractor employee who is cited for a first-time notice of a Safety/Health Violation Notice shall be immediately removed from the project site, and shall not be permitted to return to work for a period of at least 24 hours, missing the next full workday.

Subcontractors Second Violation of a Rule or Regulation
A subcontractor employee responsible for a repeat offense or receiving a second Safety/Health Violation Notice shall be immediately and permanently removed from the project site for the remainder of the contract period.

f. TRAINING

(1) New Hire SOH Orientation Training at the Time of Initial Hire

All employees will receive orientation to the Corporate Health and Safety Program by the Corporate Health and Safety Manager or his designate and will be notified of any additions or changes to the program. This includes office safety, office evacuation, and specific safety discussion geared toward that person's specific job description.

In addition to the above, all project personnel must receive training and acknowledge understanding of the contents of this APP prior to performing work at Former Stewart AFB. Personnel will attend a site safety orientation prior to starting work on-site. This training shall include a review of the project tasks and responsibilities, hazards expected to be

encountered, and means of hazard control. Specifically, the following subjects will be discussed at site project safety orientation:

- Requirements and responsibilities for accident prevention and the maintenance of safe and healthful work environments
- General safety and health policies and procedures and pertinent provisions of EM 385-1-1
- Employee and supervisor responsibilities for reporting all accidents
- Provisions for medical facilities and emergency response and procedures for obtaining medical treatment or emergency assistance
- Procedures for reporting and correcting unsafe conditions or practices
- Job hazards and the means to control/eliminate those hazards, including applicable AHAs
- Specific training as stipulated in the sections below.

(2) Mandatory Training and Certifications that are Applicable to This Project

40-HR OSHA Hazardous Waste and Emergency Response (HAZWOPER): All staff conducting onsite efforts must have taken the initial 40-Hour OSHA HAZWOPER and continue to receive the annual 8-HR OSHA HAZWOPER refresher training.

30-HR OSHA Safety in Construction: The SSHO and his alternate must have received training in safety in construction in accordance with 29 CFR 1926 include a 30-Hour Construction Safety class, and an average of at least 8-hours of documented safety training (formal, on-line, or self-study) every year.

First Aid and CPR: A minimum of one personnel trained in First Aid and CPR shall be on-site/available at all times.

Personal Protective Equipment (PPE): All personnel shall be trained in the appropriate use of PPE.

(3) Periodic Safety and Health Training for Supervisors and Employees

The SSHO shall conduct daily "tailgate" safety meetings prior to the commencement of field work to review the day's activities, the relevant AHAs, establish safe working procedures for anticipated hazards, and provide pertinent health and safety training and motivation. These meetings shall be documented, including the date, persons in attendance, subjects discussed, and name of individual who conducted the meeting. A copy of the safety meeting form is located in Appendix D.

The SHM or designated person shall conduct supplementary safety and health training for all the TI-SDC Team personnel, including supervisory personnel.

(4) Requirements for Emergency Response Training

The SSHO is responsible for management of emergency activities that may include responses to medical, fire, or injury occurrences. Prior to commencement of work at Former Stewart AFB, during the site safety orientation, the SSHO shall review actions to be taken in the event of an emergency, the location of emergency equipment to include fire extinguishers and first aid kits, and the identity and location (route) to the designated medical facility. The

SSHO shall be responsible for ensuring that emergency services are called in the event of an emergency. If the SSHO is unable to perform these duties, his designee will assume these responsibilities.

g. SAFETY AND HEALTH INSPECTIONS

(1) Safety Inspections

General Safety Inspection: The SSHO shall inspect the project location prior to commencing work and at least daily thereafter. Hazards identified or unsafe work practices shall be identified and corrected. Inspection results will be communicated to workers. All inspections shall be documented on the Site Safety Inspections are part of the daily Tailgate Meeting form, Appendix D.

Deficiencies: Deficiencies will be recorded on the Site Safety Inspection Checklist and a designated health and safety deficiency log. Specifically, the SSHO shall record the date the deficiency was identified, a brief description of the deficiency, and suggested corrective action. Once the deficiency has been resolved the SSHO shall record the date the deficiency was corrected, what actions were taken, and the personnel responsible for correcting the deficiency.

(2) External Inspections/Certifications

No external inspections/certifications are required for this project.

h. MISHAP REPORTING and INVESTIGATION

Mishap reporting and investigation is essential to preventing incidents and controlling hazards. Thorough investigations, paired with effective remedial actions, can eliminate future injury, property damage, lost time accidents, and mission interruption. Concern for employee and customer safety and well-being drives the accident investigation program. Investigation results are used to enhance the TI-SDC Team Program through a Lessons Learned program, additional safety training, and modifications to processes and procedures. Mishap reporting and investigations will be conducted in accordance with TI-SDC policy.

(1) Exposure Data

The SSHO will be responsible for collecting and recording the number of man hours worked on the site by skill trade. This data will be compiled and submitted to the PM on a daily basis. The PM is responsible for submitting this information to the Client Representative per contract requirements.

(2) Mishap Investigations, Reports, and Documentation

In the event of an injury or illness, work is to be stopped until the cause of the incident has been determined and appropriate action has been taken. Any injury or illness, regardless of severity, is to be reported on accident report forms. The SSHO shall notify the PM, SHM, and USACE Safety Manager of the accident as soon as possible but not more than twenty four (24) hours after the incident.

The SSHO shall thoroughly investigate all accidents. The investigation should determine what happened and how it happened, the results, immediate corrective action and any relevant information. The PM shall submit the findings of the investigation along with corrective actions to the Client as soon as possible but no later than twenty four (24) hours following the accident. The TI-SDC Team will implement corrective actions as soon as possible.

The TI-SDC Team will strive to identify the root cause of each accident, to effectively select corrective actions to prevent mishap recurrence. The identified causes and corresponding corrective actions will be documented. The Safety Office will schedule Safety Concern Meetings to be held for all warranted accidents and incidents at which time a discussion will be conducted with the PM and SSHO, Affected Department Manager and Supervisor, Safety Manager and involved employee. Corrective actions to prevent future accidents or incidents from reoccurring will be discussed and pertinent findings and corrections will be implemented.

The Safety Office will record the 'lessons learned' through accident investigation, where appropriate.

If the lessons learned have internal application only, the Safety Office will use the information to improve hazard awareness, prevent accidents, and better implement the Safety Plan. Lessons learned will be discussed during safety meetings and personnel certification training. Lessons learned may also stimulate the revision of policies, procedures, and work practices, and will be a standard agenda item for the safety committee meetings.

(3) Mishap Notification

The TI-SDC Team's employees will immediately report each incident, injury, illness, and near miss to the SSHO and their supervisor. The SSHO and/or supervisor will direct actions at the scene of the incident, to assure evidence preservation, thorough investigation, and compliance with applicable company policies, EM 385-1-1, and applicable provisions of 29 CFR. Telephone notification of all mishaps, including reportable property damage, will be made to USACE by the PM.

The following accidents that has, or appears to have, any of the consequences listed below require immediate notification and investigated in depth to identify all causes and to recommend hazard control measure in accordance with EM-385-1-1 Section 1.D.4:

- Fatal injury/illness*;
- Permanent totally disabling injury/illness;
- Permanent partial disabling injury/illness;
- One (1) or more persons hospitalized as inpatients as a result of a single occurrence*;
- $500,000 or greater accidental property damage;
- Three (3) or more individuals become ill or have a medical condition which is suspected to be related to a site condition, or a hazardous or toxic agent on the site;
- USACE aircraft destroyed or missing.



*Requires notifying OSHA in accordance with 29 CFR 1904.39 within 8-hours when their employee(s) is fatally injured as a result of a work-related incident; or within 24-hours when 1 or more persons are hospitalized as inpatients, there is a loss of an eye, or there is an amputation as a result of a work-related incident.

In addition to the above, any mishap occurring in any of the following high hazard areas shall be immediately reported. These mishaps shall be investigated in depth to identify all causes and to recommend hazard control measures.

- Electrical – to include Arc Flash, electrical shock, etc.;
- Uncontrolled Release of Hazardous Energy (includes electrical and non-electrical);
- Load Handling Equipment (LHE) or Rigging;
- Fall-from-Height (any level other than same surface), and
- Underwater Diving.

Also, the following will be reported:

- Property damage (exceeding $5,000 is recordable);
- Days Away Injuries;
- Days Away Illnesses;
- Restricted/Transfer Injuries.

The Accident Investigation and Reporting Form ENG 3394 is located in Appendix E.

i. OCCUPATIONAL RISK AND COMPLIANCE PLANS

Below we provide plans to provide Accident Prevention, Activity Hazard Analyses, and Occupational Risk and Compliance for the range of activities required under this contract.

(1) Fatigue Management Plans (01.A.20)

THE TI-SDC Team does not intend to implement a Fatigue Management Plan as the following criteria for employee work-hours would not be applicable:

(1) Exceed 10-hours a day for more than 4 consecutive days;

(2) Exceed 50-hours in a 7-day work week;

(3) Exceed 12-hours a day for more than 3 consecutive days, or

(4) Exceed 58-hours a week for sedentary (to include office) work

(2) Emergency Response Plans

Plan Procedures (01.E.01)

The purpose of this emergency response plan is to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous substances to air, soil, or surface water.

The provisions of this emergency response plan must be implemented immediately whenever there is a fire, explosion, or release of hazardous substances that could threaten human health or the environment.

Responsibilities of the Emergency Coordinator (EC)

The SSHO will act as the Emergency Coordinator (EC) at the project site. The EC has the responsibility for coordinating all emergency response measures, and initiating materials and equipment purchases. Qualified backup ECs will be designated so an EC will either be located on the site or on call (available to reach the site to respond to an emergency within 60 minutes). The EC has the authority to commit the resources required to implement this emergency response procedure.

The EC is responsible for being thoroughly familiar with:

- The APP and emergency response plan
- All operations and activities associated with the project
- The emergency signals and evacuation routes
- The location of all operation-specific records
- The physical layout of the facility and location of emergency equipment.

Obtaining Emergency Services

To obtain emergency services, the EC will first investigate the severity of the emergency/injury. If the emergency/injury requires outside emergency services, the EC will immediately contact the appropriate emergency services. The PM and Government Representative will next be notified of the emergency and the impending arrival of emergency services.

Communications

A communication network will be set up to alert site personnel of emergencies and to summon outside emergency assistance. Where voice communication is not feasible, an alarm system (e.g., sirens, horns) will be set up to alert employees of emergencies. Radio communication may also be used to communicate with personnel if necessary. Where phone service is not readily available, radios or portable phones will be used to communicate with outside agencies. Site personnel will be trained on the use of the site emergency communication network. Emergency phone numbers will be posted at the phone or radio used for outside communication. The PM/SSHO/EC is responsible for establishing the communication network during work activities, and for explaining it to all site personnel during the site safety briefing.

Emergency Contacts and Notifications

The name, telephone number, and location of police, fire, and other emergency response agencies will be available on site at all times. If emergency personnel are called to the site, efforts should be made to accommodate their operations at the site. Emergency telephone numbers for this project are presented below. In the event of a medical emergency, personnel will notify the appropriate emergency organization and will take direction from the

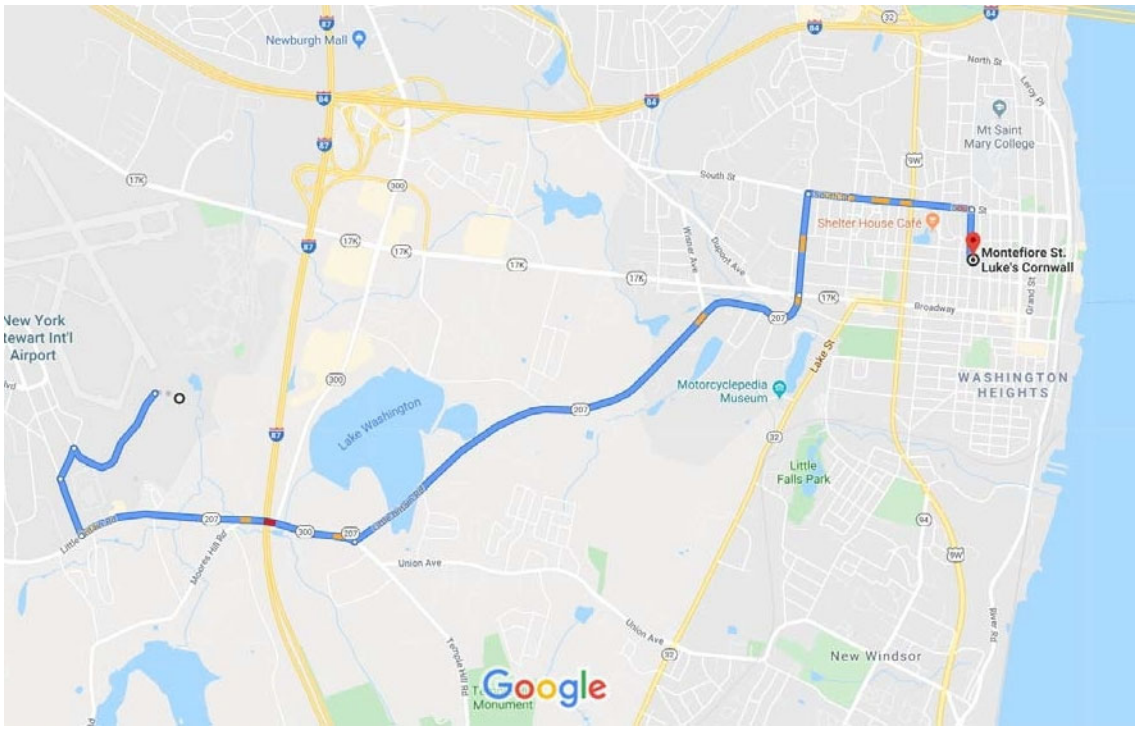
SSHO. In the event of a fire, explosion, or spill at the site, the SSHO will notify base first responders and the appropriate federal, state, and local agencies.

Emergency Telephone Numbers		
Emergency Services		
First Responders		911
Poison Control Center		(800) 523-2222
National Response Center		(800) 424-8802
OSHA Referral		(800) 321-6742
TI-SDC Team		
Keith Fields	PM	Cell: (614) 778-2618
Robert Janosy	SSHO	Cell: (614) 593-5541
David McCall	SHM/CSP	Cell: (740) 504-9714

Emergency Medical Treatments and First Aid

A first aid kit and fire extinguisher will be stored on each site as appropriate. The first aid kit will contain the American Red Cross first aid manual or equivalent. A minimum of two personnel trained and certified in adult first aid, CPR, and blood borne pathogens, in accordance with 29 CFR 1910.1030, will be on-site at all times that work is being performed. If an injured individual requires further attention, the individual will be immediately transported to the nearest hospital. A hospital route map to the closest Emergency Room is presented below for each site. The hospital route maps give directions to the nearest medical facility. If necessary, the worker will be decontaminated prior to transport to the facility; if the injury is serious, decontamination may be delayed pending emergency treatment. As explained earlier, concentrations of the chemical of concern (COC) anticipated to be encountered at these sites are not considered acutely toxic and should not prevent the implementation of emergency medical care.

Fire:	**911**
Ambulance:	**911**
Hospital:	**1-845-561-4400 (Emergency Department)**
Directions to Hospital:	**Montefiore St. Luke's Cornwall**
	70 Dubois Street
	Newburgh, NY 12550



<u>Directions to Montefiore St. Luke's Cornwall</u> **<u>6.5 miles, 20 minutes</u>**

- **Take Recreation Rd to NY-207 E**

6 min (1.1 mi)

- **Follow NY-207 E to West St in Newburgh**

8 min (3.9 mi)

- **Continue onto West St**

2 min (0.5 mi)

- **Turn right onto South St**

3 min (0.8 mi)

- **Turn right onto Dubois St and follow to your destination**

2 min (0.4 mi)

Operations Shutdown

Under certain extreme hazardous situations, the SSHO and Project Personnel may temporarily suspend operations while a hazard is corrected or controlled. During operation shutdown, all personnel will be required to evacuate the work zone and support areas as necessary. The SSHO will have ultimate authority for operations shutdown and restart.

Procedures for Plan Review and Amendment

This emergency response plan will be reviewed and amended as necessary if either one of the following happens:

- The plan fails in an emergency
- The site changes in its design, construction, operation, maintenance, or other circumstances that materially increases the potential for fires, explosions, or releases of hazardous materials or hazardous material constituents, or changes the response necessary in an emergency
- The EC changes
- The plan had to be implemented because of a site emergency and lessons learned can be incorporated.

Changes to this Emergency Response Plan will be made by the EC, SSHO, and/or SHM if any of the above mentioned occurs. Revised copies of this Emergency Response Plan shall be distributed to applicable personnel.

Spill Plans

Notification of Spills and Discharges

If a spill occurs and humans or the environment are threatened, the SSHO will immediately notify USACE. After spill response activities are completed, a Spill Report will be issued to the Contractor Officer Representative (COR). This spill report will identify the cause and extent of the spill, any resulting contamination danger, and the corrective actions taken by the TI-SDC Team and emergency personnel.

Required Equipment

The following equipment will be kept at the site at all times to provide for the means to clean up an unexpected spill or discharge:

- 5 gallon bucket
- Spill kit including absorbent pads and booms
- Shovel.

The equipment required may vary depending on the nature and extent of the work performed.

Spill Control

If a spill occurs at the site, the following actions will be immediately taken by the site project personnel, including SSHO:

- Notify the PM and USACE
- Control sources of ignition

- Contain the spill
- Do not allow anyone to touch or approach the spilled material without wearing the appropriate PPE
- Keep combustibles away from the spilled material
- Place the spilled material and affected soil in a five gallon bucket or container for disposal
- Conduct any other actions as needed.

Firefighting Plan (01.E.01)

In the event of a fire or explosion the site will be evacuated, and personnel will gather at the emergency assembly area. The local fire department shall be summoned by the PM/SSHO/EC in the event of a large fire. Personnel shall only attempt to contain or control a fire if: it is in the incipient stage (a small fire); they are properly equipped with a suitable fire extinguisher; and only if it is safe to do so (i.e., no additional hazards exists).

Smoking will not be permitted on-site.

Emergency Services Information (01.E.05)

To obtain emergency services, the EC will first investigate the severity of the emergency/ injury. If the emergency/injury requires outside emergency services, the EC will immediately contact the appropriate emergency services.

The PM and USACE will be notified next of the emergency and the impending arrival of emergency services.

The SSHO shall have full time access to a cellular telephone while on-site.

Prior to the start of work, the SSHO and project personnel will confirm that the Emergency Phone numbers and Hospital information remain appropriate. These numbers shall be posted at the worksite immediately adjacent to site access gate.

(3) Site Sanitation /Housekeeping Plan (02.B)

Housekeeping

Regular cleaning will be conducted in order to maintain safe and sanitary conditions in the workplace. All trash, garbage and waste from the operation will be collected daily, placed in closed containers and transported to an approved landfill or disposal site as needed.

Aisles and passageways shall be clear of tripping hazards and material shall be stored in such a manner that it does not present a hazard to personnel. Paths of emergency egress shall be kept unobstructed and clear at all times. Electrical panels, fire alarm stations, and fire extinguishing equipment shall never be blocked.

Any oil, grease, and chemical will be handled in the same manner as above.

Restrooms

Existing building washing and toilet facilities shall be utilized and maintained in good order, if available. Hand soap or similar cleansing agents shall be provided.

Chemical (Portable) Toilets

When applicable and/or directed, the TI-SDC Team will provide a chemical toilet(s) in the event that existing restrooms are unavailable/ unusable. A chemical toilet(s) will be placed on-site in an easily accessible location, and in a stable position. We anticipate less than 15 personnel at any one time will impacted, therefore only one chemical toilet will be required. When more personnel are utilized and/or impacted, additional chemical toilets (at the prescribed quantity/# of personnel) will be deployed for use. Sufficient paper supplies and hand sanitizer will be available to allow personnel to sanitize their hands.

When in place, the TI-SDC Team shall establish provisions for routinely servicing and cleaning chemical toilet(s) and disposing of the sewage before placing back into operation. The method of sewage disposal and the placement location selected shall be in accordance with Federal, state, and local health regulations.

Drinking Water

An adequate supply of potable water will be provided in or near all work areas for both drinking and cleansing. Potable water shall be obtained from sources approved by Federal, State, or local health authorities and shall be dispensed by means which will prevent contamination. The use of a "common" drinking cup is prohibited and receptacles will be provided for disposal of paper cups. Any portable container used to distribute drinking water shall be clearly marked “DRINKING WATER” and may not be used for other purposes.

All outlets dispensing non-potable water must be conspicuously labeled: "CAUTION -- WATER UNSAFE FOR DRINKING, WASHING, or COOKING".

Waste Disposal

All trash, garbage and waste from the operation will be collected daily, placed in closed containers and transported to an approved landfill or disposal site as needed.

Any oil, grease, and chemicals will be handled in the same manner as above.

(4) Medical Support (03.A)

On-Site Medical Support

At a typical project, no on-site medical support will be provided beyond first aid and CPR care. In the event medical support is required, emergency services will be summoned. A first aid kit complying with the criteria contained in (American National Standards Institute/ International Safety Equipment Association) ANSI/ISEA Z308.1 will be maintained onsite (03.B.03). All employees who work where there is a first aid kit shall receive a tool box training on the content and use of the kit supplies.

Off-Site Medical Arrangements

Accidents or incidents requiring medical assistance shall be immediately reported to the SSHO.

Prior to the start of work, the SSHO and project personnel will confirm that the Emergency Phone numbers and Hospital information remain appropriate. These phone numbers will be posted in a conspicuous location at the project site. Copies of this APP Plan will be provided

to emergency units, as appropriate, prior to the start of work. The designated medical provider shall also be identified, with a route to the provider's location also noted.

First Aid/CPR

At least two personnel shall be trained in First Aid and CPR shall be on-site at all times to provide initial on-site medical support should it be necessary.

Bob Janosy	FA/CPR Training Received: 4/12/2021
Greg Headington	FA/CPR Training Received: 8/8/22
Martha Headington	FA/CPR Training Received: 8/8/22
Nick Wyckoff	FA/CPR Training Received: TBD

(5) Blood-Borne Pathogen Program (03.A.05)

At a typical project, no on-site medical support will be provided beyond first aid and CPR care. In the event medical support is required, emergency services will be summoned. However, employees designated as responsible for rendering first aid (e.g., SSHO) are included in the TI-SDC Team's BBP program in accordance with 29 CFR 1910.1030:

(6) Exposure Control Plan (03.A.05)

Those designated as responsible for providing first aid (e.g., SSHO) are included in TI-SDC Team's Exposure Control Plan and are required to read this document as a part of the Blood-Borne Pathogen training.

(7) Automatic External Defibrillator (AED) Program (03.B.04)

An Automatic External Defibrillator (AED) will not be available for this contract; therefore, an AED Program will not be in place.

(8) Site Layout Plan (04.A)

Site Layout Plans are not required since the TI-SDC Team does not intend to intend to implement construction of temporary structures or facilities under this contract.

(9) Access and Haul Road Plan (04.B)

TI-SDC team will only use public roads or existing driveways on properties that have approved Rights of Entry.

(10) Hearing Conservation Program (05.C)

The TI-SDC Team and its subcontractors have participated in Hearing Conservation training. PPE shall be required for sound levels exceeding 85 dbA.

(11) Respiratory Protection Plan (05.G)

The TI-SDC Team activities are not expected to require any type of respirator. Therefore, a Respirator Protection Plan will not be implemented.

(12) Health Hazard Control (06.A)

Personal Protective Equipment

Work Clothing: Employees shall wear clothing suitable for the weather however minimum requirements for work shall be short-sleeve shirt, long pants (excessively long or baggy pants are prohibited) and leather work shoes. If analysis determines that safety-toed (or other protective) footwear is necessary, they shall be worn.

Eye and Face Protection: Eye and face protection shall be worn as determined by an analysis of the operations being performed. However, safety glasses with side shields will be worn for all work, as a minimum eye protection.

Hearing Protection: Hearing protection must be worn by all those exposed to high noise activities.

Head Protection: Hard hats shall comply with ANSI Z89.1 and shall be worn by all workers when a head hazard exists.

High Visibility Apparel shall comply with ANSI/ISEA 107, Class 2 requirements at a minimum and shall be worn by all workers exposed to vehicular or equipment traffic. Section 05.F of EM-385 provides specific situational requirements.

Gloves of the proper type shall be worn by persons involved in activities that expose the hands to cuts, abrasions, punctures, burns and chemical irritants.

Machine Guards and safety devices. Lawn maintenance equipment must have appropriate guards and safety devices in place and operational.

The TI-SDC Team personal protective equipment program will comply fully with OSHA requirements published in Subpart I of 29 CFR 1910. The individual supervisors and the SSHO will conduct the workplace hazard assessment, which will be re-assessed at a minimum annually or as necessary due to updates and changes in the environment or equipment.

The workplace hazard assessment (i.e., AHAs) and pertinent OSHA standards will guide the selection of protective equipment and clothing, which will be provided by the TI-SDC Team and its subcontractors to protect their employees. The suitability of selected PPE will be re-evaluated as needed.

Employees required to use PPE to perform assigned work tasks will receive PPE training. The TI-SDC Team will maintain the written certification of training conducted, as required by OSHA. The training includes:

- When PPE is necessary
- What PPE is necessary
- How to properly don, doff, adjust, and wear PPE
- The limitations of the PPE (including warning labels)
- The proper care, maintenance, useful life, and disposal of the PPE.

Each affected employee will demonstrate understanding of the training and the ability to properly use their PPE, before being allowed to perform work requiring the use of PPE.

Employees will be retrained as necessitated by changes in the workplace; types of PPE selected, and/or observed inadequacies in employee performance.

Procurement of PPE
The TI-SDC Team SSHO will review requisitions for PPE. Supervisors will verify that the requested PPE is required and complies with the criteria established through the workplace hazard assessment.

PPE Inspection
Employees will perform a visual inspection on their PPE at regular intervals, and before and after each use to assure that the PPE will provide the necessary protection. Defective or damaged PPE will not be used. Supervisory personnel and the SSHO will monitor PPE utilization on an ongoing basis.

The TI-SDC Team will inspect all of its subcontracts on an ongoing basis to ensure compliance for PPE. The TI-SDC Team requires that its subcontractors provide PPE to its employees and that those employees have been trained in the use of PPE. The SHM or his designee (i.e., SSHO) will ensure compliance criteria are met.

PPE Maintenance
PPE will be cleaned and maintained by the user at regular intervals and after use, to assure that it will provide the necessary protection. Defective or damaged PPE will not be used.

(13) Hazard Communication Program (06.B.01)

The TI-SDC Team shall evaluate jobsite operations, materials, and equipment involving potential exposure to hazardous or toxic agents or environments to formulate a hazard control program.

The hazard evaluation shall identify: the nature of the evaluation (air, biological or radiological samples, etc.); that it serves as certification of hazard evaluation; the workplace and activity evaluated; the name, position and credentials of the person certifying that the evaluation has been performed; and the date of the evaluation.

An AHA shall be used to document the evaluation. The hazard evaluation shall identify all substances, agents, and environments that present a health, explosive or fire hazard to workers or visitors and recommend hazard control measures. Engineering and administrative controls shall be used to control hazards; in cases where engineering or administrative controls are not feasible, PPE may be used.

The TI-SDC Team shall provide the location of SDSs, records of Contractor employee training, and inventory of hazardous materials (including approximate quantities and a site map, as appropriate) that will be brought onto Government project by the Contractor and any subcontractors.

All chemicals brought onto the site will be subject to the 29 CFR 1910.1200 and may include the following:

- Gasoline and Diesel: Gasoline and Diesel will be used for site vehicles and only filled at offsite filling stations.
- Cleaning agents: Liquids, specifically Liquinox, will be used as part of the decontamination process during groundwater sampling.



- Portland cement (ASTM C150) and bentonite will be used as part of the well installation process.

A site map illustrating the locations of the above-listed chemicals is not provided because the their storage location is unknown at this time.

Storage prior to transportation of hazardous chemicals, materials, substances and wastes shall be under the supervision of the SSHO.

Hazardous or Toxic Agent Labeling

Proper hazard labeling will be applied to containers containing hazardous substances brought on-site.

Safety Data Sheets (SDSs)

Copies of the SDSs for the above listed chemicals will be kept on-site during the field activities. The SDSs will be reviewed with all site personnel during the initial site specific safety orientation. The SDSs will be the primary source of health and safety information for all chemicals.

Employee Information and Training

Employees will be trained in the corporate Hazard Communications program upon employment and then on the specific chemicals they will be dealing with. As the information or types of chemicals changes, employees will be re-trained as necessary.

Personnel working at Former Stewart AFB will be briefed on the chemicals expected to be used or come in contact with, their locations and their identification during the initial tailgate safety meeting. Any changes in chemicals or information will be brought to the attention of all personnel immediately. The SDS for all of the expected chemicals will also be discussed during the tailgate safety meeting along with protective measures available to the personnel.

Personnel Protective Equipment

When engineering and work practice controls or substitution are either infeasible or insufficient, appropriate PPE and chemical hygiene facilities shall be provided and used for the transportation, use, and storage of hazardous or toxic agents.

(14) Process Safety Management Program (06.B.04)

A Process Management Safety Program is not required as the work involved does not constitute the following:

- A process that involves a flammable liquid or gas on site in one location in a quantity of 10,000 lb. (4,535.9 kg) or more as defined in 29 CFR 1910.119 or 29 CFR 1926.59(c); or
- A process that involves a chemical at or above the threshold quantities listed in Appendix A of the above-cited CFRs.

(15) Lead Compliance and Abatement Plan (06.C.02)

Lead is not a COC on this project; therefore, a Lead Abatement Plan is not applicable for this project.

(16) Asbestos Abatement Plan (06.C.03)

Asbestos is not a COC on this project; therefore, an Asbestos Abatement Plan is not applicable for this project.

(17) Radiation Safety Program (06.F)

The TI-SDC Team does not anticipate operations involving radiation hazards, and radioactive material or radiation generating devices.

The TI-SDC Team employees shall not enter areas designated with a radiation hazard without proper training.

(18) Abrasive Blasting Plan (06.I)

Abrasive blasting operations are not part of the scope of work (SOW) at this job site; therefore, an Abrasive Blasting Plan is not applicable.

(19) Heat/Cold Stress Monitoring Plan (06.J)

Heat Stress Monitoring Plan (HSMP) (06.J.01)

If employees are in hot weather (i.e., ambient temperature exceeding 75 degrees F and 55% Humidity), the following procedures should be used to monitor the body's physiological response to heat and to manage the work cycle.

- Measure body temperature: Measure the body temperature orally using a clinical thermometer during initial period of rest. If the oral temperature exceeds 99.4°F (37.4°C), the employee shall not be allowed to continue work until the oral temperature is maintained below the latter threshold.
- Measure heart rate: At temperatures above 85°F employees should have their heart rate measurements taken at 30 minute intervals. They should stop work in PPE when heart rate reaches 120 beats per minute. This schedule is conservative and if one is under a light work load the work periods can be extended. If under a heavy work load or a sunny day the rest periods can be extended.
- Monitor Temperature: The American Conference of Industrial Hygienists (ACGIH) Threshold Limit Values work/rest schedule and the Wet Bulb Globe Temperature (WBGT) index is designed for use with permeable ordinary work clothes, and not for impermeable PPE. Therefore, the following modified schedule will be used for employees wearing PPE (e.g., impermeable Tyvek® or Tychem® coveralls) to conduct fuel handling and tank cleaning related tasks. If PPE is not being utilized, 10° F should be added to the temperature schedule below.
  - On a cloudy day, continuous work may be performed below 70°F. Employees should be aware of the potential for heat stress above this temperature and use buddy system and guidelines below.
  - 75% work / 25% rest each hour at air temperature 70-79°F
  - 50% work / 50% rest each hour at air temperature 79-85°F
  - 25% work / 75% rest each hour at air temperature above 85°F



- Work shall cease at a shaded dry bulb temperature of 98°F.

Cold Stress Monitoring Plan (CSMP) (06.J.04)

To maintain adequate protection against cold exposure, employees shall observe the following work practices and control measures:

- Alternate work and rest periods with rest periods in a warmer area
- Utilize a supplemental heat source, if possible
- Wear an insulating liner or hood under the hard hat
- Dress warmly by layering clothing
- Avoid becoming overheated by removing layers of clothing while working to remain cool enough to not perspire
- Utilize clothing materials that do not lose insulating value when wet or dirty (i.e., use wool or polypropylene; avoid down or cotton)
- Keep clothing clean.

If excessive cold persists in the work area and control measures cannot reduce the cold stress on employees, work will be terminated until the condition subsides. If field work is carried out during the winter, an enclosed heated environment will be made available at the site for employees.

The following procedure shall be followed to monitor ambient environmental conditions during the winter:

- At ambient temperatures below 45°F (7°C) the temperature shall be monitored at a minimum of eight (8) hour intervals
- At ambient temperatures below 45°F (7°C) and above 30°F (-1°C) the temperature shall be monitored at every four (4) hour intervals
- At ambient temperatures below 30°F (-1°C) the temperature and wind speed shall be monitored at every four (4) hour intervals or more frequently if the temperature lowers further.

(20) Indoor Air Quality Management (06.L)

The TI-SDC Team will be conducting outdoor work only as a part of this contract.

(21) Mold Remediation Plan (06.L.04)

Mold Remediation operations are not part of the SOW at this job site; therefore, a Mold Remediation Plan is not applicable.

(22) Chromium (VI) Exposure Evaluation (06.M)

The TI-SDC Team does not anticipate activities that could generate chromium (VI) fumes, mists, or dusts under this contract.

(23) Crystalline Silica Monitoring Plan (06.N.02)

The TI-SDC Team will be using bentonite and cement. Crystalline silica will be controlled by keeping those material wet, as specified in the AHA.

(24) Lighting Plan for Night Operations (07.A.06)

Night operations are not anticipated under this contract. However, if work is to be performed at night, a night operations lighting plan shall be developed to ensure that all activities, areas and operations are adequately illuminated to perform work safely in accordance with the lighting levels in Table 7-1 of Section 07.A of the EM385.1.1 (November, 2014).

(25) Traffic Control Plan (08.C.05)

The TI-SDC Team does not anticipate operations involving the maintenance of traffic and access through the contract work area. However, if work is to be performed in close proximity to roadway traffic a traffic control plan shall be developed to ensure that all activities are completed in a safe manner.

(26) Fire Prevention Plan (09.A.01)

Keep work and storage areas clean and free of flammable or combustible debris at all times. Ensure that all flammable and combustible materials are stored properly; with all flammable liquids and gases separated from other flammable materials. Dispose of all rags which have oil, grease, paint thinners and cleaning agents that may be combustible in accordance with applicable local, state and federal regulations. All internal combustion engine powered equipment shall be inspected and repairs made, if such hazards as igniting of fuel exist.

Fueling Area or Stations

a) "No Smoking, Matches, or Open Flame" signs must be posted and enforced.

b) "Turn Engines Off" signs must be posted and enforced in the same area.

c) Bonding of equipment to be fueled must be accomplished through the use of internally grounded hose or an external ground cable.

d) Make sure that fuel distributors fuel tank, dispensing hose, and nozzle comply with federal, state and local regulations.

e) Only approved industrial metal safety cans will be used for the handling and storage of flammable and combustible liquids up to 60 gallons and must be labeled as to the contents.

f) Portable storage tanks with the capacity of 60 gallons or more must be:

- Plainly marked as to contents
- At least 50 feet away from any building
- Kept free from debris, trash, grass, and weeds at all time
- Properly vented, if storing 600 gallons or more.

g) The SHM must be contacted for additional rules governing fueling depots or storage areas for flammable liquids.

Fire Protection and Control

Provide access roads for emergency vehicles from the start of the project, and maintain clear access to the building and storage area at all times. Coordinate the access with the local Fire

Department to ensure it meets the requirements of the equipment that will respond in case of a fire.

Comply with the following basic rules of fire protection and control:

- Phone numbers of the nearest fire station or department must be posted at job site telephones
- All two ton or larger trucks and cranes must be equipped with not less than a 2B ABC type fire extinguisher. (Winch trucks, haul trucks, draglines, and cranes--track, rubber tire or railroad car mounted).
- A fire extinguisher rated not less than 10B shall be provided within 50 feet of wherever more than five gallons of flammable or combustible liquids or five pounds of flammable gas are being used on the job site. This requirement does not apply to the integral fuel tanks of motor vehicles.
- Carbon tetrachloride and other toxic vaporizing fire extinguishers are prohibited
- All fire extinguishers must be inspected every month and serviced at least every twelve months with refills and repairs made by a local dealer licensed by the state to service the fire extinguisher or suppression system used
- Familiarize yourself along with the members of the crew with the use and care of these extinguishers. In case of a fire make sure everyone knows where the fire extinguishers are and how to use them. The SSHO must conduct a tool box safety meeting on this subject at least annually and with new employee/owners.
- Smoke only in designated areas. Make sure to extinguish matches/cigarettes and place them in approved containers.
- Minimize the amount of flammable liquids/gases kept at the work area to a single work shift supply
- Close containers of flammable liquids when not in use. Report spills and the location of excessive flammable vapor/gas concentrations immediately.
- Obtain the necessary permits when performing hot work or disabling fire protection systems
- Make sure materials and equipment do not block the access to extinguishers and fire protection hoses, hydrants, and standpipes. Also, make sure materials are kept at least 18 inches from sprinkler heads.
- Attempt to extinguish small fires (trash can size) only if trained to do so. If trained to extinguish fires, familiarize yourself with the location of fire extinguishers in the work area.
- At least one portable fire extinguisher of not less than 20 B rating must be located not less than 25 feet or more than 75 feet from a flammable combustible liquid storage area located outside.
- Fire extinguisher location plans must be prepared before construction of a structure begins. Fire extinguishers must be placed according to the plan prior to bringing flammable materials in the area.

(27) Wild Land Fire Management Plan (09.L)

Wild Land Fire Management is not a required activity under the current SOW. If potential exposure to wild land fire exist, the TI-SDC Team will follow the facility Wild Land Fire Management Plan.

(28) Arc Flash Hazard Analysis (11.B)

Arc Flash Hazards are not a required activity under this contract. If potential exposure to arc flash hazards, the TI-SDC Team will follow the facility Wild Land Fire Management Plan.

(29) Assured Equipment Grounding Control Program (AEGCP) (11.D.05, App. E)

Electrical cords must comply with EM 385-1-1, Section 11 and will be listed by UL or other nationally recognized testing laboratory and shall have unbroken insulation and should not be exposed to water or other liquids. A ground fault circuit interrupter (GFCI) outlet or cord must be used at all times. All electrical equipment must be inspected and color coded as per the Assured Grounding and Bonding Program (EM 385-1-1: Section 11 and Appendix F) if GFCIs cannot be used as stated above his contract does not involve work portable powered tools using extension cords.

(30) Hazardous Energy Control Program and Procedures (12.A.01)

This contract does not involve work requiring hazardous energy control procedures.

(31) Standard Pre-Lift Plan –Load Handling Equipment (16.A.03)

This contract does not involve load handling activities.

(32) Critical Lift Plan – Load Handling Equipment (16.H)

This contract does not involve critical lifts using load handling equipment.

(33) Naval Architectural Analysis –Load Handling Equipment (Floating) (16.L)

The TI-SDC Team will not employ Floating Cranes/Derricks, Crane Barges, and Auxiliary Shipboard-Mounted Cranes under this contract.

(34) Floating Plant Inspection and Certification (19.A.01)

This contract does not involve Floating Plant and Marine Activities.

(35) Severe Weather Plan for Marine Activities (19.A.03)

This contract does not involve Floating Plant and Marine Activities.

(36) Emergency Plan for Marine Activities (19.A.04)

This contract does not involve Floating Plant and Marine Activities.

(37) Man Overboard/Abandon Ship Procedures (19.A.04)

This contract does not involve Floating Plant and Marine Activities.

(38) Float Plan for Launches, Motorboats, and Skiffs (19.F.04)

The TI-SDC Team will not employ Launches, Motorboats, and Skiffs under this contract.

(39) Fall Protection & Prevention Plan (21.D)

The TI-SDC Team will not be exposed to falls requiring protection and planning under this contract.

(40) Demolition/Renovation Plan (23.A)

This contract will not involve Demolition or Renovation Activities. Therefore no plans will be developed.

(41) Safe Practices for Rope Access Work Plan (24.H)

No work on this contract is expected involving a variety of advanced access techniques where roped and specialized equipment are used as the primary method for providing access and support to workers in their jobs at high or hard-to-reach places. Therefore no work plan was developed.

(42) Excavation/Trenching Plan (25.A.01)

This contract will not involve Excavation or Trenching Activities. However drilling activities in the form of soil borings and well installations will be conducted and will follow the requirements in Section 18.H of EM-385. The hazards and control methods will be identified in the associated AHA's by the CP who develops them.

(43) Fire Prevention and Protection Plan for Underground Construction (26.D.01)

Underground construction is not applicable under this contract.

(44) Compressed Air Work Plan for Underground Construction (26.I.01)

Underground construction is not applicable under this contract.

(45) Erection and Removal Plans for Formwork and Shoring (27.C)

Formwork, shoring, and bracing are not applicable under this contract.

(46) PreCast Concrete Plan (27.D.01)

Precast Concrete operations are not applicable under this contract.

(47) Lift-Slab Plans (27.E)

Lift-slab operations are not applicable under this contract.

(48) Masonry Bracing Plan (27.F.01)

Masonry Construction is not applicable under this contract.

(49) Steel Erection Plan (28.B)

Structural Steel Assembly is not applicable under this contract.

(50) Explosives Safety Site Plan (29.A)

Explosives-related operations are not applicable under this contract.

(51) Blasting Safety Plan (29.A, 26.J)

The TI-SDC Team personnel are prohibited from transporting, handling, storing, and using explosives, blasting agents, and blasting equipment.

(52) Dive Operations Plan (30.A.14)

Diving operations are not applicable under this contract.

(53) Safe Practices Manual for Diving Activities (30.A.15)

Diving operations are not applicable under this contract.

(54) Emergency Management Plan for Diving (30.A.18)

Diving operations are not applicable under this contract.

(55) Tree Felling and Maintenance Program (31.A.01)

Tree felling operations are not anticipated under this contract. If it becomes necessary to remove trees as part of the vegetation removal activities, the TI-SDC Team will prepare a Tree Felling Plan.

(56) Aircraft/Airfield Construction Safety & Phasing Plan (32.A.02)

Aircraft/Airfield Construction operations are not applicable under this contract.

(57) Aircraft/Airfield Safety Plan Compliance Document (32.A.02)

Aircraft/Airfield Construction operations are not applicable under this contract.

(58) Site Safety and Health Plan for HTRW Work (33.B)

Hazardous waste site cleanup operations are applicable under this contract. The risk plans that were determined to be applicable to this contract are incorporated into the SSHP, Appendix A.

(59) Confined Space Entry Procedures (34.A.05)

The TI-SDC Team employees shall not enter Permit Required Confined Spaces.

(60) Confined Space Program (34.A.06)

TI-SDC Team employees shall not enter Permit Required Confined Spaces.

j. RISK MANAGEMENT PROCESS

AHAs have been performed for the activities described in this APP and the scope of the contract. This analysis is contained in Appendix B. Site specific information will be reviewed during the site safety orientation prior to and during field implementation of the project. Site specific hazard information will also be covered during tailgate safety training. This training will be documented by the SSHO. As additional activities are identified that are not covered by the AHAs, new analyses will be developed and approved by the TI-SDC Team and USACE and incorporated into the safety program.

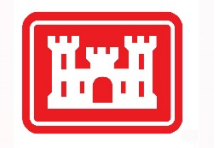
APPENDIX A
SITE SAFETY AND HEALTH PLAN

SITE SAFETY AND HEALTH PLAN
FOR REMEDIAL INVESTIGATION ACTIVITIES

AT THE
FORMER STEWART AIR FORCE BASE,
NEWBURGH AND NEW WINDSOR, NEW YORK

CONTRACT NO. W912WJ-19-D-0006
DELIVERY ORDER NO. W913WJ19F0135
FUDS PROJECT NO. C02NY0704

Prepared for:



U.S. Army Corps of Engineers
New England District
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Concord, MA 01742-2751

Prepared by:

TI-SDC JV
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Baltimore, MD 21215-7854

September 2022

SITE SAFETY AND HEALTH PLAN

FOR REMEDIAL INVESTIGATION ACTIVITIES

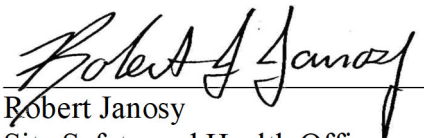
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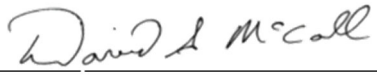
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September 29, 2022
Date

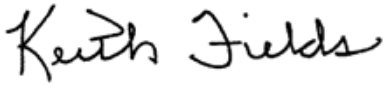
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September 29, 2022
Date

Approved by:



Keith Fields, PE, PMP
Project Manager
TI-SDC
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September 29, 2022
Date

TABLE OF CONTENTS

TABLE OF CONTENTS i
Acronyms and Abbreviations iv
1.0 Introduction 1
1.1 Purpose and Objective 1
1.2 Site Description 2
1.3 Scope of Work 2
1.4 Site Activities Requiring an Activity Hazard Analysis 4
2.0 KEY PERSONNEL and RESPONSIBILITIES 5
2.1 Project Manager Responsibilities 5
2.2 Safety and Health Manager/CIH Responsibilities 6
2.3 Site Safety and Health Officer Responsibilities 6
2.4 Project Field Staff 7
2.5 Subcontractor Responsibilities 8
2.6 Policies and Procedures Regarding Noncompliance with Safety Requirements 8
2.6.1 Subcontractors First Violation of a Rule or Regulation 8
2.6.2 Subcontractors Second Violation of a Rule or Regulation 9
2.7 Safety Accountability for Managers and Supervisors 9
3.0 HAZARD/RISK ANALYSIS 10
3.1 Chemical Hazards 10
3.2 Physical Hazards 10
3.2.1 Slips, Trips and Falls 11
3.2.2 Head and Back Injuries 11
3.2.3 Overhead Power Lines and Underground Utilities 11
3.2.4 Heavy Equipment 11
3.2.5 Electrical Hazards 13
3.2.6 Fire and Explosion Hazards 13
3.3 Environmental Hazards 14
3.3.1 Heat Stress 14
3.3.2 Cold Exposure 15
3.3.3 Noise 16
3.3.4 Biological Hazards 16

3.3.5 Radiological Hazards 17
4.0 SITE CONTROL AND WORK ZONES 18
4.1 Site Work Zones 18
4.2 Work Limitations 19
5.0 PERSONAL PROTECTIVE EQUIPMENT 20
5.1 Levels of Personal Protective Equipment 20
5.2 Anticipated Levels of Protection 20
5.2.1 Level D 21
5.2.2 Level C 21
5.2.3 Levels A & B 22
5.2.4 Disposable Gloves Utilized in Level D PPE 22
6.0 EXPOSURE MONITORING 23
6.1 Perimeter/Personnel Air Monitoring Activities 23
6.2 Meteorological Monitoring Activities 23
6.3 Dust Control Activities 23
6.4 Noise Monitoring 24
7.0 DECONTAMINATION 25
7.1 Decontamination Procedures 25
7.2 Personnel Decontamination 25
7.2.1 Level D Personnel Decontamination 25
7.2.2 Level C Personnel Decontamination 26
7.3 Equipment Decontamination 26
7.3.1 Tools 26
7.3.2 Heavy Equipment Decontamination 27
7.3.3 Respirator Decontamination 27
7.4 Disposal of Decontamination Waste 27
7.5 Decontamination During Emergencies 27
7.5.1 Physical Injury 28
7.5.2 Heat Stress 28
7.5.3 Chemical Exposure 28
8.0 EMERGENCY PROCEDURES 30
8.1 Pre-Emergency Planning 30

8.2 Personnel Roles and Lines of Authority 31
8.3 Emergency Recognition, Prevention, and Response 31
8.4 Site Security and Control 34
8.5 Evacuation Routes and Procedures 34
8.6 Emergency Contacts and Notifications 35
8.7 Emergency Medical Treatments and First Aid 36
8.8 Emergency Response Equipment 38
8.9 Reporting 39
9.0 MEDICAL SURVEILLANCE 40
9.1 Medical Examination Requirements 40
9.2 Record Keeping 40
10.0 TRAINING 41
10.1 General Personnel – Training 41
10.2 Field Personnel – Training 41
11.0 ADVERSE WEATHER CONDITIONS 44
12.0 PERSONAL HYGIENE AND SANITATION 45
13.0 REFERENCES 46

FIGURES

Figure 8-1: Hospital Route Map 37

TABLES

Table 3-1: Hand signals to be used in emergency situations 12
Table 3-2: Air horn signals to be used in emergency situations 13
Table 5-1: Action Response Levels 20
Table 8-1: Emergency Recognition, Prevention, and Response 32
Table 8-2: Hand signals to be used in emergency situations 35
Table 8-3: Emergency Telephone Numbers 36

ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
ACGIH	American Conference of Industrial Hygienists
AFB	Air Force Base
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
AOC	Area of Concern
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
COC	Chemical of Concern
CP	Competent Person
CPR	Cardiopulmonary Resuscitation
CRZ	Contaminant Reduction Zone
CSP	Certified Safety Professional
dBA	Decibels Utilizing the A Filter
DPT	Direct Push Technology
EAC	Emergency Action Coordinator
EAP	Emergency Action Plan
EZ	Exclusion Zone
FUDS	Formerly Used Defense Site
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PID	Photo-Ionization Detector
PM	Project Manager
POC	Point of Contact
PPE	Personal Protective Equipment
ppm	parts per million
SDSs	Safety Data Sheets
SHM	Safety and Health Manager
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SOW	Scope of Work
SZ	Support Zone
TI-SDC	Tidewater Inc. - Sustainable Design Consortium JV
TLV	Threshold Limit Value
UFD-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

Sustainable Design Consortium, Inc. and Tidewater, Inc., herein referred to as the TI-SDC Team, has prepared this Site Safety and Health Plan (SSHP) for implementation during Remedial Investigation activities at the Former Stewart Air Force Base, located in Newburgh and New Windsor, New York. The continued field efforts will be performed under the U.S. Army Corps of Engineers New England District (USACE) Contract No. W912WJ-19-D-0006 and Formerly Used Defense Site (FUDS) Project No. C02NY0704.

The TI-SDC Team will implement this SSHP during field activities. The TI-SDC Team will perform the scope of work in accordance with the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) prepared for this project. The UFP-QAPP describing the methods and procedures that will be used during field activities to achieve the project objectives for the tasks identified in this SSHP.

1.1 Purpose and Objective

The purpose of this SSHP is to protect human health and the environment from the risks associated with field activities at Former Stewart AFB. The TI-SDC Team will perform field activities in accordance with the United States Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities; the National Institute of Occupational Safety and Health (NIOSH) / Occupational Safety and Health Administration (OSHA), October 1985; Title 29, Code of Federal Regulations (CFR), 1926.65, 1910.120, 1910.165, 1910.1030, 1910.1200, 1910.134; the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual, EM-385-1-1, (2014); and any other relevant Federal, State, and local regulations.

The SSHP objectives are to ensure that all necessary precautions for fieldwork are in place, and that appropriate health and safety procedures are followed at all times to protect personnel. In addition, the SSHP objectives include the necessary protection to prevent damage, injury, or loss of property and equipment, and to respond quickly and effectively to the TI-SDC Team-related activities. The Site Safety and Health Officer (SSHO) will maintain a copy of the signed, final version of this SSHP and the Accident Prevention Plan (APP) on-site at all times when work is being performed. This SSHP is incorporated into the APP as Appendix A.

All TI-SDC Team employees involved in intrusive field work at the site have completed the required 40-hour initial Hazardous Waste Operations and Emergency Response (HAZWOPER) training, maintain qualification through annual refresher training, are under a program of medical monitoring supervised by a physician, and are certified to wear respiratory protection, as specified in 29 CFR Part 1910.134. Field work that does not pose a risk of coming into contact with potential onsite contamination do not require OSHA 40-hour HAZWOPER training, examples of these activities include: delivery driver, surveyor, utility location, etc.

The TI-SDC Team recognizes that conditions on a site may change, or that more information may become available, during the operation. If, during the operation, it is determined that the conditions are not as described, or the protection specified in the APP/SSHP requires modifications, the SSHO will stop work and contact the Safety and Health Manager (SHM)/CSP and the Project Manager (PM) for guidance. Work will not resume until authorized by the PM.

1.2 Site Description

Former Stewart Air Force Base (AFB), now Stewart International Airport is located in Orange County, New York in the southwest portion of the State, approximately 2.5 miles west of Newburgh, New York and 35 miles northwest of New York City. The site is currently owned by the New York State Department of Transportation. In 1930, the original tract of land was donated by Samuel L. Stewart to the City of Newburgh for use as a municipal airport. Prior to this, the land use was primarily agricultural. According to USACE sources, Parcel C02NY070401 was reportedly used as a landfill. A site location map is presented in Figure 1. A detailed summary of the site history and previous investigations are provided in the UFP-QAPP.

1.3 Scope of Work

The scope of work (SOW) for continued field activities at Former Stewart AFB will be implemented in accordance with the UFP-QAPP. The current project involves implementing site investigation activities at the Former Southern Landfill [Area of Concern (AOC) 2, Areas A through D, totaling approximately 70.2 acres] and the "Half-Acre" Landfill (AOC 3, totaling approximately 1.4 acres) at the Former Stewart AFB. The work at Former Stewart AFB will be implemented in accordance with the UFP-QAPP and conducted in three phases. The following phases will be implemented at Former Stewart AFB:

Phase 1: Preliminary Site Preparation and Data Collection:

Data collected during this initial phase will help guide a more comprehensive sampling event to be performed during Phase 2:

- Perform site preparation activities to include vegetation removal at proposed sampling locations and staging areas for field project equipment and materials.
- Perform a potable well survey to identify off-site drinking water supply wells that are at risk for impacts from site groundwater.
- Conduct a site reconnaissance to identify the location of existing monitoring wells and other site features, such as outfalls and seeps. Assess the condition of the existing monitoring wells to determine if they are suitable for gauging and sampling.
- Perform a wetland delineation for AOC 2 and AOC 3. Assessment criteria will include: hydrology, hydric soils, and vegetation. Areas where assessment criteria are met will then be delineated.

- Install up to 15 piezometers and gauge water levels for the purpose of updating the groundwater surface map and flow direction for the site.
- Verify the integrity of existing monitoring wells and their construction relative to the water table and observed free-phase product (if any). Pending usability, these wells will be incorporated into the overall groundwater sampling program. If the integrity of the wells is compromised, then the existing wells will be abandoned properly.
- Conduct a geophysical survey to locate potential buried containerized waste and metallic debris. The area for the geophysical survey shall encompass the AOC 2 and AOC 3.

Phase 2: Comprehensive Sampling:
Investigation samples will be collected to focus sampling locations for the third phase and consists of surface water and sediment, surface and subsurface soil, and groundwater samples.

- Collect up to 20 co-located surface water and sediment samples in identified seep and drainage areas at AOC 2 and AOC 3. Discrete (grab) samples of sediment will be collected from a depth of 0 to 6 inches bgs, using a Petit Ponar grab sampler, or equivalent. Surface water samples will be obtained using a long-handled dip sampler. Surface water will be collected from 2 ft above the bottom of the surface water body unless the depth is less than 2 ft; then the sample will be collected with as little bottom disturbance as possible.
- Collect discrete (grab) surface soil samples at up to 50 locations throughout AOC 2 and 10 locations within AOC 3. Surface soil will be collected manually using a stainless-steel hand trowel or stainless-steel hand auger, at a depth of approximately 0 to 12 inches bgs.
- Conduct up to 25 soil borings to an average depth of 30 feet at AOC 2 and 5 soil borings at AOC 3. The soil borings will be drilled using a Direct Push Technology (DPT) rig with core barrel lined with acetate sleeves for sample collection.
- If suitable for sampling, sample groundwater from the 10 existing wells at AOC 2.

Phase 3: Focused Groundwater Sampling and Background Study:
Groundwater Investigation and Grab Sampling:

- A DPT groundwater investigation will be conducted during the third phase of the investigation along transects at AOC 2 and AOC 3. Up to 60 discrete grab groundwater samples will be collected at average depths of 25-30 feet using a groundwater profiler (such as a Waterloo Sampler or Geoprobe® Screen Point Tool).
- If additional permanent wells are deemed necessary, they will be installed and sampled during a subsequent phase of investigation.
- Background Study: Identify uncontaminated areas outside the influence of the Site, with similar physical conditions. Select an upgradient area for performance of a background DPT investigation.

1.4 Site Activities Requiring an Activity Hazard Analysis

Work phases that require an activity hazard analysis (AHA) are identified below. The AHA's and control measures for these work phases planned are provided in Appendix B of the APP.

1. Mobilization and Demobilization
2. Vegetation Clearing
3. Surveying (to include Land, Utility, Geophysical, Wetland Delineation)
4. Direct Push Technology (DPT)
5. Soil and Groundwater Sampling
6. Equipment Decontamination
7. Investigation Derived Waste (IDW) Management and Disposal

2.0 KEY PERSONNEL AND RESPONSIBILITIES

Key personnel for this project include the TI-SDC Team PM, Mr. Keith Fields; the SSHO, Mr. Robert Janosy; and the alternate SSHO, Mr. Greg Headington; the SHM, Mr. David McCall, Certified Safety Professional (CSP); and subcontractor personnel. An alternate SSHO with the required training will be available at all times, and will be assigned when the SSHO is not on-site. All project field staff, including subcontractor personnel, have completed comprehensive health and safety training, which meets the requirements of Title 29 CFR Parts 1926.65, 1910.120. In addition, all workers assigned to this project will comply with the health and safety requirements associated with this project.

Specific project safety responsibilities for these key personnel are provided in detail in Section d (2) of the APP, and are briefly outlined below. The TI-SDC Team developed this SSHP for the TI-SDC Team personnel. Subcontractor personnel will, at a minimum, follow this SSHP or a plan approved by USACE and the TI-SDC Team.

2.1 Project Manager Responsibilities

The PM for this project will be Mr. Keith Fields, Professional Engineer (PE) and Project Management Professional (PMP), who has completed the 40-hour HAZWOPER class, and completes annual 8-hour HAZWOPER refresher classes. As the PM, Mr. Fields is responsible for generating, organizing, and compiling the SSHP, which describes planned field activities and potential hazards that may be encountered at the site. The PM will be responsible for establishing emergency communications with all potential emergency response organizations and verifying all emergency telephone numbers prior to the start of on-site work. The PM is also responsible for ensuring that adequate training and site safety briefings (including provisions for specific pieces of equipment) are provided to the project field team. The PM will provide a copy of this SSHP to the project field team, and a copy to each subcontractor prior to field activities. A copy of this SSHP shall be on-site at all times. Associated health and safety responsibilities will include:

- Coordinating the activities of all contractors' field personnel, including their signed acknowledgment of the SSHP;
- Selecting a SSHO and field personnel for the contractual site work to be undertaken;
- Ensuring that the tasks assigned to the contractor are being completed as planned and are kept on schedule;
- Providing authority and resources to ensure that the SSHO is able to implement and manage safety procedures;
- Preparing reports and recommendations about the project to the client and the concerned contractor's personnel;
- Ensuring that the SSHO is aware of all of the provisions of this SSHP and instructing all personnel on site safety practices and emergency procedures defined in this plan

- Ensuring that the SSHO is monitoring site safety;
- Directing changes in work practices to improve worker health and safety, if necessary;
- Removing individuals from the site if their conduct jeopardizes the health and safety of themselves and/or others;
- Suspending work on any project or operation that jeopardizes the safety of anyone in the area; and
- Suspending work on a project or activity if the health and safety plan and/or protocols used are (or are suspected to be) inappropriate or inadequate.

2.2 Safety and Health Manager Responsibilities

The SHM for this project is Mr. David McCall. The SHM is responsible for developing and coordinating the health and safety program. The SHM will also be responsible for reviewing and approving the SSHP for accuracy and incorporating new information or guidelines that aid the PM and SSHO in further definition and control of the potential health and safety hazards associated with this project. Along with the PM and the SSHO, the SHM also can suspend or modify work practices for safety reasons and dismiss individuals whose on-site conduct endangers the health and safety of themselves and/or others.

2.3 Site Safety and Health Officer Responsibilities

The SSHO for this project is Mr. Robert Janosy, and the alternate SSHO is Mr. Greg Headington. The SSHO has a direct line of authority from the TI-SDC Team's SHM to implement specific health and safety requirements for specific site activities, and for ensuring that all team members, including subcontractor(s), comply with the APP/SSHP. It is the SSHO's responsibility to inform the subcontractor(s) and other field personnel of chemical and physical hazards, as they become aware of them. The SSHO and alternate SSHO are the competent persons (CP) overseeing site activities during this field investigation. No project activities will be conducted unless the SSHO/CP is on site supervising. Additional SSHO responsibilities include:

- Ensuring that all project-related personnel have signed the personnel agreement and acknowledgments contained in this SSHP (Refer to the APP);
- Providing a daily site safety briefing (tailgate meeting) for team members;
- Evaluating weather conditions and chemical hazard information to make recommendations to the PM about any modification to work plans or personal protective equipment (PPE) requirements to maintain personnel safety;
- Monitoring the compliance activities and the documentation processes;
- Approving all field personnel working on site while taking into consideration their level of training, physical capacity, and ability to wear PPE necessary for the assigned tasks;
- Inspecting all PPE prior to use;

- Inspecting all equipment prior to use, which includes observing the testing of all "emergency" stop switches and ensuring that the required number of emergency stop switches are available;
- Assisting the PM in SSHP documentation compliance by completing standard forms (Refer to the APP);
- Monitoring the compliance of field personnel for the routine and proper use of PPE that is required for each task;
- Assisting in, and evaluating the effectiveness of, decontamination procedures for personnel, protective equipment, sampling equipment, heavy equipment and vehicles;
- Enforcing the "buddy system" as appropriate for site activities;
- Reviewing with site personnel the emergency phone numbers, the location and route to the nearest medical facility, the procedures for arranging emergency transportation to the nearest medical facility, and posting the related information (i.e., the telephone numbers of the local hospital, police and fire along with the route to the hospital);
- Stopping operations that threaten the health and safety of the field team or the surrounding population;
- Entering the exclusion area in emergencies after notifying emergency services and taking appropriate precautions;
- Observing field team members for signs of exposure, stress, or other conditions related to pre-existing physical conditions and/or site work activities;
- Serving as the Emergency Action Coordinator (EAC);
- Directing changes in work practices to improve health and safety;
- Removing individuals from operations if their conduct jeopardizes the health and safety of themselves and/or others; and
- Suspending work on a project or activity if the health and safety plan and/or protocols used appear, or are suspected to be, inappropriate or inadequate.

2.4 Project Field Staff

The project field staff is responsible for ensuring that activities are performed in accordance with the APP/SSHP/AHAs, and that deviations from the plan are based upon field conditions encountered, have been approved by the PM and/or SSHO, and that the information is well documented in field notes. Field staffs' health and safety responsibilities include:

- Following the APP/SSHP/AHAs;
- Following the Corporate Health and Safety Program;
- Reporting to the SSHO any unsafe conditions or practices;
- Reporting to the SSHO all facts pertaining to incidents that result in injury or exposure to toxic materials or chemicals of concern (COCs);
- Reporting equipment malfunctions or deficiencies to the SSHO;

- Reviewing the APP/SSHP in the field, as necessary;
- Attending the daily pre-work safety tailgate meetings;
- Attending the scheduled health and safety training classes; and
- Attending all scheduled medical examinations.

It is the responsibility of individual organizations involved in the field activities to ensure understanding of, and compliance to, the SSHP by its on-site employees or representatives working in controlled areas. Failure by any person to adhere to this plan may result in removal from site activities.

2.5 Subcontractor Responsibilities

All subcontractors are responsible for their own health and safety program and the health and safety of their own employees. This requirement is based on OSHA regulations, which recognize the employer-to-employee responsibility for health and safety. Each subcontractor will submit a properly completed AHA to the TI-SDC Team's SSHO for review prior to commencing fieldwork for each task they will perform under this scope of work.

As stated above, subcontractors are responsible for instituting health and safety training for their employees. At a minimum, each must comply with the TI-SDC Team APP/SSHP. The TI-SDC Team will provide copies to the subcontractor's employees when requested, and they will be required to sign the Site Safety Tailgate Meeting Form as part of the TI-SDC Team safety protocol prior to working on site.

2.6 Policies and Procedures Regarding Noncompliance with Safety Requirements

Whenever a violation of safety policy occurs and requires correction, the SSHO will document the situation and request the subcontractor's competent person to initiate corrective action. Corrective action will be documented with further explanation given in the daily project notes. If immediate corrective action is not taken by the subcontractor, they will be notified in writing using the Safety/Health Violation Notice. The SSHO and PM will be informed of the action taken within 24 hours of the violation. The involvement of the PM is essential to ensuring that there are no additional violations of safety policies at the work site. The TI-SDC Team reserves the right to immediately remove any personnel from the site for a serious violation of safety requirements.

2.6.1 Subcontractors First Violation of a Rule or Regulation

A subcontractor employee who is cited for a first-time notice of a Safety/Health Violation Notice shall be immediately removed from the site, and shall not be permitted to return to work for a period of at least 24 hours, missing the next full workday. For example, if an employee was cited on a Friday afternoon, they would leave the site that day and would not be permitted to return to work until Tuesday morning.

2.6.2 Subcontractors Second Violation of a Rule or Regulation

A subcontractor employee responsible for a repeat offense or receiving a second Safety/Health Violation Notice shall be immediately and permanently removed from the site for the remainder of the contract period. This requirement may only be waived if the subcontractor demonstrates, on behalf of the employee, extenuating or mitigating circumstances, and obtains a waiver from the TI-SDC Team SSHO and/or PM.

2.7 Safety Accountability for Managers and Supervisors

The following has been adopted into the TI-SDC Team's Policies and Procedures Manuals:

"First line supervisors and management, site managers, department managers, and safety representatives are responsible for enforcing all safety and health policies. TI-SDC will take disciplinary action against employee-owners for failing to enforce such policies." TI-SDC will follow the violation procedures discussed for subcontractors with their own employees.

Also, the following statement was adopted into the policy: "The TI-SDC Team reserves the right to dismiss employee-owners who commit serious or repeat safety or health violations."

3.0 HAZARD/RISK ANALYSIS

This section discusses chemical, physical and environmental hazards that workers may encounter. Section 3.1 identifies COCs anticipated to be present at the site. Section 3.2 discusses physical hazards identified with this site including those associated with the use of heavy equipment. Environmental hazards discussed in Section 3.3 are associated with the physical location of the site, weather conditions (such as, heat stress and noise), and contact with flora and fauna.

Daily "Tailgate" safety meetings will be held at the start of each workday; potential chemical, physical, and environmental hazards and preventative safety measures will be discussed. Subsequent Tailgate safety meetings may be called when the SSHO, SHM, or PM believes that a potential safety issue that was not covered in the morning meeting may exist. An AHA has been developed for each task associated with the general contract activities and is included in this SSHP as Appendix B to the APP. This analysis identifies the sequence of work, specific hazards anticipated, and the control measures to be implemented to minimize or eliminate each hazard. The AHAs will be used to augment daily safety meetings intended to heighten safety and hazard awareness on the job.

3.1 Chemical Hazards

The primary COC for Former Stewart AFB is TCE. Other COCs include TCE breakdown products and several metals. The Safety Data Sheets (SDSs) for COCs and other chemicals that may be used will be kept on-site, at the point of storage during field activities. The SDSs will be provided in a combined project site list and made accessible in a centralized location for both the TI-SDC Team and subcontractor personnel to use.

Exposure to a listed COC on site is possible, but anticipated to be improbable due to the nature of work. Site workers will use Level D PPE protection while working on site, including hard hats, coveralls/standard work clothing, safety glasses with protective side shields, safety-toed work boots and chemical-resistant (nitrile) gloves and/or leather work gloves. The TI-SDC Team will acquire, and review with all personnel during daily safety meetings, all SDSs for any additional chemicals brought onto the site.

3.2 Physical Hazards

There are numerous physical hazards associated with this project, which, if not identified and addressed, could cause accidents and personal injury to field personnel, as well as operational problems. Field personnel should maintain awareness of potential safety hazards, and should immediately inform the SSHO of any new hazards, so that corrective measures can be taken. In the event of a medical emergency, the nearest medical facilities (with directions) are outlined in

Section 8. For specific physical hazards associated with well abandonment activities and IDW handling, refer to respective AHAs.

3.2.1 Slips, Trips and Falls

During field activities, work may occur in areas where uneven surfaces or job supplies and other equipment at ground level present possible slip, trip and fall hazards. Wet weather conditions and areas where heavy equipment has traveled over may exacerbate such hazards. Work locations will be kept as tidy as possible and free of ground debris. Personnel will wear appropriate footwear for site conditions and walk carefully.

3.2.2 Head and Back Injuries

As minimum requirements, hard hats and safety glasses will be donned prior to performing any site activities where hazards exists (drilling or other heavy machinery). This will prevent minor head injuries caused while working around equipment, with hand tools, or process related structures. At the daily safety meeting, personnel will be educated in proper lifting techniques and will not lift heavy items without assistance.

3.2.3 Overhead Power Lines and Underground Utilities

All field vehicles and equipment will be maintained a minimum distance of 20 feet, in vertical and horizontal directions, from all overhead electrical power lines (energized lines) and/or electrical equipment with a voltage less than or equal to 50 kilovolts. If the voltage exceeds 50 kilovolts, the clearance will be increased by at least 4 inches for every 10 kilovolts over that voltage. While not likely, various forms of overhead and underground utility lines or pipes may be encountered during field activities. Prior to the start of borehole advancement and well installation, authorization from all concerned public and base utility department offices will be received. Should any site activities cause equipment to come in contact with utility lines, the SSHO and SHM will be notified immediately. Work will be suspended until the appropriate actions for the given situation can be implemented.

3.2.4 Heavy Equipment

The use of heavy equipment presents the greatest potential for injury to personnel. The moving parts of heavy equipment may create pinch points, which can cause serious injury or death. Each piece of heavy equipment (i.e., drilling rig) shall have emergency shut-off switches, and all shut-off switches must be operable and tested at the beginning of each work day the equipment is operated. No unrestrained hair longer than shoulder length will be allowed on site workers. A tight fitting bandanna or hair net below the hard hat will be required to restrict hair longer than shoulder length. In all cases, rotating shafts or gears should be guarded to prevent accidental contact. Loose clothing and/or jewelry will also be prohibited around heavy equipment. Clothing hanging away from the body must be restricted and if this is not possible, the worker will have to change clothes. Jewelry around the neck, hands, forearms and waist will be removed prior to

working around activity areas. Mobile equipment operators will have had the required training and will have demonstrated the necessary skills to operate the heavy equipment.

Another hazard associated with heavy machinery is the lack of visual contact between the operator and ground personnel when mobilizing, or possibly positioning the equipment. Personnel approaching heavy equipment while operating will observe the following protocols:

- Make eye contact with the operator (and spotter);
- Wear a brightly colored vest or shirt (high-visibility);
- Signal the operator/driver to cease heavy equipment activity/movement; and
- Approach the equipment and inform the operator of intentions.

All personnel associated with drilling activities will wear Level D PPE, which includes a hard hat, safety glasses, coveralls/standard work clothing, steel-toed boots, chemical-resistant gloves, and a brightly colored shirt/vest. In addition to the standard clothing, disposable earplugs will be available for utilization by all on-site workers. Mobile equipment will be equipped with occupant restraints and/or rollover protection according to 29 CFR 1926, Subpart O. All heavy equipment and trucks (except for pick-up trucks) will have back-up alarms.

A communication program including the use of hand signals, air horn, 2-way radios, and/or cellular phones among workers shall be implemented during the project. Workers on the ground are to use the "buddy system" at all times and be cognizant of the reduction of communication abilities in high noise areas. The specific hand signals to be used during the project shall be discussed in the tailgate safety meeting. Hand signals that will be used by site personnel in emergency situations or when verbal communication is difficult will include the following.

Table 3-1: Hand signals to be used in emergency situations

Signal	**Definition**
Hands clutching throat	Out of air or cannot breath
Hands on top of head	Need assistance
Thumbs up	Okay, I am all right, or I understand
Thumbs down	No or negative
Arms waving upright	Send backup support
Fist clenched tight	Exit area immediately
Index and thumb rubbing together	Stop Slowly

In case of an emergency, an air horn shall be used by the SSHO to alert site personnel. The following signals will be used.

Table 3-2: Air horn signals to be used in emergency situations	
Signal	**Definition**
One Short Blast	Warning or Attention, Stand By for Directions
One Extended Blast	Evacuation
Repetitive Short Blasts	Fire
One Short and One Long Blast	All Clear
Short and Long Blasts Repeatedly	Medical Emergency

Any sounding of this device shall be cause to stop work and prepare to mobilize to the predetermined emergency meeting area (i.e., the Support Zone unless changed by the SSHO and announced during the morning Safety/Tailgate Meeting) for further direction or information. Personnel will remain in the emergency meeting area until the SSHO or his authorized representative provides further instructions. A roll call will be conducted to confirm that all workers are mobilized in the meeting area.

3.2.5 Electrical Hazards

The SSHO will inspect all equipment daily prior to its use to confirm that it is functioning as designed. The SSHO will remove from service any equipment which is found to be malfunctioning. The equipment will be replaced in lieu of on-site repair. If applicable, all equipment will be properly grounded prior to and during all work activities performed on-site.

All electrical wiring on the heavy equipment shall be covered by the appropriately colored wire insulation. Junction boxes and connections will be sealed to protect from inclement weather.

3.2.6 Fire and Explosion Hazards

It is unlikely that explosive atmospheres will be encountered during the proposed remedial activities; however, knowledge of fire/explosion prevention is required.

The following standard safety procedures will be implemented:

- All field vehicles and heavy equipment will be equipped with a type-ABC fire extinguisher. Fire extinguishers will be mounted on the vehicles where field personnel can easily access them. A fire extinguisher check, including inspecting gauges, hoses, and tanks, must be done monthly to ensure proper operation of the equipment.
- When necessary, other fire-fighting equipment should be made available.
- Open fires and burning are prohibited. Smoking will be prohibited in all areas where flammable, combustible, or oxidizing materials are stored or are in use.
- No flammable and combustible liquids (i.e., gasoline or diesel) will be stored on-site. All equipment used during site activities will arrive on-site with a full fuel tank.
- Vehicle engines will be shut off when not in use.
- Smoking is prohibited.

3.3 Environmental Hazards

Environmental hazards associated with the site will be discussed at the orientation meeting prior to the start of field activities. Personnel will be apprised of symptoms of exposure to certain biological hazards and heat stress. If site workers are required to wear semi-permeable or impermeable protective clothing, physiological monitoring for signs of heat stress injury will commence when ambient temperatures reach 75 degrees Fahrenheit (°F). There shall be at least one quart of water per person per hour and shade available throughout the workday. Employees may stop work whenever they believe it is necessary to prevent heat stress and have water and/or sit in the shade for at least 5 minutes. The SSHO is responsible for monitoring the weather on hot workdays (i.e., over 75°F when disposable suits are being worn) in order to adequately monitor the work force.

3.3.1 Heat Stress

The TI-SDC Team's field workers may spend some part of their day in a hot, humid environment. The amount of heat stress a worker faces in a hot work area may be affected by four environmental factors: temperature, radiant heat, humidity, and air velocity. Personal characteristics such as age, weight, fitness, medical condition, and acclimatization to the heat also affect the level of stress. The human body has defenses to reduce the effects of heat on the body. However, under certain situations, these body functions are not substantial enough to eliminate the problem. When this occurs, the body may be subject to heat stress. Physical reactions to heat stress will range from mild reaction such as fatigue, irritability, anxiety, and decreased concentration, to death.

Heat stress occurs in four stages. These are listed below in order from least to most severe:

1. Heat Rash: Heat rash is caused by continuous exposure to hot, humid air and is aggravated by chafing clothes. This condition decreases the ability to tolerate heat. The symptom is a mild red rash.
2. Heat Cramps: Heat cramps are caused by loss of body fluid through perspiration that is not balanced by adequate fluid intake. They typically are the first sign of heat stress, and can lead to heat stroke. Symptoms include acute, painful voluntary muscle spasms, particularly in the abdomen and the extremities. These may also occur during rest.
3. Heat Exhaustion: Heat exhaustion is a weakness caused by loss of fluids. This is the next sign that may lead to heat stroke. Symptoms are pale, moist, clammy skin; perfuse perspiration; and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. These symptoms may be accompanied by headache, vomiting and dizziness.
4. Heat Stroke: Heat stroke is the most serious and dangerous reaction to heat stress and is caused by a failure of the body's natural heat regulating mechanisms. Symptoms are red, hot, dry skin, nausea, dizziness, confusion, extremely high body temperature, rapid breathing and pulse rate, and unconsciousness.

To minimize heat stress, employees shall observe the following work practices and control measures in hot work areas:

- Alternate work and rest periods with rest periods in a cooler area;
- Reduce work load under extreme heat conditions;
- Drink large amounts of water;
- Ensure adequate ventilation and air movement around the worksite; and
- If excessive heat persists in the work area and control measures do not adequately reduce the heat stress on the employees, work will be terminated until the condition subsides.

3.3.2 Cold Exposure

During winter months employees will work in cold environments. Working outdoors at low temperatures may subject employees to cold stress. Exposure to extreme cold for a short period of time causes severe injury to the surface of the body. Prolonged exposure may result in a generalized cooling of the body and eventually in death.

Two factors influence the development of cold injuries: ambient temperature and wind velocity. Wind chill is used to quantify the chilling effect of wind in combination with the temperature. Moisture, from environmental conditions or perspiration, increases the cooling rate of the body and may decrease the insulating effectiveness of clothing.

Frostbite is the result of exposure of the skin to excessive cold conditions. It is characterized by a grayish or whitish appearance of the skin. Frostbite also causes a deadening of the nerve endings in the exposed areas. For example, a frostbitten hand will no longer feel cold to the victim. As a result, frostbite may go unrecognized for a period of time, which can cause more injury. To prevent frostbite, workers should stop work and warm cold skin at the onset of numbness.

Hypothermia is a general cooling of the body caused by freezing or rapidly dropping temperatures.

Symptoms occur in five stages:

1. Shivering
2. Apathy, listlessness, sleepiness and cooling of the body to less than 95°F
3. Unconsciousness, glassy stare, slow pulse and slow respiratory rate
4. Freezing of the extremities
5. Death

To maintain adequate protection against cold exposure, employees shall observe the following work practices and control measures:

- Alternate work and rest periods with rest periods in a warmer area;
- Utilize a supplemental heat source, if possible;
- Wear an insulating liner or hood under the hard hat;
- Dress warmly by layering clothing;
- Avoid becoming overheated by removing layers of clothing while working to remain cool enough to not perspire;
- Utilize clothing materials that do not lose insulating value when wet or dirty (i.e. use wool or polypropylene; avoid down or cotton); and
- Keep clothing clean.

If excessive cold persists in the work area and control measures cannot reduce the cold stress on employees, work will be terminated until the condition subsides.

3.3.3 Noise

Noise is a potential hazard in areas where heavy equipment, power tools, pumps, compressors, or large generators are being operated. Equipment operation may produce noise levels that reach or exceed 85 decibels utilizing the A filter (dBA). Exposure to elevated noise levels can lead to temporary or permanent hearing loss, and can also cause muscle tension and irritability. Exposure levels will comply with the American Conference of Industrial Hygienists (ACGIH), threshold limit value (TLV) continuous noise exposure limits outlined in Table 5-4 of EM-385.

Noise levels in excess of 85 dB are likely to be generated due to the inherent nature of diesel engines on heavy equipment. Site workers on drilling crews or possibly using a wood chipper and anyone working in the immediate vicinity, will don either disposable earplugs or earmuffs. Site workers not directly involved in site activities in these areas will not be allowed in the area.

The TI-SDC Team's SSHO and Alternate SSHO have completed the 30-hour OSHA Construction Safety training. Instruction on the use of and proper fitting of disposable earplugs was included in both classes. The SSHO will visually confirm workers hearing protection is properly fitted into the ear.

3.3.4 Biological Hazards

Potential biological hazards associated with working at Former Stewart AFB include poison ivy, giant hogweed, snakes, ticks, bees, and other insects. While no specific biological hazards have been identified or communicated by the host, the TI-SDC Team employees and their subcontractors will be instructed to maintain awareness for biological hazards in their surroundings, especially when initially entering the work site. If any such hazards become known during the course of the project, the SSHO and/or the SHM will make the appropriate changes in this SSHP and communicate the dangers/concerns to the workers. Workers will

exercise caution when traversing the site and avoid heavily vegetated areas where biological hazards likely exist. No significant populations of any of the referenced potential biohazards have been identified at the work site.

Serious and/or threatening chemical and physical hazards frequently overshadow any potential exposure to biological hazards. However, specific biological hazards can cause injury and even death. Therefore, when appropriate, such hazards will be identified and evaluated in conjunction with all other actual or potential hazards associated with an operation, and steps taken to control exposure. Procedures as prescribed in the First Aid Book will be properly implemented. Paramedics will be summoned for workers exhibiting symptoms of allergic reaction to a biological hazard.

3.3.5 Radiological Hazards

Radiological hazards are not expected. Should radiological hazards be encountered during field activities, an amendment to this plan must be prepared.

4.0 SITE CONTROL AND WORK ZONES

Site access control during vegetations clearing and drilling operations will be conducted by the TI-SDC Team's employees who will be responsible for keeping work areas clear of unauthorized personnel. The TI-SDC Team SSHO will be responsible for maintaining site access control restrictions and keeping unauthorized and untrained personnel out of restricted access zones.

Visitors will not be permitted within active work areas. All visitors, regardless of affiliations or approvals, will not be permitted unless they provide documentation of the training and medical surveillance requirements specified in this plan, have read and signed this APP/SSHP, and are escorted. Under no circumstances shall anyone enter the work zone without authorization from the TI-SDC Team SSHO. This shall include client, utility, and regulatory representatives. A visitor sign-in sheet will be maintained by the TI-SDC Team, recording all who enter onto the site into the support zone. A Site Control Log will be used by the SSHO to record all personnel entering the work zone, the times at which they enter and depart, and their company affiliation. All visitors will be advised by the SSHO of the following upon arrival to the site:

- Safe work practices, such as proper site entry and egress, and proper hygiene during meal and rest breaks
- Recognition, in oneself and others, of physical conditions requiring immediate medical attention, especially heat stress, and application of simple first aid measures
- Procedures to be followed in case of emergencies

4.1 Site Work Zones

Work location restrictions will primarily be determined upon the potential physical safety concerns, as the potential for exposures to the COCs are highly unlikely to occur at or above their respective Permissible Exposure Limits (PELs). The site work zones shall include, but not necessarily be limited to, the following zones:

- Exclusion Zone (EZ)
- Contamination Reduction Zone (CRZ)
- Support Zone (SZ)

The EZ and CRZ will consist of any area in the immediate vicinity of the drilling rig and/or sampling activities. All employees will use appropriate PPE when working in those areas. The EZ will be defined as an area where there is a possible respiratory and/or contact health hazard and/or physical safety concern. In most instances, this area will be approximately a 30-foot radius from all intrusive site activities (i.e., drilling rig), in order to allow for safe movement of the equipment and the personnel in the work zone. Cones, yellow caution tape, or other appropriate means will identify the location of the EZ. The EZ and CRZ will be subject to

change based on the extent of contamination levels and changing site conditions. It is also possible, based upon the extent of contamination (or the lack thereof) that decontamination of site personnel may consist of dry-decon followed by thorough hand and face washing. Air monitoring (if applicable) will be conducted to determine contamination levels. The SSHO will restrict access to this area to site personnel. The personnel decontamination station will be located at the entrance to this area if deemed necessary by the SSHO.

The SZ includes the areas surrounding the EZ and CRZ. The SZ can be any area located outside of the CRZ where activity support may occur. The SZ will be located to prevent employees from being exposed to any particulate levels above regulatory limits, and to allow the safe movement and use of drilling equipment. Eating, drinking, or smoking will be permitted in the support area only after washing face and hands. Smoking will only be allowed in designated areas, and will not be permitted if flammables and/or gas cylinders are stored in the area and/or if hot work is being conducted. A Site Operations Center may be established if required.

4.2 Work Limitations

Work limitations include the following:

- No eating, drinking or smoking in the EZ.
- All persons must wear eye protective equipment when and where appropriate. (Refer to applicable AHA for PPE requirements.)

Facial hair must not interfere with the fit of the respirator or come in contact with the face of the respirator where the respirator touches one's face.

5.0 PERSONAL PROTECTIVE EQUIPMENT

5.1 Levels of Personal Protective Equipment

The harmful effects that chemical substances have on the human body often necessitate the use of respiratory protection and personal protective clothing. Proper selection of PPE depends upon a number of factors. Protection against different types of chemicals and differing concentrations of those substances can be quite varied. The tasks to be performed and the probability of exposure to the substances must also be considered when specifying protective clothing.

Once the specific hazard has been identified, appropriate PPE can be selected. The protection level assigned must match the hazard confronted. The specific equipment comprising each level of protection will vary slightly, but is defined primarily by the type of respiratory protective equipment used, and secondly by skin protection.

The following list briefly describes the various PPE Levels:

Level A: Used when the greatest level of skin, eye, and respiratory protection is needed and consists of a totally encapsulated suit with supplied breathing air

Level B: Used when the highest level of respiratory protection is needed, but a lesser level (than Level A encapsulating suit) of skin protection is required

Level C: Used when criteria for using air-purifying respirators are met, and a lesser level of skin protection is required

Level D: Used in areas without respiratory hazards

5.2 Anticipated Levels of Protection

The PPE Level will be determined by air monitoring discussed in Section 8.0. Based on the hazard analysis for the environmental project at the site, Level D protective clothing is the anticipated primary level of protection to be worn during site activities. Table 5-1, Action Response Levels, summarizes the criteria developed utilizing OSHA 1910.1000 Table Z-2.

Table 5-1: Action Response Levels

Monitoring Device	Action Level	Action
PID or Equivalent	0 to 10 PPM above background levels in the breathing zone	Wear Level D PPE
PID or Equivalent	= or > 10 PPM above background levels in breathing zone	Engineering controls i.e., work up wind or ventilation, field

Table 5-1: Action Response Levels		
Monitoring Device	**Action Level**	**Action**
		personnel will don Level C respiratory protection until levels decrease below 10 ppm in the breathing zone. If needed, contaminant specific detector tubes may be used to determine levels of concentrations and, if needed, a change in the level of PPE
PID or Equivalent	= or > 25 PPM above background levels in breathing zone	Work will be discontinued, personnel will evacuate to the predetermined safe area, and control measures initiated

PID: Photo-ionization Detector
PPM: Parts Per Million
PPE: Personal Protective Equipment

5.2.1 Level D

Level D protection is the minimum level of personal protection allowed on hazardous waste sites. Respiratory protection is not required, as the atmosphere is assumed breathable and uncontaminated.

Level D protection will consist of the "basic work clothing" plus:

- Hard hat (during drilling activities)
- Coveralls/standard work clothing
- Safety glasses with protective side shields
- Safety-toed work boots
- Chemical-resistant (nitrile) gloves and/or leather gloves

Earplugs or earmuffs with noise reduction ratings sufficient to attenuate the sound level will be mandatory during drilling activities due to the inherent nature of diesel engines and the sound generated by drilling. Hard hats, safety glasses (goggles with splash shields or optional full-face shield), and safety shoes must meet American National Standards Institute (ANSI) approval.

5.2.2 Level C

Level C protection is defined by the use of either a full-face or half-face, air-purifying respirator. This level is used when low levels of contaminants of a known nature are present, sufficient

oxygen is available, and contaminants are not considered immediately dangerous to life and health. Level C will consist of Level D above plus:

- Half-face (or full face), air-purifying respirator with NIOSH approved filter cartridges, which are selected depending upon the type of exposure
- Chemical-resistant or polyethylene-coated disposable outer coveralls (e.g., Tyvek®)
- Chemical-resistant (e.g., butyl) outer gloves (taped to outer coveralls)
- Chemical-resistant (e.g., nitrile) inner gloves
- Chemical-resistant safety boots (taped to coveralls)

5.2.3 Levels A & B

Levels A and B protection are not anticipated during field activities. If it appears that these levels may be required, the SSHO will immediately shut down and secure the operation and contact the PM, SHM, USACE point of contact (POC) for further guidance. The SSHO will be responsible for determining the appropriate level of personal protection to be used, based on the Action Response Levels established in this document. The SSHO, with the consent of the SHM and PM, shall notify the POC prior to implementing any modifications to the PPE or levels of protection.

5.2.4 Disposable Gloves Utilized in Level D PPE

When working in Level D PPE, site workers will utilize disposable nitrile gloves as their primary hand protection for site COCs. Leather gloves will also be available as another source of hand protection. If the worker is allergic to nitrile gloves, then latex or rubber gloves will be used. Nitrile gloves are made of synthetic rubber, contain no latex proteins, and offer good resistance to wear. They are more puncture resistant than many other types of rubber gloves and offer superior resistance to many types of chemicals, petroleum hydrocarbons included.

6.0 EXPOSURE MONITORING

This section outlines monitoring strategies that will be used to assess employee exposure to chemical hazards. The anticipated chemical hazards present on site are volatile organic compounds (VOCs) and metals. The TI-SDC Team will utilize direct reading instruments to monitor for chemical hazards. All direct reading instruments will be calibrated before and after each period of use in accordance with manufacturers' recommendations and standard industrial hygiene practice. Records detailing date, time, span gas, or other standards used and the name of the person performing the calibration will be stored with the instrument. The direct-reading instrument will be calibrated in accordance with the standard operating procedures found in the operator's manual accompanying the instrument. The SSHO will charge the batteries and verify that instruments are fully charged before each use.

6.1 Perimeter/Personnel Air Monitoring Activities

To monitor petroleum hydrocarbon vapors emitted from the soil during drilling and sampling activities, the TI-SDC Team will implement the use of a photo-ionization detector (PID). The PID is a real-time, direct-reading instrument for volatile organic vapors. The breathing zone of workers on-site will be monitored periodically. If the PID reading shows a sustained concentration greater than 10 ppm, engineering controls will be implemented (i.e., field personnel will move to an upwind, safe location), and the SSHO will contact the PM, SHM, and USACE POC for further instructions. PPE will not be upgraded due to consistent organic vapor readings in excess of 100 ppm or other work conditions; however, work will stop until the APP/ SSHP has been revised to reflect new working conditions or conditions subside. Action levels for respiratory protection are provided in Table 5-1, Action Response Levels.

6.2 Meteorological Monitoring Activities

On-site, ambient weather conditions (wind speed and direction, temperature, and relative humidity) will be monitored continuously via real-time Internet weather locations, and/or the National Weather Service. If a local station can provide data relevant to the site, its website will be used to obtain forecasts. On-site meteorological conditions will be observed by the SSHO for change in direction, magnitude, incoming storms, or conditions favorable for lightning. More stringent controls will be in place when wind direction is such that residences or populations are downwind from the site.

6.3 Dust Control Activities

The TI-SDC Team will implement appropriate procedures to control the generation of airborne dusts and vapors by monitoring drilling and site activities. Such procedures may include, but will not be limited to, the following:

- Emissions of fugitive dust from any active operation or disturbed surface area shall not be allowed such that the presence of dust remains visible in the atmosphere beyond the sites property line.
- If necessary, dust generation will be controlled by misting onto these materials prior to and as they are poured.

6.4 Noise Monitoring

Noise monitoring will not be performed because noise levels in excess of 85 dB are likely to be generated due to the inherent nature of diesel engines and drilling equipment. Therefore, hearing protection will be required during drilling activities. Site workers not involved directly with site activities in this area will not be allowed in the area unless hearing protection is donned.

7.0 DECONTAMINATION

Decontamination involves the physical removal and/or neutralization of harmful contaminants. The extent of decontamination depends on the hazard and the quantities of the contaminant. Contamination can occur from:

- Contacting vapors, gases, mists, or particulates;
- Splashes while sampling or opening containers;
- Handling contaminated instruments, protective clothing, or equipment; and
- Assisting contaminated personnel during project operations, decontamination procedures, and emergencies.

All decontamination will be performed by personnel wearing a level of protective gear that is appropriate for the level of decontamination.

7.1 Decontamination Procedures

Contaminant reduction procedures appropriate for the existing work area will be implemented as explained in Sections 7.2 through 7.5 below.

7.2 Personnel Decontamination

Decontamination procedures are performed on all personnel leaving hazardous waste sites. A procedure appropriate to the degree of contamination recorded will be utilized. Site personnel will use single-use Nitrile gloves during sampling activities to reduce the chance of exposure to potential COCs. Disposable gloves will be disposed of and replaced frequently by site workers to avoid exposure to regulated chemicals.

7.2.1 Level D Personnel Decontamination

When the use of Level D (Section 5.2.1) PPE is required, personnel will perform decontamination in accordance with the following guidelines:

- Place tools, instruments, samples and trash at an appropriate location. Plastic bags will be available for trash. Waste PPE will not be placed in the same containers as general trash.
- Inspect equipment and samples and, if applicable, tools for signs of residual amounts of contamination. If present, contamination must be completely cleaned off of equipment, samples, and tools prior to removal from the EZ.
- Personnel will visually check themselves for signs of possible contamination. If observed, gross contamination will be completely removed before further decontamination is performed.

- Prior to exiting the work areas, personnel will wash their hands with soap and water in order to minimize the potential for contaminant exposure.

7.2.2 Level C Personnel Decontamination

Personnel involved in site activities that require the use of Level C PPE (Section 5.2.2) will observe the decontamination procedures outlined below:

- Place tools, instruments, samples and trash at an appropriate location. These areas should be clean and dry and will be supplied with plastic trash bags. Waste PPE will not be placed in the same containers as general trash.
- Inspect equipment and tools for signs of residual amounts of contamination. If present, contamination must be completely cleaned off of equipment, samples, and tools prior to removal from the EZ areas.
- Personnel will visually check themselves for signs of possible contamination. If observed, contamination will be completely removed before further decontamination is performed.
- Wash and rinse outer work gloves and boots (boot covers) with soap and water;
- Wash/brush off outer protective coverall (Tyvek®).
- Untape wrists and ankles.
- Remove outer work gloves and place them in a specified waste PPE container.
- Remove outer Tyvek® coveralls and place them in a specified waste PPE container.
- Remove eye protection.
- Remove respirator mask, if worn.
- Wash hands using a soap and water solution.

7.3 Equipment Decontamination

Decontamination will be performed on tools and the decontamination equipment itself after all site activities have been completed, or between sampling locations. Before entering the site, all equipment will be cleaned to remove any potential contaminants. General equipment decontamination consists of an Alconox® soap and water wash followed by a double deionized water rinse. Equipment decontamination will take place in the CRZ according to the following procedures. Wash water will be containerized, characterized, and disposed according to the procedures described in Section 7.4.

7.3.1 Tools

Generally, tools will be washed with a detergent solution and then a final rinse with de-ionized water. Wooden tools will not be used, as they cannot be adequately decontaminated due to their porous nature and absorptive properties.

7.3.2 Heavy Equipment Decontamination

Prior to performing drilling operations, the drill rig will be inspected to ensure residual soil is not present from a previous site. In the event gross soil is present, the rig is required to be cleaned prior to operations on site.

Excess soil will be removed from drilling equipment, comingled with the drill cuttings, and transported to the disposal facility. Drilling and sampling equipment will be decontaminated between borings locations utilizing a steam cleaner or pressure washer with a non-phosphate detergent.

7.3.3 Respirator Decontamination

The use of disposable respirators, when worn on a voluntary basis (dust masks), will be discarded daily.

In addition to decontamination, all respirators, protective clothing, and other personal articles must be sanitized before they can be used again. The insides of masks become soiled from exhalation, body oils, and perspiration. Field personnel shall follow the manufacturer's instructions for respirator mask sanitization.

7.4 Disposal of Decontamination Waste

Decontamination rinsate water will be collected and temporarily stored on site in labeled, 55-gallon drums with bunghole tops pending characterization and disposal. The drums will be removed by a licensed waste hauler and disposed of or recycled at an approved landfill or recycling facility. The drums will be clearly labeled for content, the operation from which they were filled, and the dates. Waste will not be stored on site for more than 60 days. Drums containing waste materials generated during site activities will be staged in a designated area and cordoned off.

Because other cleanup activities are being conducted upgradient of the investigation, the possibility exists that generated water and soil waste may contain perfluoroalkyl and polyfluoroalkyl substances (PFAS) contaminants. If it is determined that any waste contains PFAS, the drummed containers will remain onsite until the appropriate final disposition is determined.

7.5 Decontamination During Emergencies

Often during emergencies, the need to quickly respond to an accident or injury must be weighed against the risk to the injured party from chemical exposure. Time lost or the additional handling of an injured person during the decontamination process may cause greater harm to the individual than the exposure that would be received by undressing that person without

"textbook" decontamination. This decision must be made by the SSHO. The SSHO, as the on-site focus for safety matters, must be familiar with the safety criteria and the logic behind them. Each operation is different, and the risks to personnel from exposure versus injury vary.

If personal decontamination must be delayed because immediate transport to the emergency facility is critical, the worker will be wrapped in plastic to prevent cross contamination of the ambulance and to protect emergency responders from being exposed to contaminants from the worker's clothing. A site representative shall accompany the injured person to the medical facility to assist or provide guidance to medical personnel in matters concerning decontamination of the injured worker. A copy of the SDSs will accompany the injured worker to the medical facility. The PM will verify facility acceptance standards as to receiving injured personnel with residual contamination.

7.5.1 Physical Injury

Physical injuries can range from minor to life threatening. Life-saving care should be instituted immediately without considering decontamination. The outside garments can be removed (depending on the weather) if this does not cause delays, interfere with treatment, or aggravate the problem. Considering the SOW, this type of situation is not expected to happen at this site with workers adhering to safe working practices, as provided in the SSHP. For minor medical problems or injuries, the normal decontamination procedure should be followed.

If the outer contaminated garments cannot be safely removed, the individual should be wrapped in plastic or blankets to help prevent contaminating medical personnel and/or the inside of ambulances. Outside garments are then removed at the medical facility. No attempt should be made to wash or rinse the worker unless it is known that he has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life. For minor medical problems or injuries, the normal decontamination procedure should be followed. The need for additional protective clothing or excessive contamination of Level C or D clothing during site activities associated with the approved SOW is not anticipated.

7.5.2 Heat Stress

Heat-related illness ranges from heat fatigue to heat stroke, the latter being the most serious. Heat stroke requires prompt treatment to prevent irreversible damage to health or death. Protective clothing may have to be cut off. Less serious forms of heat stress require prompt attention, or they may lead to a heat stroke. Unless the worker is obviously contaminated, decontamination should be minimized and treatment begun immediately.

7.5.3 Chemical Exposure

Chemical exposure can be divided into two categories.

1. Direct contact through touch (e.g., acid burns), inhalation, and/or ingestion
2. Indirect contact through gross contamination of clothing or equipment

Only a qualified physician can treat contaminant inhalation and/or ingestion injuries. If the contaminant is on the skin or in the eyes, immediate measures must be taken to counteract its effect. First-aid treatment will involve flooding the affected area with copious quantities of water. The treatment of acid or alkaline exposure will also be the same.

When protective clothing is grossly contaminated, contaminants may be transferred to the wearer or to treatment personnel and cause injuries. Unless splashing may cause severe medical problems, the protective clothing should be washed off as rapidly as possible and carefully removed. Personnel must be aware of the chemical properties of the site hazards as well as the decontamination rinse solutions used to prevent cross contamination during field activities.

8.0 EMERGENCY PROCEDURES

This section describes emergency action procedures to be implemented at the site in case of an accidental spill or release of regulated substances. This section is consistent with the requirements of 29 CFR 1910.38 / CFR 1910.120(q)(1) and local, state, and federal disaster and emergency management plans. This Emergency Action Plan (EAP) will be implemented to prevent or minimize the impacts of unplanned events that could affect the safety and health of site workers or base personnel. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area are not considered to be emergency responses within the scope of this standard.

No regulated chemicals other than fuel in fuel tanks and hydraulic fluid in the drilling equipment will be on-site during project work. SDSs for all chemicals anticipated to be onsite are provided in Attachment 4 of the APP. The potential for an uncontrolled release of large volumes of hazardous materials is remote.

The following sections discuss pre-emergency planning, personnel roles and lines of authority, emergency recognition and prevention, evacuation routes and procedures, emergency contacts and notifications, hospital route directions, emergency medical treatment procedures, protective equipment failure, fire or explosion, weather-related emergencies, spills or leaks, emergency equipment and facilities, and reporting.

The SSHO will conduct (and document) an emergency response/evacuation drill during the first day of work. He or she will also conduct unannounced tests of this EAP and record subsequent site worker responses to the simulated emergency situations. The SSHO and the SHM will review the worker responses and, if necessary, prepare an addendum to the SSHP identifying revisions to the EAP. Results of this review will be discussed with all site workers in subsequent tailgate safety meetings.

8.1 Pre-Emergency Planning

All employees working at the site will be trained in the provisions of this EAP during the initial site safety briefing, and be updated of changes and/or reminded of these provisions as necessary during the daily tailgate safety meetings. The SSHO will review this EAP on a regular basis to ensure that the provisions of this plan are adequate and consistent with the current site conditions. The plan will be amended, if necessary, to keep it current with new or changing site conditions or information. This includes changing or moving the evacuation route or meeting area that the workers are directed to meet at following a site evacuation. The location of and access to the spill response equipment will be discussed and any personnel unfamiliar with deployment of sorbent booms onto the ground will be trained in the appropriate manufacturer's

recommended deployment procedure. Proper deployment of sorbent pads and/or sorbent granular material onto the liquid will also be rehearsed.

8.2 Personnel Roles and Lines of Authority

The SSHO will also serve as the EAC for this project. The SSHO/EAC has the primary responsibility for responding to and correcting emergency situations, and for responding appropriately to ensure the safety of site personnel and the public. The SSHO/EAC will have the authority to cease any response activity if the safety of responders, site personnel, or the public is threatened. The SSHO/EAC's duties will include:

- Maintaining emergency preparedness;
- Performing site inspections and informing site workers and subcontractors of work activities and emergency action plans;
- Coordinating with emergency services prior to and during an emergency action scenario;
- Making notifications to appropriate authorities; and
- Preparing follow-up reports.

Site personnel are required to report all injuries, illnesses, spills, fires, and property damage to the SSHO/EAC. The SSHO/EAC must be notified of any on-site emergencies and is responsible for ensuring that the appropriate emergency procedures described in this section are followed.

Subcontractors are required to coordinate with the SSHO/EAC concerning activities associated with their individual scopes of work.

8.3 Emergency Recognition, Prevention, and Response

Table 8-1, Emergency Recognition, Prevention, and Response, of this APP/SSHP identifies potential emergency scenarios and provides emergency recognition, prevention, and response guidance for each scenario. All on-site personnel will be made familiar with this information through pre-work training and tailgate safety meetings. All site personnel and visitors will be made aware of their responsibility in notification and warning of any identified emergency situations.

Table 8-1: Emergency Recognition, Prevention, and Response	
Emergency Scenario - Employee Injury/Illness	
Recognition	**Prevention and Response**
Employees who have been exposed to site contaminants without the use of respiratory protection will report the exposure to their supervisor and the SSHO. Employees who feel they are suffering symptoms of exposure to site contaminants or have suffered an injury will also report to their supervisor and the SSHO. Employees should observe each other for signs and symptoms of exposure to site contaminants and other environmental stress. Signs of exposure include the following: • Skin discoloration • Excessive perspiration • Lack of coordination • Staggered gait • Sleepiness, dizziness, drowsiness • Incorrect responses to questions • Irritability or irrational behavior	**Prevention:** The provisions of the SSHP, including the Activity Hazard Analyses, will be followed to prevent injury and illness. **Response:** If an injury occurs due to an accident, the SSHO will be notified immediately. The SSHO will be provided with all appropriate information concerning the nature and cause of the injury to allow for treatment to be initiated. The PM will be notified and will investigate the cause of the injury and make any necessary changes in work procedures. Personnel Injury in the EZ – Upon notification of an injury in the EZ, work will immediately cease and the injured person assessed. If the injury was the result of a site emergency situation, all personnel will evacuate the site and assemble at the pre-determined safe area. If it is a local problem, personnel in the work area will evacuate to the decontamination reduction area. If the injured party(s) can be evacuated without the risk of further injury, they will be removed from the work zone immediately. If not, stretchers will be obtained to evacuate the injured party(s). The nature of the injury will be evaluated and the injured person will be decontaminated to the extent possible prior to movement to the SZ. The appropriate first aid will be administered and contact will be made for an ambulance with the designated medical facility, if required. No persons will re-enter the EZ or work area until the cause of the injury or symptoms is determined. If the injury is the result of chemical exposure, an assessment of potential airborne contaminant concentration will be performed using field instrumentation. Rescue will be performed in a level of protection appropriate for the anticipated airborne contaminant concentrations. Emergency decontamination procedures are described in Section 7.5. A copy of the decontamination procedures will be given to the local ambulance and emergency room personnel. Personnel Injury in the SZ – Upon notification of an injury in the SZ, the SSHO will assess the nature of the injury. If the cause of the injury or the loss of the injured person does not affect the performance of the site personnel, operations will continue with appropriate first aid and necessary follow-up. If the designated emergency signal is sounded, all site personnel will move to the pre-designated safe area and wait for further instructions. Work will stop until any risk is removed or minimized.

Table 8-2: Emergency Recognition, Prevention, and Response	
Emergency Scenario – Fire/Explosion	
Recognition	**Prevention and Response**
All fires and visible smoke will be immediately reported to the SSHO and the PM.	**Prevention:** The primary goals of fire prevention and protective measures are to control ignition sources and early detection and rapid response. The following preventative measures will be taken at the site: • Smoking will be prohibited at the site except in designated areas • No welding, open flames, or spark-producing activities will be allowed on-site unless evaluated and approved by the SSHO • Only approved containers will be used to store flammable and combustible liquids **Response:** In the event of a fire or explosion, site evacuation procedures will be implemented and emergency response services will be notified. TI-SDC Team personnel will only attempt to extinguish small incipient fires (e.g., fires that can be extinguished with available portable fire extinguishers). In the event of larger fires, TI-SDC Team will notify the proper authorities and evacuate the site in accordance with the Emergency Response Plan.
Emergency Scenario – Environmental Release	
Recognition	**Prevention and Response**
Visual observations of leaking containers or puddles of unknown liquids will be reported to the SSHO and the site supervisor immediately. The SSHO will report the incident to the PM. The air monitoring program discussed in Section 6.0 of the SSHP will be the primary recognition tool for air releases.	**Prevention:** All liquids will be stored in approved containers. Additional spill and discharge information is provided in Section 9.2.2 of the APP. Engineering controls such as dust suppression will be used to minimize the release of airborne contaminants. **Response:** Response to an environmental release will involve ceasing site work, notification of the USACE and Facility points of contact and appropriate federal, state and local agencies, and implementing spill or dust control procedures. In the event of a severe spill or leak, site personnel will follow the procedures listed below: • Evacuate the affected area and relocate personnel to the pre-determined safe area • Inform the SSHO, the site supervisor, and the PM immediately • Locate the source of the spill/leak and stop the flow if it is safe • Begin containment and recovery of spilled or leaked materials • Notify appropriate federal, state and local agencies

Table 8-3: Emergency Recognition, Prevention, and Response	
Emergency Scenario – Miscellaneous Emergencies (weather, adverse community activity, etc).	
Recognition	**Prevention and Response**
Any forecasts of severe weather conditions or indications of adverse community activities (e.g., vandalism, threats, pickets, etc.) will be reported immediately to the PM.	**Prevention:** The TI-SDC Team will take reasonable measures to protect the site and site personnel against other potential emergency situations such as severe weather and adverse community activities. Preventative measures will include securing temporary office and storage facilities, grounding of buildings and electrical systems, and implementation of site security and control measures. **Response:** All outdoor work will immediately cease at the first indication of thunder. Work will continue 30 minutes after the last thunder. The safety of work in high winds or other severe weather conditions will be assessed by the SSHO. The SSHO will cease site operations if weather conditions will not allow the safe conduct of work. The TI-SDC Team will not respond to any adverse community situation other than to obtain as much information as possible and to report that information to the USACE and Project POCs, or in the case of an emergency, contact the appropriate authorities.

8.4 Site Security and Control

Work areas will be delineated with traffic cones, barricades, and/or yellow caution tape. Site control zones will be established as described in Section 6.0 of this APP/SSHP to control the spread of contamination and employee exposure to chemical and physical hazards. Access to the exclusion zone will be restricted to authorized personnel only. The perimeter of a delineated EZ will be established in a manner that will provide adequate room for the number of workers involved, their equipment, and be a safe distance and method of travel to the decontamination area. All tools, equipment, and materials will be stored in work vehicles or a secure area for overnight storage. Such overnight storage locations will be identified by the POC for the facility. Temporary storage facilities will be equipped with locks that will be secured at the end of each work shift.

8.5 Evacuation Routes and Procedures

The on-site communication systems that will be used for this project include the use of an air horn, hand signals, and cellular phones among workers. Workers are to use the "buddy system" at all times and be cognizant of the reduction of communication abilities in high noise areas and/or poor air cellular service areas. Hand signals that will be used by site personnel in emergency situations or when verbal communication is difficult are listed in Table 8-2.

Table 8-4: Hand signals to be used in emergency situations	
Signal	**Definition**
Hands clutching throat	Out of air or cannot breath
Hands on top of head	Need assistance
Thumbs up	Okay, I am all right, or I understand
Thumbs down	No or negative
Arms waving upright	Send backup support
Gripping partner's wrist	Exit area immediately

In the event of an emergency that necessitates an immediate work stoppage or site evacuation, the air horn shall be used by the SSHO to alert site personnel. One extended blast of the air horn will signal an immediate work stoppage, with all personnel moving into a predetermined meeting/safe area.

Whenever possible, evacuation should be in the direction perpendicular to the wind direction without passing through the plume or smoke cloud, if any. The emergency meeting location and site evacuation route for the site will be communicated to site personnel during the morning tailgate meeting, and the evacuation route map will be reviewed during the daily tailgate safety meeting. Personnel will remain in the emergency meeting area until the SSHO or his/her authorized representative provides further instructions.

8.6 Emergency Contacts and Notifications

The name, telephone number, and location of police, fire, and other emergency response agencies will be available on site at all times. If emergency personnel are called to the site, efforts should be made to accommodate their operations at the site. Emergency telephone numbers for this project are presented in Table 8-3, Emergency Telephone Numbers. In the event of a medical emergency, personnel will notify the appropriate emergency organization and will take direction from the SSHO. In the event of a fire, explosion, or spill at the site, the SSHO will notify first responders and the appropriate federal, state, and local agencies and will follow the procedures discussed in Table 8-1, Emergency Recognition, Prevention, and Response.

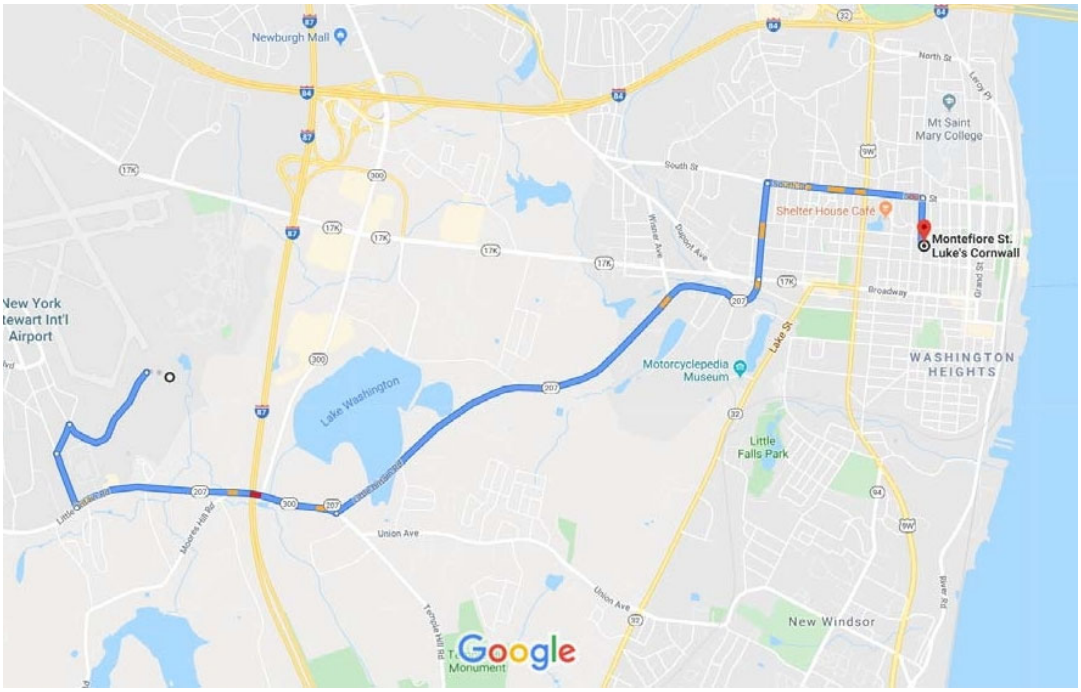
Table 8-5: Emergency Telephone Numbers		
Emergency Services		
First Responders		911
Montefiore St. Luke's Cornwall Emergency Room		(845) 561-4400
Poison Control Center		(800) 222-1222
National Response Center		(800) 424-8802
OSHA, Albany Area Office		(518) 457-1263
OSHA Referral		(800) 321-6742
USACE		
Julie Rupp	Project Manager	Office: (978) 318-8962 Cell: (716) 435-7031
Gina Romano	Project Geologist	Office: (978) 318-8052 Cell: (978) 753-8437
TI-SDC Team		
Keith Fields	Project Manager	Mobile: (614) 778-2618
Robert Janosy	Site Safety & Health Officer	Mobile: (614) 593-5541
Greg Headington	Alternate Site Safety and Health Officer	Mobile: (614) 374-2722
David McCall	Safety and Health Manager	Office: (740) 504-9714

8.7 Emergency Medical Treatments and First Aid

A first aid kit and fire extinguisher will be located in the SZ or as appropriate. The first aid kit will contain the American Red Cross first aid manual or equivalent. A minimum of two personnel trained and certified in adult first aid, cardiopulmonary resuscitation (CPR), and bloodborne pathogens, in accordance with 29 CFR 1910.1030, will be on-site at all times that work is being performed. If an injured individual requires further attention, the individual will be immediately transported to the nearest hospital. A hospital route map for the Montefiore St. Luke's Cornwall Emergency Room is presented in Figure 8-1. If necessary, the worker will be decontaminated prior to transport to the facility; if the injury is serious, decontamination may be delayed pending emergency treatment. As explained earlier, concentrations of the COC anticipated to be encountered at these sites are not considered acutely toxic and should not prevent the implementation of emergency medical care.

Fire:	**911**
Ambulance:	**911**
Hospital:	**1-845-561-4400 (Emergency Department)**
Directions to Hospital:	**Montefiore St. Luke's Cornwall**
	70 Dubois Street
	Newburgh, NY 12550

Figure 8-1: Hospital Route Map



<u>Directions to Montefiore St. Luke's Cornwall</u> **<u>6.6 miles, 20 minutes</u>**

- **Take Recreation Rd to NY-207 E**

6 min (1.1 mi)

- **Follow NY-207 E to West St in Newburgh**

8 min (3.9 mi)

- **Continue onto West St**

2 min (0.5 mi)

- **Turn right onto South St**

3 min (0.8 mi)

- **Turn right onto Dubois St and follow to destination**

2 min (0.4 mi)

General first aid procedures are outlined below:

- Skin/Eye Contact: Use copious amounts of soap and water. Wash/rinse affected area thoroughly and then provide appropriate medical attention. Eyewash system will be provided on-site at the SZ or as appropriate. Eyes should be rinsed for 15 minutes if there was chemical contact with the eyes. The eyewash station will be ANSI-certified and will meet the Z¬358.1-2004 standard. This eyewash station will be capable of providing flushing fluid to the eyes at 1.5 liters per minute (0 to 4 gallons per minute) for a minimum of 15 minutes.

- Inhalation: Move to fresh air and, if necessary, decontaminate and transport to hospital. Any loss of consciousness or exposure to airborne toxic substances, even if the individual appears to have fully recovered, will require immediate treatment or surveillance by a qualified physician.

- Ingestion: Notify Poison Control Center and emergency medical facility and transport to nearest emergency medical facility immediately.

- Puncture Wound or Laceration: Decontaminate and transport to emergency medical facility. Apply direct compression to stop or slow the flow of blood. Universal precautions to prevent contacting the blood of another shall be implemented.

8.8 Emergency Response Equipment

Based on similar work, the low potential for spills, and the lack of acutely toxic concentrations, it is anticipated that the specified safety equipment worn (U.S. EPA Level D) by the workers will be sufficient for the emergency action events that may occur at this site. The hazard analyses conducted did not identify a risk of a release of potentially flammable or explosive substances.

EPA Level D PPE will include hard hats (as needed), steel-toed boots, work gloves, chemical resistant gloves (as needed), hearing protection (as necessary), and eye protection.

In addition, the following emergency equipment will be available at the site:

- First aid kit
- Eye wash station (portable)
- Fire extinguisher
- Mobile phone
- Sorbent booms and granular material
- Drums
- Spill kits

8.9 Reporting

All emergency situations require follow-up and reporting. Attachment 2 to the APP, TI-SDC Health and Safety Forms, includes the TI-SDC Injury and Illness Report. This report must be completed and submitted to the PM within twenty-four (24) hours of an emergency situation. The PM will review the report and forward it to the SSHO for review. The report must include proposed actions to prevent similar incidents from occurring. The SSHO must be fully informed of the corrective action process so that he or she may implement applicable elements of the process in the future.

The USACE PM will be notified within four (4) hours of the incident, following administration of necessary first-aid procedures to workers, if applicable. If the accident is serious and the injury(s) results in permanent disfigurement, loss of limb or death, the area will be immediately secured and will not be released until authorized by the USACE PM. OSHA will be notified within eight hours.

9.0 MEDICAL SURVEILLANCE

9.1 Medical Examination Requirements

The TI-SDC Team site personnel (as outlined in both SDC and Tidewater's Health and Safety Programs) and subcontractor project personnel working on-site will have undergone either a baseline or annual medical monitoring examination within 12 months prior to participation in fieldwork. Medical screening is conducted at the start of employment and annually thereafter and may consist of the following as directed by the medical doctor:

- Medical and occupational history
- Physical examination, with particular attention to the cardiopulmonary system, general physical fitness, skin, blood forming, hepatic, renal, and nervous systems
- Urinalysis
- Blood analysis
- OSHA Noise questionnaire
- Pulmonary function test
- Chest X-ray
- Audiogram
- Electrocardiogram

Based on this examination, the physician will certify in writing whether the individual is capable of full participation in the program, or whether that person must work within certain restrictions. Personnel may be excluded from this project for medical reasons. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work on site.

9.2 Record Keeping

All medical records must be maintained by the employer for a period of at least 30 years after the employee's termination of employment, in accordance with OSHA regulations on confidentiality and record keeping. Prior to the initiation of work, subcontractors will submit copies of their medical fitness certifications to the TI-SDC Team SSHO for each employee to be assigned to the site. The certifications will state that the employee has received a medical examination within the previous 12 months and has been determined fit to perform on-site work.

10.0 TRAINING

It is recognized that conditions on a site may change or that more information may become available during the operation. If during field activities, it is determined that the conditions are not as described, or the protection specified in the APP and SSHP require modifications, work will cease, and the SSHO will contact the PM for guidance. Work will not resume until authorized by the PM.

In addition to conducting the daily tailgate meetings (which may include supplemental safety training), the SSHO will conduct a Site Supervisors' safety meeting at least once a month. These monthly Supervisor safety meetings will include a discussion on past and present safety issues on site, plans for new or changed activities, reviewing the appropriate AHA (by trade), establishing safe working procedures for anticipated hazards, and providing pertinent health and safety training and reinforcement.

10.1 General Personnel – Training

All of the TI-SDC Team personnel are required to attend new employee orientation training. This training includes:

- Hazard Communication/Petroleum Hydrocarbons
- Emergency Action Response Procedures
- Basic Safety Training
- A review and discussion of the Corporate Health & Safety Policy

10.2 Field Personnel – Training

Subcontractors are to provide acceptable certification of training for all personnel on site. At a minimum, all subcontractor personnel will be required to provide 40-hour HAZWOPER Training and applicable 8-hour Refresher Training Certificates prior to the start of fieldwork. These documents will be presented to the SSHO before any field activities take place. Mandatory training (which must be current) required on this project includes:

1. An initial 40-hour HAZWOPER Training Class
   - Workers will have 3-days of on-site, supervised field training
   - Supervisors will have 3-days of on-site supervised field training with at least 8 additional hours of specialized training at the time of job assignment (i.e., on the following programs: Company's Health & Safety policy, employee training, PPE, spill containment and health hazard monitoring and techniques).

2. An annual 8-hour HAZWOPER Refresher Training class and OSHA Construction Safety Training
   - The SSHO and/or Alternative SSHO shall have completed the 30-hour OSHA Construction Safety Training.
   - Potential Topics covered in these classes include the following:
     - Introduction to OSHA
     - Hazard Communication/Lead and Asbestos
     - Cranes/Rigging
     - PPE
     - Confined Space Entry
     - Legal Issues
     - Fall Protection
     - Electrical Safety
     - Material Handling
     - Excavations, Trenching, and Shoring
     - Ladders/Stairs
     - Scaffolds
     - Steel
     - Demolition

3. At least two (2) personnel with current Adult First Aid/Adult cardiopulmonary resuscitation (CPR) and Bloodborne Pathogens Training will be on site at all times during site work.

4. Hazard Communication Training

5. PPE Training

6. The SSHO or his/her alternate will be the competent person on site when any fieldwork associated with this project is being conducted. The competent person will have experience in mobilization, site set up, soil sampling, use of protective systems, and requirements of 29 CFR 1926.650-652.

7. All heavy equipment operators will have received proper training and have extensive experience. No certification and/or licensing are required for heavy equipment operators. Drillers will possess a current drilling license.

Records of employee qualifications are kept in SDC and Tidewater's corporate offices. As required by OSHA regulations (29 CFR 1926.65), all TI-SDC Team's on-site employees have received 3 days of supervised field training and an 8-hour supervisor class. All site personnel

will complete this initial HAZWOPER training before assignment to this project. The course content of this training will include, but not be limited to, the following:

- Names of personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on the Site
- Use of protective clothing and equipment
- Work practices by which the employee can minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements including recognition of symptoms and signs which might indicate overexposure to hazards
- Emergency response procedures
- Refresher training requirements

In addition, the on-site management, supervisors, and SSHO will receive additional management training, which will include, but not be limited to, the following:

- The employer's safety and health program
- Associated employee training program
- PPE program
- Spill containment program
- Health hazard monitoring procedures and techniques
- CPR/First Aid Training

The SSHO will keep copies of the certifications for the completion of such training for all site workers on site in a file. Workers without such certification will not be allowed to work at the site. Prior to commencement of field operations at the project site, personnel will receive site-specific training (briefed in the tailgate safety meeting). This training will include a review of all information contained in this SSHP, with particular emphasis on the following:

- Types and anticipated levels of hazardous substances known to be present on site, their PELs, health effects, and exposure routes
- The need for PPE
- The importance of maintenance and attention to proper fit of PPE
- Prescribed decontamination procedures
- Safe work practices, such as proper site entry and egress, and proper hygiene during meal and rest breaks
- Recognition in oneself and others of physical conditions requiring immediate medical attention, especially heat stress and application of simple first aid measures
- Procedures to be followed in case of emergencies

11.0 ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSHO will determine if work can continue without endangering the health and safety of the field workers. The SSHO will monitor the weather news morning and afternoon through the radio or internet, and will document it in the contractor production report. He or she will also coordinate with a local weather center, if available, to obtain specific information about the current weather conditions. Some of the items to be considered prior to determining if work should continue are:

- Potential of heat stress and heat-related injuries
- Potential for frostbite and cold-related injuries
- Dangerous weather-related working conditions (e.g., high winds, rain, snow, lightning, smog, fog)
- Limited visibility
- The potential for electrical storms (no outdoor activities will be permitted during electrical storms)

12.0 PERSONAL HYGIENE AND SANITATION

The TI-SDC Team will establish and maintain basic sanitation provisions for all employees and subcontractors. The TI-SDC Team will ensure that an adequate supply of drinking water is available at the job site while work is being performed. Access to public toilets or rental of portable toilets with hand-washing capacity will be afforded to site workers when needed. The supervisor will assure that adequate breaks are given for personnel to use the toilet facilities and water intake. The SSHO will ensure that employees wash their hands and faces thoroughly before breaks, before lunch, and at the end of the workday.

No eating, drinking, smoking, or applying cosmetics will be allowed in the CRZ or EZ. Drinking water will be available in the SZ during working hours. Plastic bags or steel containers will be provided for the collection of refuse and disposable garments and materials. Good housekeeping practices will be enforced at all times.

13.0 REFERENCES

Chemical Information File, USDOL-OSHA, 1985.

National Institute of Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards, DOHS Pub No. 2005-149.

Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Administration Standards, Title 29 CFR, Parts 1910 and 1926, United States Department of Labor, Occupational Safety and Health Administration.

Occupational Safety and Health Administration Standards, Title 29 CFR, Sections 1910.1001 and 1926.58 (as amended), 1910.134, 1910.20, and 1910.1200.

1989b. Hazardous Waste Operations and Emergency Response, Final Rule. 29 CFR 1910.120.54 FR 9294, March 6.

1985. Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/EPA/ USCG, DHH, Publication No. 85-115.

U.S. EPA. See United States Environmental Protection Agency Standards.

United States Army Corps of Engineers, 2014. Safety & Health Requirements Manual, EM 385-1-1, November 30.

United States Department of the Navy, 2006. Environmental Restoration Program Manual, August.

APPENDIX B
ACTIVITY HAZARD ANALYSIS

Activity Hazard Analysis (AHA)

Activity/Work Task: Tasks w/ Potential for Covid-19 Exposures	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: Former Stewart AFB	**Risk Assessment Code Matrix**	
Contract Number: W912WJ-19-D-0006	**Severity** / **Probability**	
Date Prepared: March 27, 2020		
Prepared by (Name/Title): Bob Janosy/Geologist		
Reviewed by (Name/Title): Bernard Himmelsbach SHM,CSHO		
Notes: (Field Notes, Review Comments, etc):		

Severity	Unlikely	Seldom	Occasional	Likely	Frequent
Catastrophic (I)	M	H	H	E	E
Critical (II)	L	M	H	H	E
Marginal (III)	L	L	M	M	H
Negligible (IV)	L	L	L	L	M

Exposure to Coronavirus Disease 2019 (COVID-19) Hazard relevant to all Tasks.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

This AHA serves as the PPE hazard assessment certification as required by 29 CFR 1910.132.

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC

All tasks having potential contact with other employees.	Exposure to Coronavirus Disease 2019 (COVID-19)	(For more information, check the resources listed at the end of AHA.)
		
		Pre-Planning
		• Check local and state government health agencies regarding possible travel restrictions.
		• Carry Tidewater letter of essential employee status.
		• Personnel considered to be at higher risk of contracting the virus are not recommended for work. Conditions include:
		  ◦ Older adults (aged 65 years and older)
		  ◦ People who are immunocompromised
		  ◦ People with moderate to severe asthma, chronic lung disease, or other respiratory condition.
		  ◦ People who have serious heart conditions.
		  ◦ People of any age with severe obesity (body mass index [BMI] ≥ 40) or certain underlying medical conditions, such as diabetes, renal failure, liver disease.
		  ◦ People who are pregnant should be monitored.
		• Personnel shall maintain at least 6-foot distance from each other.
			M

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC

All Tasks listed in this AHA	Exposure to COVID-19 virus.	• Ensure all site workers don't congregate in groups of 10 or more. (Note: Some states have more restrictive policies.)
		• Personnel shall maintain at least 6-foot distance from each other.
		• Face cloth coverings (i.e. face masks) shall be worn when 6-foot distancing cannot be maintained, to the extent practicable.
		• Practice proper disinfecting protocol as outlined in Center for Disease Control (CDC) guidelines.
		  o Frequently wash hands with soap and water for 20 seconds.
		  o Always wash immediately after removing gloves.
		  o Hand sanitizer: If soap and water are not available and hands are not visibly dirty, use an alcohol-based hand sanitizer that contains at least 60% alcohol. However, if hands are visibly dirty, always wash hands with soap and water.
		  o Routinely disinfect surfaces before coming into contact with them. Wear disposable gloves and wash hands after removing.
		  o Use CDC recommended disinfectants:
		  1. EPA-registered household disinfectant
		  2. Diluted household bleach solutions may be used if appropriate for the surface
		  3. Alcohol solutions with at least 70% alcohol
		• Practice proper personal hygiene habits:
		  o Wash/sanitize hands after blowing one's nose, coughing, or sneezing.
		  o Wash hands after using the restroom.
		  o Wash hands before eating or preparing food.
		• Where possible, employees are encouraged to pack meals and snacks as needed for the project duration and avoid visiting stores and restaurants. If necessary, modify your schedule to avoid restaurants and public restrooms during peak, i.e., crowded, periods to minimize contact with the public. Use drive-through service for food pick-up if available.
		
		<u>Vehicle Use:</u>
		• Drive separately when possible. Minimize number of people in one vehicle. Avoid renting vehicles if possible. Use personal vehicles or company trucks when possible. If personal vehicles are used, they must be in good condition and fit for purpose. If sharing a vehicle occurs, roll down the windows to let air circulate. For projects of multiple days duration, plan on traveling home rather than staying in a hotel if this can be done in accordance with fatigue protocols.
			M

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
All Tasks listed in this AHA	Exposure to COVID-19 virus.	• Wipe down "touch point" surfaces frequently, including the steering wheel, door handles, shift lever, buttons, wiper and turn signal stalks, passenger and driver door armrests, grab handles, keys and seat adjusters. • Use appropriate cleaners for each surface type, particularly touch screens. • Have readily accessible: soap, water, paper towels and/or antibacterial wipes, hand sanitizer, and disposable gloves. • Use disposable gloves at gas stations or sanitize hands prior to re-entering the vehicle <u>Overnight Travel:</u> If overnight travel is unavoidable: • Call hotel in advance regarding any stay restrictions including delivery of shipments. • Wash hands after contact with front desk counters and touch screens, communal service utensils, and coffee machines/ dispensers. • Avoid common areas and fitness facilities. • Wipe down all touch point surfaces in hotel room with disinfectant or alcohol wipes including remote controls, alarm clocks and the landline phone, cabinet and drawer handles, doorknobs and door locks, light switches, desk surfaces and information booklets or brochures. • Wear gloves when handling packages that were sent to hotel. If unavoidable, store packages in designated area of hotel room. Wipe down package surfaces with disinfectant or wipes. Open cardboard packages and dispose of the boxes immediately in the recycling bin, wash hands. • Keep toiletries inside of a toiletry bag instead of unpacking them. • Put a "do not disturb" sign on door handle to prevent hotel staff from entering room to clean during the day. <u>Field Activities</u>: • Personnel shall maintain at least 6-foot distance from each other. Practice social distancing at tailgate meetings, meeting rooms, and job trailers. Limit the number of people in job trailers and other confined areas at any one time so that this distance can be maintained. If possible, hold meetings outside. If indoors, open window(s) for circulation. • Wipe down and disinfect equipment before use with soap or alcohol wipes. When possible, wear disposable gloves when handling tools or equipment.	**M**

Equipment to be Used	**Inspection Requirements**	**Training Requirements**
First Aid/BBP Kit, Disinfecting materials to include wipes, sanitizer, soap.	Tailgate safety meeting Site-specific orientation	All TI-SDC personnel receive CPR/First Aid training. Bloodborne Pathogens. Hazardous Communication.

Resources/Information on COVID 19	**Website**
CDC	https://www.cdc.gov/coronavirus/2019-ncov/index.html)
CDC Interim Guidance for Businesses and Employers	https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fspecific-groups%2Fguidance-business-response.html
National Governors Association: Current Information On The Status Of COVID-19 In The United States And Abroad, What Actions States/Territories Have Taken To Address It, And The Latest Efforts By The Federal Government.	https://www.nga.org/coronavirus/
OSHA	https://www.osha.gov/SLTC/covid-19/

Activity Hazard Analysis (AHA)

Activity/Work Task: Site Clearing	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: Former Stewart AFB	**Risk Assessment Code (RAC) Matrix**	
Contract Number: W912WJ-19-D-0006	**Severity** / **Probability**	
Date Prepared: 4/1/2020		
Prepared by (Name/Title): Bob Janosy/Project Geologist		
Reviewed by (Name/Title): Bernard Himmelsbach/SHM		
Notes: (Field Notes, Review Comments, etc.)		

Severity	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Communication	Non communication, Misunderstanding of roles and responsibilities	• Ensure field crew has cell phone communication with each other and emergency contacts. • Ensure property owners and Regulators are aware of site inspection activities and have communicated any existing property specific hazards.	L
Area Preparation.	Slips, Trips, Falls Cold/Heat Stress Cuts/Scrapes/Bruises Stream Crossing Traffic	• Watch your step and ensure proper footing and avoid walking on uneven terrain or slippery surfaces. Do not run. Stay on paths or roads where practical. • Drink adequate water. • Slow down work rate and increase breaks in hot weather. • Dress appropriately in cold weather and avoid getting clothing wet. • Wear appropriate clothing for weather conditions. • Use buddy system to assist site personnel across streams during periods of high flow. Maintain 3 points of contact when climbing into vehicle. • Avoid working and parking in high traffic areas. Use high visibility safety vests, traffic cones if necessary. • Avoid parking near or on roadway, blind curves, or near hills where visibility of oncoming traffic may be obscured. If parking is required in off- road areas, park to the side of the road, deploy safety cones and ensure to leave adequate room for passing traffic.	L

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
		• Check standing water or berms for depth, cliffs and mud. • Do not drive faster than conditions allow. • Utilize a spotter when backing up, pulling into or out of areas with dangerous conditions (i.e. blind curves, crowded roadways, etc.), and driving forward in densely vegetated areas where the roadway ahead is not clearly visible.	
	Unexploded Ordnance (UXO) Encounter	• Practice the 3 R's of explosive safety: Recognize, Retreat, Report • In the event that an object resembling military munitions is discovered during field activities, the SSHO shall stop work in the immediate vicinity of the discovery and report the finding. • Personnel are briefed during initial safety brief on hazards associated with UXO. • If a possible UXO item is encountered, alert the rest of the team. Instruct UXO technician to conduct an inspection of the item.	**M**
	Biological (insects, plants, animals) Tick Exposure	• Assess work area for snakes, poisonous plants, and insects and communicate observations to avoid them. • Implement controls including the use of disposable (Tyvek) coveralls, insect repellent, light-colored clothing, permethrin treated-clothing, barrier creams, frequent tick checks should be implemented. • Check during tailgate meetings if any staff member has acute allergies to any biological hazards. • If hazardous insects or plants are identified or suspected in a work area, controls including the use of disposable (Tyvek) coveralls, insect repellent, light-colored clothing, treated- clothing, barrier creams. • Field clothing and equipment should be thoroughly cleaned, removed and/or segregated from clean to avoid transfer of hazardous plants/insects. • Bathe immediately following fieldwork and use cleansers designed to remove oils associated with poison ivy. **When working in areas infested with ticks:** • Wear long-sleeved shirts, pants, and socks. • Tuck your pant legs into your socks. • Tuck your shirt into your pants. • Use a tick repellent on your clothes.	**M**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
	Tick Exposure	• Do a body check at the end of each work day, paying particular attention to armpits, navel, behind the ears, and the groin area. **Tick Removal.** • The sooner ticks are removed, the better. • Tweezers work best at removing ticks. If fingers are used, shield them with a piece of paper. • Grasp the tick as close to the skin surface as possible and pull outward with a steady, even pressure. DO NOT jerk or twist, as this may cause the head of the tick to break off in the skin. • Take care not to squeeze, crush, or puncture the body of the tick, as this may cause the injection of fluids from the tick to enter the wound. • After removing the tick, disinfect the area with alcohol or soap and water. You may want to keep the tick in a small jar for later identification in case you become sick with Lyme disease or another illness. • Methods of tick removal, such as painting the tick with Vaseline, fingernail polish or alcohol or applying a hot match head, DO NOT WORK.	**M**
General Material Lifting/Handling	Ergonomic Injury Impact Injury Back injury-muscle pulls, sprains & strains, lacerations	• Use proper lifting methods, including team lifting when necessary. (Less Than 50 lbs) • Use mechanical equipment whenever possible. • Lift with legs, keep loads close to body, don't twist while picking up loads. • Wear cut-resistant work gloves whenever materials are being handled.	**L**
Use of hand and power tools	Eye Injury Lacerations and hand injuries Improper Grounding, Improper Operation & Maintenance	• Choose the right tool for the task. Inspect tools before & remove defective tool from service • Wear eye protection when using hand/power tools which cause flying debris. • Eye wash to be immediately available • Tools must be in good condition and used for their intended purpose; • Familiarize workers with tool operation. • De-energize power equipment prior to changing bits or blades. • Wear appropriate hand protection; observe good work practices in ensuring that work gloves are in good condition. • Use properly grounded or double-insulated tools with ground-fault circuit interrupters (GFCI);	**L**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Use of hand and power tools	Walking/hiking over terrain that may be contaminated with UXO or other hazards to individuals or the environment when using a magnetometer.	• Ensure that you have at least one hand free while walking when conducting a sweep or a surface clearance to provide balance and a means of breaking your fall should you slip or trip. • Maintain your proper distance from the individual on your right or left and warn the team should you encounter a hazard of see one in their rout of travel.	**L**
Use of Chipper	Flying debris, Contact with moving parts Noise	• Wear proper PPE • Be sure everyone is clear of the machine. • Be sure shields and guards are in place and in good condition • Horn will be sounded 2 or 3 times to alert all personnel when ready to start up the power unit. • While in operation pay loader will be used to feed trees into machine. Absolutely no personnel will be near machine while in operation • Hearing protection required	**M**

Equipment to be Used	Inspection Requirements	Training Requirements	
Hand, Power Tools, Hand-held magnetometer, GPS equipment, Chipper	Competent person Certification	Hot Work Permits (if applicable)	
Personal protection equipment: • Level D PPE (safety-toed boots, safety glasses, hard hats, nitrile gloves) • Modified Level D PPE (safety-toed boots, safety glasses, nitrile gloves) • Leather gloves for equipment handling First Aid Kit Fire extinguisher	Prior to use Quarterly Monthly	Training on proper use of PPE; 40-hour HAZWOPER training and 8-hour HAZWOPER Refresher training (if applicable) All TI-SDC personnel receive CPR/First Aid training	

Activity Hazard Analysis (AHA)

Activity: Surveying (Land, Utility, Geophysical, Wetland Delineation)	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: Former Stewart AFB	**Risk Assessment Code (RAC) Matrix**	
Contract Number: W912WJ-19-D-0006		
Date Prepared: March 30, 2020		
Prepared by (Name/Title): Bob Janosy/Project Geologist		
Reviewed by (Name/Title): Bernard Himmelsbach/SHM		
Notes: (Field Notes, Review Comments, etc.)		

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Manual material handling	Back injuries and strains	• Site personnel will be instructed on proper lifting techniques. • Do not lift loads greater than 50 pounds without assistance.	L
Walking, working on uneven or marshy terrain	Slips, Trips, Falls Cold/Heat Stress Cuts/Scrapes/Bruises Stream Crossing Traffic	• Watch your step and ensure proper footing and avoid walking on uneven terrain or slippery surfaces. Do not run. Stay on paths or roads where practical. • Watch your step and ensure proper footing when walking in marshy terrain. Do not run. Walk slowly. • Drink adequate water. • Slow down work rate and increase breaks in hot weather. • Dress appropriately in cold weather and avoid getting clothing wet. • Wear appropriate clothing for weather and/or marshy conditions. • Use buddy system to assist site personnel across streams during periods of high flow. • Maintain 3 points of contact when climbing into vehicle. • Avoid working and parking in high traffic areas. Use high visibility safety vests, traffic cones if necessary. • Avoid parking near or on roadway, blind curves, or near hills where visibility of oncoming traffic may be obscured. If parking is required in off- road areas, park to the side of the road, deploy safety cones and ensure to leave adequate room for passing traffic.	L

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
		• Check standing water or berms for depth, cliffs and mud. • Do not drive faster than conditions allow. • Utilize a spotter when backing up, pulling into or out of areas with dangerous conditions (i.e. blind curves, crowded roadways, etc.), and driving forward in densely vegetated areas where the roadway ahead is not clearly visible.	
	Unexploded Ordnance (UXO) Encounter	• Practice the 3 R's of explosive safety: Recognize, Retreat, Report • In the event that an object resembling military munitions is discovered during field activities, the SSHO shall stop work in the immediate vicinity of the discovery and report the finding. • Personnel are briefed during initial safety brief on hazards associated with UXO. • If a possible UXO item is encountered, alert the rest of the team. Instruct UXO technician to conduct an inspection of the item.	**M**
	Biological (insects, plants, animals) Tick Exposure	• Assess work area for snakes, poisonous plants, and insects and communicate observations to avoid them. • Implement controls including the use of disposable (Tyvek) coveralls, insect repellent, light-colored clothing, permethrin treated-clothing, barrier creams, frequent tick checks should be implemented. • Check during tailgate meetings if any staff member has acute allergies to any biological hazards. • If hazardous insects or plants are identified or suspected in a work area, controls including the use of disposable (Tyvek) coveralls, insect repellent, light-colored clothing, treated- clothing, barrier creams. • Field clothing and equipment should be thoroughly cleaned, removed and/or segregated from clean to avoid transfer of hazardous plants/insects. • Bathe immediately following fieldwork and use cleansers designed to remove oils associated with poison ivy. **When working in areas infested with ticks:** • Wear long-sleeved shirts, pants, and socks. • Tuck your pant legs into your socks. • Tuck your shirt into your pants. • Use a tick repellent on your clothes. • Do a body check at the end of each work day, paying particular attention to armpits, navel, behind the ears, and the groin area.	**M**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
	Tick Exposure	**Tick Removal**. The sooner ticks are removed, the better. • Tweezers work best at removing ticks. If fingers are used, shield them with a piece of paper. • Grasp the tick as close to the skin surface as possible and pull outward with a steady, even pressure. DO NOT jerk or twist, as this may cause the head of the tick to break off in the skin. • Take care not to squeeze, crush, or puncture the body of the tick, as this may cause the injection of fluids from the tick to enter the wound. • After removing the tick, disinfect the area with alcohol or soap and water. You may want to keep the tick in a small jar for later identification in case you become sick with Lyme disease or another illness. • Folklore methods of tick removal, such as painting the tick with Vaseline, fingernail polish or alcohol or applying a hot match head, DO NOT WORK.	
General Material Lifting/Handling	Ergonomic Injury Impact Injury Back injury-muscle pulls, sprains & strains, lacerations	• Use proper lifting methods, including team lifting when necessary. (Less Than 50 lbs) • Use mechanical equipment whenever possible. • Lift with legs, keep loads close to body, don't twist while picking up loads. • Wear cut-resistant work gloves whenever materials are being handled.	**L**
Use of hand and power tools	Eye injury; Lacerations and hand injuries	• Choose the right tool for the task. Inspect tools before & remove defective tool from service • Wear eye protection when using hand/power tools which cause flying debris. • Eye wash to be immediately available • Tools must be in good condition and used for their intended purpose; • Familiarize workers with tool operation. • Wear appropriate hand protection; observe good work practices in ensuring that work gloves are in good condition.	**M**
Move equipment to designated location	Handling of instruments could cause strain to worker.	Carry/Operate instruments as required by the manufacturer of the instrument. Use straps when provided and adjust for comfort. Use care when walking so that there are no sudden jerks or mis-steps that can cause the worker to strain to maintain control of the instrument. Get assistance from other workers if several instruments must be carried. For loads greater than 50 pounds, use two people to carry.	**L**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Survey	Worker could be struck by vehicle.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when surveyor is using instruments (a surveyor is often focused on the task and may not be aware of nearby traffic). Use traffic controls or barricades, if necessary, to keep traffic away from workers.	L
	Use of striping spray paint could expose employees to paint fumes.	Follow manufacturers' instructions on use of paint. Review SDSs. Never point spray paint canisters at another person.	
	When carrying stakes, worker could trip and impale body.	Carry survey stakes in leather or canvas bag that is puncture proof, and carry bag to side of body. Ensure that all tips are pointed toward ground at all times.	
	Hammering wooden stakes presents puncture and splinter hazards.	Keep stake tip pointed at ground. Wear leather gloves. Use caution when using tools to pound stake in.	
	Walking/hiking over terrain that may be contaminated with UXO or other hazards to individuals or the environment when using a magnetometer.	Ensure that you have at least one hand free while walking when conducting a sweep or a surface clearance to provide balance and a means of breaking your fall should you slip or trip. Maintain your proper distance from individual on your right or left and warn the team should you encounter a hazard of see one in their route of travel.	

Equipment to be Used	Inspection Requirements	Training Requirements	
Survey equipment to include voltmeter/ electromagnetic (EM), magnetometer, ground penetrating radar etc, pushcart, tri-pod, theodolite, transits, grade rods, measuring wheels, Hand Tools	Prior to use	Certifications (if applicable)	
Personal protection equipment • Level D PPE (steel-toed boots, safety glasses, hard hats, nitrile gloves) • Modified Level D PPE (safety-toed boots, safety glasses, nitrile gloves)Leather gloves if needed during site set-up, equipment handling • First Aid Kit	Current certification	All TI-SDC personnel receive CPR/First Aid training	

Activity Hazard Analysis (AHA)

Activity/Work Task: Mobilization and Demobilization	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: Former Stewart AFB	**Risk Assessment Code Matrix**	
Contract Number: W912WJ-19-D-0006	**Severity** / **Probability**	
Date Prepared: March 30, 2020		
Prepared by (Name/Title): Bob Janosy/Geologist		
Reviewed by (Name/Title): Bernard Himmelsbach SHM,CSHO		
Notes: (Field Notes, Review Comments, etc)		

Severity	Unlikely	Seldom	Occasional	Likely	Frequent
Catastrophic (I)	M	H	H	E	E
Critical (II)	L	M	H	H	E
Marginal (III)	L	L	M	M	H
Negligible (IV)	L	L	L	L	M

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

This AHA serves as the PPE hazard assessment certification as required by 29 CFR 1910.132.

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
In transit to/from site, driving within the site	Driving while fatigued, unfamiliarity with route, surroundings, distractions while driving, erratic, careless behavior of other drivers on the road, not regarding blind spots, not paying attention, Faulty vehicle, Non-compliance to standards and procedure (i.e., use of mobile phone while driving), Minimum space / improper planning	Get plenty of rest the night before. Conduct a proper vehicle inspection prior to leaving the office. Keep maps of the areas with you for reference. Do not use cell phones while operating the vehicle. Always use Defensive Driving techniques. Leave yourself an out. Always wear seat belts while operating the vehicle. Defensive driving training for staff; Apply Life Saving Rule on Driving; Apply Journey management process for planning and executing necessary road transport journeys safely; Keep a safe distance between yourself and other vehicles in accordance with highway safety guidelines; Avoid reversing: try to park facing out so you can later exit your parking space as safely as possible, Avoid sudden braking.	**L**
Work off site on roadways	No clear Red Zone boundaries set at work site, Faulty equipment, Non-compliance with standards and procedures	Appropriate barrier and signage system (Installation of barricades and warning signs and Training in Work Area barricading and Temporary site closure guidelines).	**L**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Weather issues from floods, windstorms, tornadoes, lightning, ice storm, snow and ice build-up, fog, or waterspouts Applicable in any operational environment (facility location) where such weather events occur.	Inadequate preventative measures applied; Lack of awareness	Follow local procedure / equipment to monitor weather service for severe weather warnings. Follow local procedure that defines requirements to address relevant severe weather conditions. Activate shutdown procedure during inclement weather. If needed, execute relevant scenario of the Emergency Response Plan. Consider particular elements of the work that could be affected by the weather e.g. changes in wind during lifting operations and working at height. Suspend work if weather conditions change. Verify that conditions remain the same when returning after a short break in work. Stop work during an electrical storm. Wait 30 minutes from the last sound of thunder before resuming work.	**L**
General Assessment of Work Site	General Construction Hazards, slips, trips, falls, exposed debris. Traversing streams during periods of high flow.	Minimum Personal Protective Equipment Dress: • Long Pants • Shirts with Sleeves • Hardhat (if overhead hazards are present) • Safety Boots/Shoes (Steel or composite Toe) • Safety Glasses / Safety Goggles / Face Shields • Leather Palm Gloves • Hearing Protection (pneumatic tools) • Reflective Safety Vests Coordinate work activities at daily site safety meetings Caution should be used when navigating the site. Be aware of changes in grade, elevation, and any surface contamination when walking. Clear area leading to and around work locations. Place cones or mark-out holes or depressions in the ground to avoid stepping in them. When crossing streams during periods of high flow, use extra caution and "buddy system" to assist one another.	**L**
Identify sampling locations (including GPS locating and returning from the sample location.	Uneven or unstable ground, hazardous flora/fauna, exhaustion/over-exertion, heat and cold stress, UV exposure. Tick exposure	Be aware of changes in grade and elevation when walking. Clear area leading to and around locations. Place cones or mark out holes or depressions in the ground to avoid stepping in them. Check for biological hazards (poison ivy, insects, etc). Take regular breaks and hydrate if feeling faint or over exerted. Wear appropriate clothing for the current field conditions. Use sun block to avoid sunburn. Avoid prolonged exposure to the sun. **When working in areas infested with ticks:** • Wear long-sleeved shirts, pants, and socks. • Tuck your pant legs into your socks. • Tuck your shirt into your pants.	**M**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
		• Use a tick repellent on your clothes. • Do a body check at the end of each work day, paying particular attention to armpits, navel, behind the ears, and the groin area. **Tick Removal**. • The sooner ticks are removed, the better. • Tweezers work best at removing ticks. If fingers are used, shield them with a piece of paper. • Grasp the tick as close to the skin surface as possible and pull outward with a steady, even pressure. DO NOT jerk or twist, as this may cause the head of the tick to break off in the skin. • Take care not to squeeze, crush, or puncture the body of the tick, as this may cause the injection of fluids from the tick to enter the wound. • After removing the tick, disinfect the area with alcohol or soap and water. You may want to keep the tick in a small jar for later identification in case you become sick with Lyme disease or another illness. • Methods of tick removal, such as painting the tick with Vaseline, fingernail polish or alcohol or applying a hot match head, DO NOT WORK.	**M**
Equipment usage on Site	Faulty or inappropriate equipment. Pinch points, abrasion, cuts to the hands. Spills, fire.	Inspect equipment (including hand tools) prior to use. Put faulty equipment out of service. Do not refuel generators, etc. until the equipment has cooled down. Always use a funnel to avoid spillage of fuel.	**L**
Unload/Load Equipment from Vehicle	Back strain, pinch points, abrasion.	Utilize proper lifting procedures (keep your back straight, lift with your legs and knees) when unloading equipment from the vehicle. No individual employee is permitted to lift any object that weighs over 60 pounds. Proper lifting techniques shall be used. Multiple employees or the use of mechanical lifting are for lifting objects over the 60-pound limit. Materials shall be inspected for sharp edges prior to being handled, and avoid pinch point hazards.	**L**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
		Utilize material handling devices when possible to move equipment (lift gates, pallet jacks, hand trucks, etc.). If necessary, use a ramp for loading/unloading wheeled devices, ensuring the ramp is properly supported prior to use. Communicate with co-workers who are assisting you to avoid back strain and pinch points. Do not carry heavy equipment over long distances without use of a cart, etc. If workers are above 4 feet elevation from ground surface or lower level, fall protection must be provided/used.	**L**
Movement on Site	Vehicle collisions, pedestrian injuries	Do not exceed the posted speed limit. Be careful when backing up that you do not hit other vehicles, bollard, monitoring well stickups, other objects, and pedestrians. Use a spotter when possible. Always be aware of traffic movements around you. Only park in designated areas, and back into the space when practicable.	**L**

Equipment to be Used	Inspection Requirements	Training Requirements
Equipment for soil and groundwater sampling activities, monitoring well installation, work vehicles, hand tools for work tasks, generator, Traffic cones, Barricades, Work Signage, First Aid/BBP Kit, Portable Fire Extinguisher	All TI-SDC equipment is inspected daily prior to use. Daily walk-arounds are conducted and equipment safety checklists are completed where applicable. Tailgate safety meeting Site-specific orientation	All TI-SDC personnel are 40-hour OSHA HAZWOPER trained, complete yearly 8-hour OSHA refresher training, and are trained in company health and safety procedures and policies. Competency and qualifications are based on years of experience. All TI-SDC personnel receive CPR/First Aid training.
Personal protection equipment: Modified Level D PPE (safety-toed boots, safety glasses, nitrile gloves) Leather gloves for equipment handling First Aid Kit	Prior to use	Training on proper use of PPE; 40-hour HAZWOPER training and 8-hour HAZWOPER Refresher training (if applicable) First Aid/CPR

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
		• Check standing water or berms for depth, cliffs and mud. • Do not drive faster than conditions allow. • Utilize a spotter when backing up, pulling into or out of areas with dangerous conditions (i.e. blind curves, crowded roadways, etc.), and driving forward in densely vegetated areas where the roadway ahead is not clearly visible.	
	Unexploded Ordnance (UXO) Encounter	• Practice the 3 R's of explosive safety: Recognize, Retreat, Report • In the event that an object resembling military munitions is discovered during field activities, the SSHO shall stop work in the immediate vicinity of the discovery and report the finding. • Personnel are briefed during initial safety brief on hazards associated with UXO. • If a possible UXO item is encountered, alert the rest of the team. Instruct UXO technician to conduct an inspection of the item.	**M**
	Biological (insects, plants, animals) Tick Exposure	• Assess work area for snakes, poisonous plants, and insects and communicate observations to avoid them. • Implement controls including the use of disposable (Tyvek) coveralls, insect repellent, light-colored clothing, permethrin treated-clothing, barrier creams, frequent tick checks should be implemented. • Check during tailgate meetings if any staff member has acute allergies to any biological hazards. • If hazardous insects or plants are identified or suspected in a work area, controls including the use of disposable (Tyvek) coveralls, insect repellent, light-colored clothing, treated- clothing, barrier creams. • Field clothing and equipment should be thoroughly cleaned, removed and/or segregated from clean to avoid transfer of hazardous plants/insects. • Bathe immediately following fieldwork and use cleansers designed to remove oils associated with poison ivy. **When working in areas infested with ticks:** • Wear long-sleeved shirts, pants, and socks. • Tuck your pant legs into your socks. • Tuck your shirt into your pants. • Use a tick repellent on your clothes.	**M**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
	Tick Exposure	• Do a body check at the end of each work day, paying particular attention to armpits, navel, behind the ears, and the groin area. **Tick Removal.** • The sooner ticks are removed, the better. • Tweezers work best at removing ticks. If fingers are used, shield them with a piece of paper. • Grasp the tick as close to the skin surface as possible and pull outward with a steady, even pressure. DO NOT jerk or twist, as this may cause the head of the tick to break off in the skin. • Take care not to squeeze, crush, or puncture the body of the tick, as this may cause the injection of fluids from the tick to enter the wound. • After removing the tick, disinfect the area with alcohol or soap and water. You may want to keep the tick in a small jar for later identification in case you become sick with Lyme disease or another illness. • Methods of tick removal, such as painting the tick with Vaseline, fingernail polish or alcohol or applying a hot match head, DO NOT WORK.	**M**
General Material Lifting/Handling	Ergonomic Injury Impact Injury Back injury-muscle pulls, sprains & strains, lacerations	• Use proper lifting methods, including team lifting when necessary. (Less Than 50 lbs) • Use mechanical equipment whenever possible. • Lift with legs, keep loads close to body, don't twist while picking up loads. • Wear cut-resistant work gloves whenever materials are being handled.	**L**
Use of hand and power tools	Eye Injury Lacerations and hand injuries Improper Grounding, Improper Operation & Maintenance	• Choose the right tool for the task. Inspect tools before & remove defective tool from service • Wear eye protection when using hand/power tools which cause flying debris. • Eye wash to be immediately available • Tools must be in good condition and used for their intended purpose; • Familiarize workers with tool operation. • De-energize power equipment prior to changing bits or blades. • Wear appropriate hand protection; observe good work practices in ensuring that work gloves are in good condition. • Use properly grounded or double-insulated tools with ground-fault circuit interrupters (GFCI);	**L**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Use of hand and power tools	Walking/hiking over terrain that may be contaminated with UXO or other hazards to individuals or the environment when using a magnetometer.	• Ensure that you have at least one hand free while walking when conducting a sweep or a surface clearance to provide balance and a means of breaking your fall should you slip or trip. • Maintain your proper distance from the individual on your right or left and warn the team should you encounter a hazard of see one in their rout of travel.	**L**
Use of Chipper	Flying debris, Contact with moving parts Noise	• Wear proper PPE • Be sure everyone is clear of the machine. • Be sure shields and guards are in place and in good condition • Horn will be sounded 2 or 3 times to alert all personnel when ready to start up the power unit. • While in operation pay loader will be used to feed trees into machine. Absolutely no personnel will be near machine while in operation • Hearing protection required	**M**

Equipment to be Used	Inspection Requirements	Training Requirements	
Hand, Power Tools, Hand-held magnetometer, GPS equipment, Chipper	Competent person Certification	Hot Work Permits (if applicable)	
Personal protection equipment: • Level D PPE (safety-toed boots, safety glasses, hard hats, nitrile gloves) • Modified Level D PPE (safety-toed boots, safety glasses, nitrile gloves) • Leather gloves for equipment handling First Aid Kit Fire extinguisher	Prior to use Quarterly Monthly	Training on proper use of PPE; 40-hour HAZWOPER training and 8-hour HAZWOPER Refresher training (if applicable) All TI-SDC personnel receive CPR/First Aid training	

Activity Hazard Analysis (AHA)

Activity/Work Task: Drilling	Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location: Former Stewart AFB	**Risk Assessment Code (RAC) Matrix**	
Contract Number: W912WJ-19-D-0006	**Severity** / **Probability**	
Date Prepared: 03-30-2020		
Prepared by (Name/Title): Bob Janosy/Project Geologist		
Reviewed by (Name/Title): Bernard Himmelsbach/SHM		
Notes: (Field Notes, Review Comments, etc.)		

Severity	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Park contractor vehicle carrying drilling equipment	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.	M
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.	
Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove each tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling on that side.	L
	Lifting equipment and materials from vehicle could cause strain to worker.	Use proper lifting techniques: keep the back straight, lift with legs, limit twisting, and get help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.	
	Cuts and abrasions could occur while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.	
	Slip, trip and fall hazards could be present.	Visually inspect work areas and mark, barricade or eliminate slip, trip and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. If workers are above 4 feet elevation from ground surface or lower level, fall protection must be provided/used.	

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Identification of subsurface utilities and equipment operation	Chemical Contamination exposure. Struck by equipment, drill mast, rod sections. Improper use and/or damaged drilling equipment Pinch points, positioning of drill head onto probe section Electrocution Exposure to excessive noise levels	All personnel assigned to perform drilling operations will operate inside a designated work zone. All PPE will be removed properly prior to exiting the Exclusion Zone (EZ). All equipment and hand tools will be decontaminated in accordance with the established procedures. Be aware of your surroundings and never turn your back to the equipment while in operation. Level D PPE will be worn inside the designated EZ. Any PPE upgrade will be in accordance with SSHP guidelines. Qualified personnel must inspect the drilling equipment prior to operation. Only qualified personnel shall be permitted to operate equipment. Materials shall be inspected for sharp edges prior to being handled, and avoid pinch point hazards. The mast and other equipment must be at least 15 feet from any overhead utility lines. Verify the voltage of any overhead power lines. If any lines are above 50 kV, the clearance distance must be greater. Refer to National Electrical Code and Table 16-1 in Section 16 of EM-385-1-1 for voltages above 50 kV. Hearing protection shall be worn if noise survey results above 85 dBA.	**M**
Pre-survey area that drilling equipment will drive over	Vehicle could run over unstable ground hazards	Mark all physical hazards. Weight of rig can be significant; verify stability of all routes of travel.	**L**
Set up work area and move rig into position	Review site layout to avoid potential hazards such as electrocution, damage to underground utilities and/or tipping rig over in unstable soil conditions. Rig could contact overhead lines. Vehicle may move if not properly set up. Rig may not install properly due to the condition of the rig and connecting cables while raising it. When raising rig, rig may not install properly due to the condition of rig and connecting cables.	Do not move drill rig into any work area until site layout plan has been completed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss site layout plan and analysis of route of travel, along with AHAs. Use a spotter for positioning as necessary. Set brake and place wheel chocks under front wheels of mobile rig. Extend stabilizer jacks and ensure sound footing. Vehicle must be level to vertical and horizontal planes. Do not position wheels (loads) or rig over manholes, vaults, valve boxes, etc. Do not place rig within 15 feet of any overhead electrical lines. Never move the rig when the mast is extended Use spotter to properly position vehicle and set breaks and wheel chocks under front wheels of mobile rig. Always use stabilizer jacks to ensure sound footing. Make sure vehicle is level to the vertical and horizontal planes. Inspect all components to the rig to determine condition and make all necessary repairs prior to raising it.	**M**

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
	Operators could become pinned between rig and other truck components.	The mast and equipment must be at least 15 feet from any overhead utility lines. Verify the voltage of any overhead power lines and if any lines are above 50 kV, the clearance must be greater (refer to National Electrical Code and Table 16-1 in Section 16 of EM-385-1-1 for voltages above 50 kV).	
		Stand far enough away from any moving parts and never manually guide any moving parts of the rig when it is raised up.	
	High winds could destabilize rig.	Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. Never operate rig if it is raining or winds exceed manufacturer's recommended tolerances.	
	Traffic in area of drilling could injure workers because vehicles fail to see to worker or workers fail to see the vehicles.	Always wear safety vests and use a flagger, if necessary, to direct traffic away from drilling areas.	
Startup drill and perform drilling	Unqualified operators and personnel in area do not have knowledge of drilling hazards.	Ensure that only trained personnel use drilling equipment. Have fire extinguisher, spill-control kit, first aid kit, eye wash and an emergency air horn available on site.	**M**
	Once started, rig could cause serious injury.	Never start drilling activities until zone has been cleared. Under no circumstance are workers allowed to approach rotating equipment.	
	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with an engine. Hot fluid could burn workers. Fluid could cause environmental contamination	Inspect hydraulic lines and replace any damaged hoses or connections before placing rig in use. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads.	
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connections of any lines under pressure. To minimize the length of the hose, tie back or attach hoses whenever possible.	
	Strains could result from manually moving materials, equipment and drums.	Use care when handling augers or drill rods and do not lift more than 50 pounds without assistance.	
	Come into contact with hazards from chemical agents such as gases from the bore hole or refuse material.	Avoid exposure to dust and other chemical that might results from drilling. Determine if PPE is contaminated (based on exposure to contaminants). Place contaminated PPE in a separate, properly labeled, container. Do not place face or head over hole.	
	Overloading of mast could cause potential failure of the mast.	Masts shall be used in a manner specified by the manufacturer and should be loaded beyond their capacity.	
	Workers could trip or fall by borehole	Cap and flag open boreholes. Once the site is left unattended, protect and clearly label all open boreholes.	

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
	Unexploded Ordnance (UXO) Encounter	• Practice the 3 R's of explosive safety: Recognize, Retreat, Report • In the event that an object resembling military munitions is discovered during field activities, the SSHO shall stop work in the immediate vicinity of the discovery and report the finding. • Personnel are briefed during initial safety brief on hazards associated with UXO. • If a possible UXO item is encountered, alert the rest of the team. Instruct UXO technician to conduct an inspection of the item.	
Equipment to be Used	**Inspection Requirements**	**Training Requirements**	
Drilling equipment, Hand Tools, Power Tools, PPE Peristaltic Pump and Tubing to collect grab ground water sample.	Prior to use	Tailgate safety meeting Site-specific orientation 40-hour HAZWOPER training and 8-hour HAZWOPER Refresher training (if applicable) Only trained equipment operators may operate heavy equipment; only Department of Motor Vehicle licensed personnel will operate trucks. All operators and helpers must have documented training on use of equipment.	
Personal protection equipment: Level D PPE (safety-toed boots, safety glasses, hard hats, nitrile gloves) Leather gloves for equipment handling First Aid Kit	Prior to use	Training on proper use of PPE; 40-hour HAZWOPER training and 8-hour HAZWOPER Refresher training (if applicable) First Aid/CPR	

Activity Hazard Analysis (AHA)

Activity/Work Task: Soil/Sediment; Surface/Ground Water Sampling	Overall Risk Assessment Code (RAC) (Use highest code)	L
Project Location: Former Stewart AFB		
Prepared by: Robert Janosy/Project Geologist		
Date Prepared: March 30, 2020		
Reviewed by (Name/Title): Bernard Himmelsbach/SHM		
Contract Number: W912WJ-19-D-0006		
Notes: (Field Notes, Review Comments, etc.)		

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Unlikely	Seldom	Occasional	Likely	Frequent
Catastrophic (I)	M	H	H	E	E
Critical (II)	L	M	H	H	E
Marginal (III)	L	L	M	M	H
Negligible (IV)	L	L	L	L	M

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Locate sampling location	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle. Wear steel-toed, non-skid boots and safety glasses	L
Clear area to be sampled or open well cap	Contact with contaminated material	Wear Modified Level D PPE when working with contaminated areas.	L
Monitor VOCs and combustible gases in the surrounding atmosphere	Exposure to site contaminants or vapors.	Set equipment upwind of site work. Perform air monitoring for VOCs, and combustible gases. If action level is exceeded, evacuate to upwind direction	L
Measure depth to water and insert pump or sampling device	Injury from improper use of hand tools	Only trained personnel will use hand tools.	L
Cut tubing to length	Cut or skin puncture	Review proper cutting procedures; cut away from your body; use a proper cutting tool; use sharp tools.	L
Run electric pumps, generators or other electrical equipment	Electrical shock from energized equipment	Use GFCI plugs and heavy duty extension cords	L
Purge Well/Collect groundwater sample, collect soil sample and collect soil vapor sample	Contact with contaminated materials	Wear Modified Level D PPE when working with contaminated soil. Handle samples carefully to avoid spills.	L

Task Steps	Potential Hazards	Critical Safety Procedures and Controls	RAC
Remove sampling equipment from area	Muscle strain due to improper lifting	Rotate the task among workers to share the sample collection duties. Follow proper lifting techniques; no manual lifting of heavy loads. Do not over pack coolers greater than 50 pounds. Use two person lifts for heavy objects.	**L**
Close well cap or clear area sampled	Contact with contaminated material	Wear Modified Level D PPE when working with contaminated areas.	**L**
Decontaminate equipment	Chemical exposure	Use non-toxic detergent for decontaminated equipment (Alconox). Minimize need for decontamination by using dedicated and/or disposable equipment. Wear appropriate PPE.	**L**

Equipment to be Used	Inspection Requirements	Training Requirements
Hand Tools	Visual prior to use	Tailgate safety meeting
Voltmeter/Multimeter	Instrument Readings	• Site-specific orientation Electrical Safety
Personal protection equipment • Level D PPE (steel-toed boots, safety glasses, hard hat, safety vest, ear plugs) • Modified Level D PPE (safety-toed boots, safety glasses, nitrile gloves)	Current Certification	• 40-hour HAZWOPER training and 8-hour HAZWOPER Refresher training (if applicable)

APPENDIX C
SITE SAFETY HEALTH OFFICER QUALIFICATIONS

OSHA Medical Program—Physician's Report

U.S. Department of Labor
Occupational Safety and Health Administration

To be completed by examining Physician

This information is for official and medically confidential use only and will not be released to unauthorized persons. The release of this information is subject to the Privacy Act.

Physical Examination

Name: Robert Janosy ID#:

Type of Examination: Wellness Exam Date: 02/10/2022 Time:

Weight: 201 lb Temp: Resp:

Height: 6'1 Pulse: 68 BP: 128/77

Normal	Abnormal	Clinical Evaluation	Normal	Abnormal	Clinical Evaluation
☑	☐	General Appearance	☑	☐	Vascular system (varicosities, etc.)
☑	☐	Head, face, neck, scalp	☑	☐	Abdomen & Viscera (include hernia)
☑	☐	Nose (septum)	☑	☐	Anus & Rectum
☑	☐	Sinuses	☑	☐	G-U System
☑	☐	Mouth and Throat	☑	☐	Upper Extremities
☑	☐	Ears (general)	☑	☐	Lower Extremities
☑	☐	Drums (perforation)	☑	☐	Skin, other musculoskeletal
☑	☐	Ophthalmoscopic	☑	☐	Spine, lymphatics
☑	☐	Pupils (equality & reaction)	☑	☐	Neurological
☑	☐	Ocular mobility	☑	☐	Peripheral
☑	☐	Lungs, Chest (include breasts)	☑	☐	Cranial nerves
☑	☐	Heart (thrust, size, rhythm, sounds)	☑	☐	Deep tendon reflexes

Comments

Summary of Findings

Base on Medical Evaluation:

1. **Lead exposure in last year?____**
   –If so, work related?____
2. **–blood test done?___**
   TB exposure in last year?____
   --skin test done?___
3. This employee has, has not (circle) been informed of the results of this medical examination.

Jason Diehl
Typed or Printed Name of Physician

Signature 9/2/22 Date

OSHA 178
Rev. 2/2009

STATE OF CALIFORNIA

State of California Department of Consumer Affairs

Board for Geologists and Geophysicists

CERTIFICATE

IT IS HEREBY CERTIFIED THAT

ROBERT JOHN JANOSY

IS A DULY

REGISTERED GEOLOGIST

Certificate No. 7346

DEPARTMENT OF CONSUMER AFFAIRS BOARD FOR GEOLOGISTS & GEOPHYSICISTS STATE OF CALIFORNIA

BOARD FOR GEOLOGISTS AND GEOPHYSICISTS

By Doreen C. Dominguez
President

Paul Sweeney
Executive Officer

This 28th day of November, 2001

EGGGEO 01/01/01.

CERTIFICATE OF TRAINING

CALIFORNIA CONSTRUCTION GENERAL PERMIT

QUALIFIED SWPPP DEVELOPER (QSD)
AND
QUALIFIED SWPPP PRACTITIONER (QSP)

Robert Janosy

Apr 23, 2018 - May 02, 2020

Certificate # 22898

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

California Stormwater Quality Association and
California Construction General Permit Training Team

EMILCOTT ASSOCIATES, INC.
EMILCOTT - DGA, Inc.

HEALTH, SAFETY AND ENVIRONMENTAL TRAINING PROGRAM

This Certifies That

Robert J. Janosy

Has Successfully Completed

40 Hour Health and Safety Training Course for Hazardous Waste Operations

Date **June 15, 1995** Location **Westerville, Ohio**

5.0 ABIH CM Point
4.0 CEU Point

Dianne Grote Adams

Dianne Grote Adams, CIH Course Director

Certificate of Completion

This certifies that

Bob Janosy

has successfully completed

8 Hour HAZWOPER Refresher Training

Refresher certification does NOT necessarily indicate initial 24 or 40 Hour HAZWOPER certification

In Accordance w/Federal OSHA Regulation 29 CFR 1910.120(e) & (p)

And all State OSHA/EPA Regulations as well including 29 CFR 1926.65 for Construction.

This course (Version 3) is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) (Accreditation # 044).

Safety Unlimited, Inc., Provider #5660170-2, is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU. As an IACET Accredited Provider, Safety Unlimited, Inc. offers CEUs for its programs that qualify under the ANSI/IACET Standard. Safety Unlimited, Inc. is authorized by IACET to offer 0.8 CEUs for this program.

Julius P. Griggs

Julius P. Griggs
Instructor #892

2205085319007

Certificate Number

5/8/2022

Issue Date

ACCREDITED IACET PROVIDER

Scan this code or visit safetyunlimited.com/v to verify certificate.

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OSHA Compliant Safety Training Since 1993

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(855) 784-2677 or 805 306-8027
https://www.safetyunlimited.com

Proof of initial certification and subsequent refresher training is NOT required to take refresher training

EMILCOTT/DGA

HEALTH, SAFETY AND ENVIRONMENTAL TRAINING PROGRAM

THIS CERTIFIES THAT

Robert Janosy

HAS SUCCESSFULLY COMPLETED

8-Hour Supervisor Training Course for Hazardous Waste Operations CFR 1910.120

DATE April 19, 2000 LOCATION Battelle Memorial Institute

Dianne Grote Adams

Dianne Grote Adams, CIH, CSP Course Director

OSHA Occupational Safety and Health Administration

36-600707675

This card acknowledges that the recipient has successfully completed a 30-hour Occupational Safety and Health Training Course in

Construction Safety and Health

ROBERT JANOSY

Rick C. Knight

(Trainer name – print or type)

3/1/2010

(Course end date)

OSHA 001687144

U.S. Department of Labor
Occupational Safety and Health Administration

Robert Janosy

has successfully completed a 10-hour Occupational Safety and Health Training Course in

Construction Safety & Health

R N Culpepper — 2/08

(Trainer) (Date)

Safex

Health, Safety and Environmental Training Program

This Certifies That

Robert Janosy

Has Successfully Completed

Trenching and Excavation Training

Date Oct 22 2007 **Location** Westerville, OH

Dianne Grote Adams

Dianne Grote Adams, CIH, Course Director

American Red Cross
Training Services

Certificate of Completion

Bob Janosy

has successfully completed requirements for

Adult First Aid/CPR/AED

Date Completed: 4/12/2021
Validity Period: 2 - Years

Conducted by: American Red Cross

To verify certificate, scan code or visit redcross.org/digitalcertificate and enter ID.

Learn and be inspired at LifesavingAwards.org

00J7VIN

American Red Cross
Training Services

CEU

Bob Janosy

has succesfully completed requirements for

Adult First Aid/CPR/AED-BL

Date Completed: 4/12/2021

Conducted by: American Red Cross

Contact Hours: 4.5
CEUs Awarded: 0.5

To verify certificate, scan code or visit redcross.org/digitalcertificate and enter ID.

Learn and be inspired at LifesavingAwards.org

Certificate of Completion

This is to certify that

Robert Janosy

has completed

Bloodborne Pathogens (GI)

Completion Date 02/22/2018

Course Duration 1.0

Certificate # 000013526138

360training.com™

Certificate of Completion

This is to certify that

Robert Janosy

has completed

GHS and OSHA Hazardous Communication

Completion Date 02/22/2018

Course Duration 1.0

Certificate # 000013526129

360training.com™

360training.com ♦ 6801 N Capital of Texas Hwy Suite 150 ♦ Austin, TX 78731 ♦ 877.881.2235 ♦ www.360training.com

APPENDIX D
SAFETY MEETING FORMS

TAILGATE SAFETY MEETING FORM

Date:_____ Time:_____ Job Number: W912WJ-19-D-0006

Site Location: Former Stewart AFB (AOC 2 & AOC 3)

Scope of Work: Site Visit/Reconnaissance; Vegetation Removal; Geophysical Survey; Wetland Delineation; Utility Survey; Piezometer Installation; Land Survey; Well Installation; Hand Augering; Soil Sampling; Surface Water Sampling; Groundwater Sampling;

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment: Level D: hard hat (if applicable), standard work clothing, safety glasses, safety-toed boots, work gloves, traffic vest, etc.
Chemical/Biological Hazards: COVID-19 exposure.
Physical Hazards: Slips/trips/falls; heavy equipment; uneven conditions; airfield operations; ticks. Potential for UXO encounter.
Equipment Used: Geoprobe rig, stake body truck; wood chipper; chainsaws; hand/power tools
Emergency Procedures: 911, First Aid
Hospital:
Montefiore St. Luke's Cornwall
70 Dubois Street
Newburgh, NY 12550
Phone: **845-561-4400** Ambulance Phone: 911

Hospital Address and Route: Take Recreation Rd to NY-207 E (1.1 mi). Follow NY-207 E to West St in Newburgh (3.9 mi). Continue onto West St (0.5 mi). Turn right onto South St (0.8 mi). Turn right onto Dubois St (0.4 mi).

Noise Impacts and Mitigation: Ear plugs/muffs during wood chipping and drilling activities
Odor Impacts and Mitigation:
Permits Required: Hot work permit (if necessary); Dig Alert

ATTENDEES

NAME PRINTED	SIGNATURE

Meeting Conducted by: _____ Signed by: _____
Site Safety Officer: _____ Quality Manager: _____

Daily Issues and Lessons Learned:_____

Daily Site Closure Actions:_____

APPENDIX E
ENG FORM 3394

U.S. Army Corps of Engineers (USACE)

MISHAP NOTIFICATION AND INVESTIGATION

For use of this form, see instructions in the attachments and USACE ER 385-1-99; the proponent agency is CESO.

Requirement Control Symbol

RCS-CESO-21-0001

DATA REQUIRED BY THE PRIVACY ACT OF 1974

Authority 10 U.S.C. 7013, Secretary of the Army; 5 U.S.C. 7902, Safety Programs; Public Law 91-596, Occupational Safety and Health Act of 1970; DoD Instruction 6055.1, DoD Safety and Occupational Health Program; Army Regulations 385-10, Army Safety Program; DoD Instruction 6055 .07, Mishap Notification, Investigation, Reporting, and Record Keeping; and E.O. 9397 (SSN), as amended.

Principal Purpose Information collected is to provide the USACE leaders, soldiers, families and civilians in injury, illness, and loss data to effectively manage its safety and occupational health program.

Routine Uses In addition to those disclosures generally permitted under 5 U.S.C. 552a(b) of the Privacy Act of 1974, these records or information contained therein may specifically be disclosed outside the DoD as a routine use pursuant to 5 U.S.C. 552a(b) as follows: To the Department of Labor, the Federal Aviation Agency, the National Transportation Safety Board, and to Federal, State, and local agencies and applicable civilian organizations, such as the National Safety Council, for use in a combined effort of accident prevention. In some cases, data must also be disclosed to an employee's representative under the provisions of 29 CFR 1960.29. Records will be made available consistent with applicable laws and regulations. Information will be withheld from the public only if authorized by 5 U.S.C. Section 552 (Freedom of Information Act (FOIA), 5 U.S.C. 552a (Privacy Act)), or other statutory or regulatory authority.

Disclosure Failure to provide all the required information on the report may result in the rejection of report submission.

1. WHO IS REPORTING MISHAP

a. Name:		b. Phone number:
c. Email address:		d. Signature:
e. Report type:	☐ 1. Near Miss Report. *(No injury/illness, or property damage. Complete all fields with underlined text.)*	Date:
	☐ 2. Initial Accident Report. (*For accident notification within 24 hrs, Complete all fields with underlined text.*)	Date:
	☐ 3. Final Accident Report. *(For reporting findings from accident investigation, complete full form.)*	Date:

f. Mishap Type. *(Check all that apply)*

☐ Fatality ☐ Injury/Illness ☐ Property Damage ☐ Near Miss

g. Were any of the following items associated with the mishap ? ☐ Yes ☐ No *(If yes, check all that apply)*

☐ Electrical and/or Hazardous Energy ☐ Working at Heights ☐ Diving ☐ Load Handling Equipment or Rigging ☐ Occupational Health Exposure

2. WHO WAS INVOLVED IN THIS MISHAP?

a. Name:		
b. Personnel Classification:	c. Time employee began work:	
d. Gender:	e. Date of birth (for Government personnel only):	f. Age:
g. Date hired:	h. Primary language:	
i. Is individual a supervisor? ☐ Yes ☐ No	j. Duty status at time of mishap:	k. Years experience in job:

l. What was individual doing when mishap occurred? (*Select activity from the drop downs below.*)

1. General activities:	2. Vehicle/Equipment/Vessel:
3. Sports/Recreation:	4. Other not listed:

m. Did individual utilize all OSHA/EM 385-1-1 required Personal Protective Equipment (PPE) for activity? ☐ Yes ☐ No ☐ N/A

If no, identify missing PPE:

n. Was a Personal Flotation Device used? ☐ Yes ☐ No ☐ N/A | o. Was a seat belt used? ☐ Yes ☐ No ☐ N/A

p. **Government personnel only:**		
1. Job series:	2. Rank:	3. Grade:
4. Center/Division/Lab:		5. District:
q. **Contractor personnel only:**		
1. Employer/Contractor name:		
2. Individual's occupation/trade:		Other not listed:
r. If mishap occurred on a contractor site, provide the following:		
1. Prime Contractor name:		
2. Contract number:	3. Contract type:	4. Funding type:

3. WHAT TYPE OF INJURY/ILLNESS OCCURRED?

a. Severity of injury/illness?	b. Type of Injury/Illness:
c. Identify body part(s) affected by injury/illness:	
Primary body part affected:	Secondary body part affected:
d. Identify cause and source of injury/illness:	
Cause of injury/illness:	Source of injury/illness:
e. Was employee treated by a physician or health care professional provider? ☐ Yes ☐ No	
If yes, provide name of physician or health care professional provider?	
f. Was treatment given away from work site? ☐ Yes ☐ No	g. Was employee treated in an emergency room ? ☐ Yes ☐ No ☐ N/A
h. If treatment was given away from the work-site, where was it given? (For Government Personnel Only)	
Treatment facility name: Address: City: State: Zip: Country:	
i. Was employee hospitalized as an in-patient? ☐ Yes ☐ No	If yes, how many nights? / Was OSHA notified? ☐ Yes ☐ No
Note: OSHA requires reporting all work-related fatalities within 8 hours and in-patient hospitalizations, amputations and loss of an eye within 24 hours to OSHA.	
j. Estimated days away from work:	k. Estimated days of restricted/transferred duty:

4. WHAT HAPPENED?

a. What was the primary activity occurring at the time of the mishap?
Other, not listed:
b. What happened? Provide a detailed description of the mishap. (Do not include any personally identifiable information (name, etc.).)
Note: Provide supporting photos, charts, diagrams, etc. with this report.
c. What other organizations or agencies have been notified about this mishap?

5. WHAT TYPE OF PROPERTY/MATERIAL WAS INVOLVED?

a. List all property/material involved in the mishap. (Include damaged and undamaged property.)

	Item A	*Item B*	*Item C*
i. Type of item:			
Other not listed:			
ii. Name of item(s):			
iii. Collision type:			
Other not listed:			
iv. Ownership of item:			
v. Dollar cost of damage:			

6. WHEN DID THE MISHAP OCCUR?

a. Date the mishap occurred:	b. Time mishap occurred:
c. What day did mishap occur on?	d. What period of day did mishap occur?

7. WHERE DID THE MISHAP OCCUR?

a. Did the mishap occur on a military Base/Post? ☐ Yes ☐ No

b. USACE Office/Program/Project name:

c. Select the location type most closely associated with the mishap:

d. Identify exact location where mishap occurred:

Address:

City: State: Zip: Country:

e. Latitude:	f. Longitude:

8. WHY DID THE MISHAP OCCUR? (*Recommend completing this section for Near Misses.*)

A. Performance Causal Factors

1. Did a problem with performance contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

B. Support Causal Factors

1. Did a problem with resources contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

C. Standards/Policy/Planning Causal Factors

1. Did an organizational standard/policy/or plan contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Was a written Activity Hazard Analysis (AHA) or equivalent completed and accepted by Government Designated Authority (GDA) for task(s) being performed at time of mishap? (If yes, attach a copy to this report) ☐ Yes ☐ No

If yes, was the AHA available and used by worker? ☐ Yes ☐ No

3. Was a written work plan (critical lift plan, fall protection plan, etc.) required, completed and accepted by the GDA for task(s) being performed at time of mishap? ☐ Yes ☐ No

If yes, was the plan available and used by worker? ☐ Yes ☐ No

4. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

D. Training Causal Factors

1. Did a problem with training contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Was individual trained to perform the activity/task? ☐ Yes ☐ No

If yes, select type of training: ☐ Classroom ☐ Certification/License ☐ On the job

☐ Other, describe:

What was date of most recent training?

3. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

E. Leader/Supervisor Causal Factors

1. Did any leader/supervisory mistake/task error contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Did the safety climate/culture contribute to the mishap? ☐ Yes ☐ No

3. Did challenges with teamwork contribute to the mishap? ☐ Yes ☐ No

4. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

F. Individual Causal Factors

1. Did any individual mistakes/task errors contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

G. Physical Environment Causal Factors

1. Did any physical environment contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

H. Material Causal Factors

1. Did any material failure contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the error that contributed most to the mishap:

2. Which failure is most closely associated with the material failure/malfunction?

3. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

I. Environmental Causal Factors

1. Did any environmental condition contribute to this mishap occurring? ☐ Yes ☐ No

If yes, select the factor that contributed most to the mishap:

2. Describe action(s) taken, anticipated or recommended to eliminate cause(s):

J. Facility/Building Design
1. Did the design of the facility/building contribute to the mishap? ☐ Yes ☐ No
If yes, describe:
2. Describe action(s) taken, anticipated or recommended to eliminate hazard:
K. Existing Hazard
1. Did a hazard(s) contribute to the mishap? ☐ Yes ☐ No
If yes, describe the hazard(s):
2. Describe action(s) taken, anticipated or recommended to eliminate hazard(s):
9. Corrective Action plan
a. Have all corrective action(s) to prevent mishap recurrence been completed? ☐ Yes ☐ No
b. Who is responsible for the corrective action plan?
c. What date will/have all corrective action(s) be/been completed by:
d. Additional information:
10. Additional Information

APPENDIX J

COMMUNITY AIR MONITORING PLAN

DRAFT FINAL

COMMUNITY AIR MONITORING PLAN
FOR
REMEDIAL INVESTIGATION ACTIVITIES

AT THE
FORMER STEWART AIR FORCE BASE,
NEWBURGH AND NEW WINDSOR, NEW YORK

CONTRACT NO. W912WJ-19-D-0006
DELIVERY ORDER NO. W913WJ19F0135

FUDS PROJECT NO. C02NY0704

Prepared for:



U.S. Army Corps of Engineers
New England District
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November 2019

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 MONITORING 4
2.1 VOC Monitoring 4
2.2 Particulate Monitoring 5
2.3 Meteorological Monitoring 5
3.0 RESPONSE LEVELS AND ACTIONS 6
3.1 VOCs 6
3.2 Particulate Matter 6
4.0 DOCUMENTATION 7
5.0 REFERENCES 8

TABLES

Table 2-1. Applicability of Continuous or Periodic Monitoring 4
Table 2-2. VOC Monitoring 4
Table 2-3. Particulate Monitoring 5
Table 3-1. VOC Response Levels and Actions 6
Table 3-2. Particulate Response Levels and Actions 6

FIGURES

Figure 1-1. Stewart AFB Location Map 2
Figure 1-2. AOC 2 and AOC 3 Site Map 3

LIST OF ACRONYMS

AFB .....Air Force Base
AOC.....Area of Concern

CAMP .....Community Air Monitoring Plan

DER .....Division of Environmental Remediation
DO.....Delivery Order

FUDS .....Formerly Used Defense Sites

µg/m^3 .....micrograms per cubic meter

NYSDEC .....State of New York Department of Environmental Conservation
NYSDOH.....New York State Department of Health
NYSDOT .....New York State Department of Transportation

PID .....photoionization detector
PM-10 .....particulate matter less than micrometers in size
ppm .....parts per million

RI .....Remedial Investigation

SSHP .....Site Safety and Health Plan

TI-SDC .....TI-SDC Joint Venture

USACE .....United States Army Corps of Engineers

VOC .....volatile organic compound

1.0 INTRODUCTION

This Community Air Monitoring Plan (CAMP) was developed by TI-SDC Joint Venture (TI-SDC) for activities at the Former Stewart Air Force Base (AFB), located in Newburgh and New Windsor, New York. The purpose of the plan is to protect the community from any potential airborne releases that could result from field activities associated with the Remedial Investigation (RI) at the Former Stewart AFB Area of Concern (AOC) 2 and AOC 3. This work is being performed as delivery order (DO) No. W913WJ19F0135 under the United States Army Corps of Engineers (USACE) Contract No. W912WJ-19-D-0006. It has been prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) Program Policy Division of Environmental Remediation (DER)-10/Technical Guidance for Site Investigation and Remediation, dated May 3, 2010.

DER-10 (NYSDEC, 2010) includes a Generic CAMP from the New York State Department of Health (NYSDOH) as Appendix 1A. The generic CAMP is sufficient to cover Former Stewart AFB; however, site-specific details and requirements are included in this CAMP. The CAMP is intended to protect off-site receptors and those not directly involved with RI activities from potential airborne contaminant releases that could result directly from investigative activities. For this reason, CAMP monitoring is limited to the perimeter of the work area and is in addition to any monitoring specified in the Site Safety and Health Plan (SSHP) to protect on-site workers in the investigative work zone.

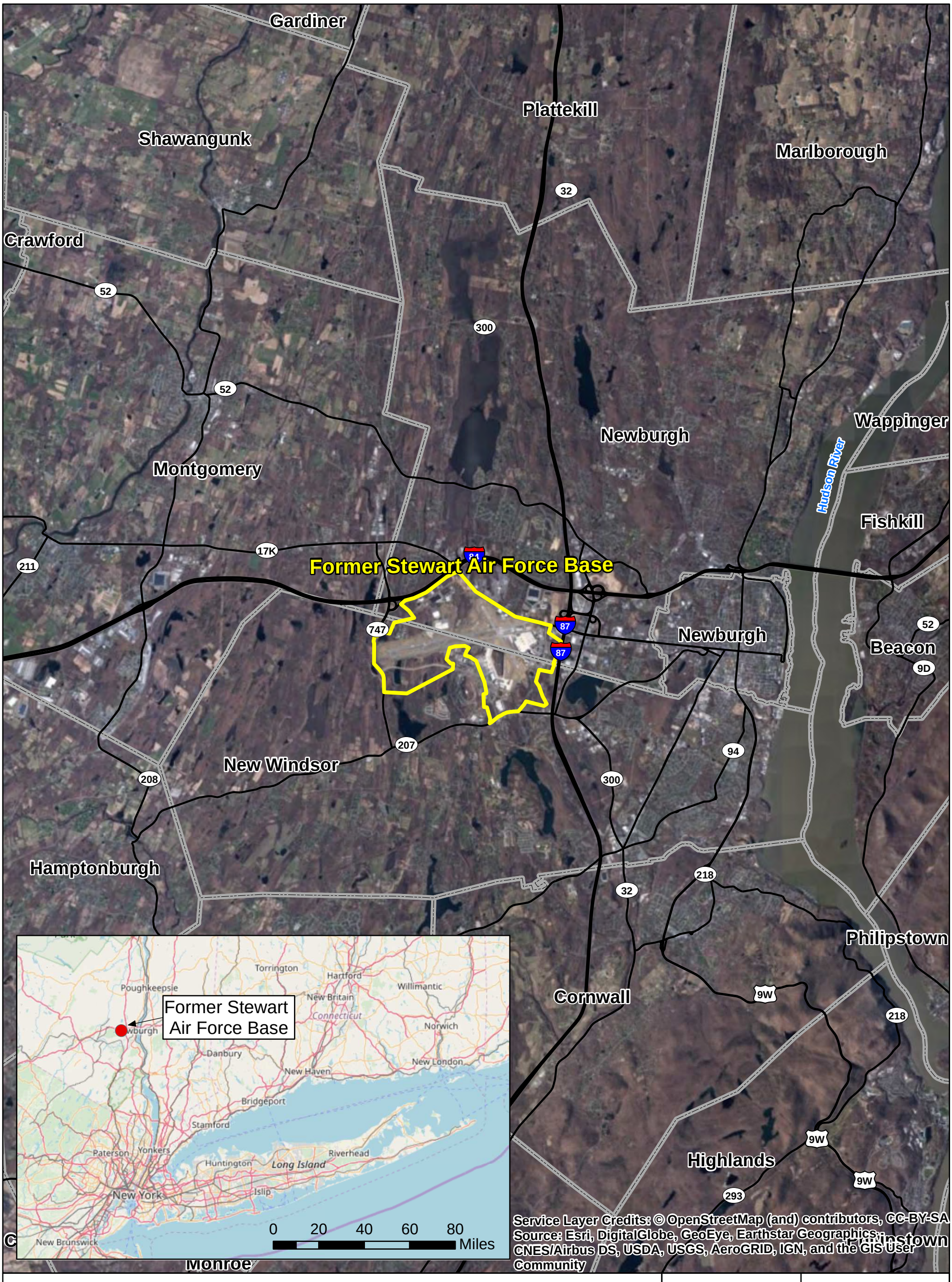
The Former Stewart AFB, now Stewart International Airport is located in Orange County, New York in the southwest portion of the State, approximately 2.5 miles west of Newburgh, New York and 35 miles northwest of New York City. The site is currently owned by the New York State Department of Transportation (NYSDOT). In 1930, the original tract of land was donated by Samuel L. Stewart to the City of Newburgh for use as a municipal airport. Prior to 1930, the land use was primarily agricultural. AOC 2 and AOC 3 were reportedly used as landfills during Department of Defense use of the property. A general site location map is shown in Figure 1-1, and a site map is shown in Figure 1-2. RI activities are expected to consist primarily of wetland delineation; soil boring, piezometer, and monitoring well installation; and surface soil, subsurface soil, sediment, surface water, and groundwater sampling. The CAMP presents the continuous and periodic monitoring that will be conducted during the RI activities. Furthermore, the site is greater than 20 feet from potentially exposed individuals and there is no indoor work with co-located residences or facilities.

The overall objectives of this document are as follows:

- Prevent exposure to the public from potential contaminant releases resulting from on-site investigation activities;
- Specify monitoring and documentation requirements; and
- Provide contingency details.

This plan is organized as follows:

- Section 1.0, Introduction – includes a site description and CAMP objectives;
- Section 2.0, Volatile Organic Compounds (VOC) Monitoring and Particulate Monitoring – describes monitoring locations, frequency, and methodology for VOC and particulate matter, as well as meteorological monitoring;
- Section 3.0, Response Levels and Actions – describes response levels and actions based on VOC and particulate monitoring results;
- Section 4.0, Documentation – describes documentation required during monitoring activities; and
- Section 5.0, References – lists the references used in preparing this document.



Legend

- Former Stewart Air Force Base
- Major Roads
- Town Boundaries

N W E S

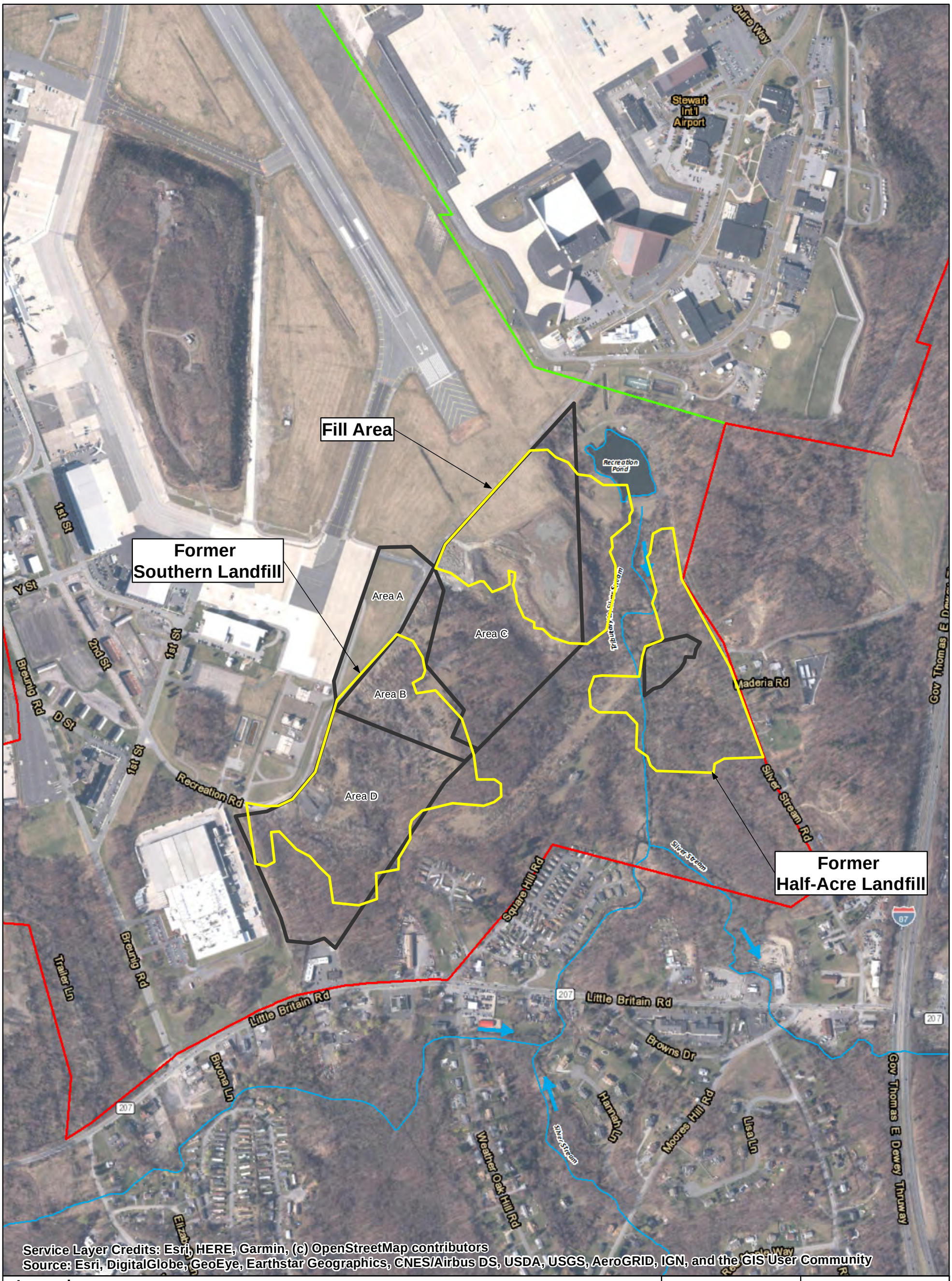
0 1 2 3 4 Miles

Figure 1-1

Site Location Map

Former Stewart Air Force Base, New York

Nov 2019



Legend

- Approximate Extent of Former Southern Landfill and Former Half-Acre Landfill boundaries Involving DoD Activities (1940s through 1970). Fill Area Involved Non-DoD Activities from 1980s through 2000s. Interpreted from USAGC Report (USAGC, 2019).
- Historical Interpretations of Former Southern Landfill and Former Half-Acre Landfill
- Former Stewart Air Force
- Streams
- Surface Water Flow Direction
- Water Bodies
- New York Air National Guard

N W E S

0 400 800 1,200 1,600 Feet

Figure 1-2

Site Map Showing Landfill Boundaries

Former Stewart Air Force Base, New York

Nov 2019

2.0 MONITORING

Monitoring at the site will include VOCs and particulates monitoring with instrumentation, visual monitoring of fugitive dust migration, and monitoring of meteorological conditions. Monitoring locations, frequency, and methodology for VOCs and particulate matter are described in Sections 2.1 and 2.2, respectively. Meteorological monitoring is described in Section 2.3.

2.1 VOC Monitoring

VOC monitoring will take place according to the specifications described in this section. Locations will vary according to wind direction, and frequency will be determined by the type of activity being performed at the site. Table 2-1 summarizes the activities applicable to continuous or to periodic monitoring.

Table 2-1. Applicability of Continuous or Periodic Monitoring.

Type of Monitoring	Applicable Activities
Continuous Monitoring	Intrusive • Excavation of test pits or trenches • Advancement of soil borings • Installation of piezometers and/or monitoring wells
Periodic Monitoring	Non-Intrusive • Utility survey • Land survey • Geophysical survey • Wetland delineation • Collection of sediment and soil samples • Collection of surface water and groundwater samples

The general parameters for VOC sampling are outlined in Table 2-2 below. The upwind location will be determined at the start of each work day and a VOC reading taken. If the wind direction changes, another reading will be taken at the new upwind location to establish baseline levels. The downwind measurement will be taken at the downwind perimeter of the work area. If work activities are ground intrusive, continuous monitoring will be required. If they are non-intrusive, periodic monitoring will be conducted.

Table 2-2. VOC Monitoring.

Location	Frequency
Upwind of work area	• Start of each day • Additional measurements if wind directions changes or if background levels need to be re-established
Downwind perimeter of the immediate work area	• Continuous for ground-intrusive activities • Periodic for non-intrusive activities

An example of periodic monitoring during sample collection would be taking readings as follows:

- Upon arrival at sampling location;
- While opening well cap;
- During groundwater purging; and
- Upon leaving sampling location.

VOC readings will be taken with a photoionization detector (PID). The PID will be calibrated on a daily basis prior to use with an appropriate surrogate. The PID will be capable of running 15-minute (min) running average concentrations.

2.2 Particulate Monitoring

Particulate monitoring will take place according to the specifications described in this section. Monitoring will take place on a continuous basis, and locations will vary according to wind direction. Refer to Table 2-3 for locations and frequency. The upwind location will be determined at the start of each work day. If wind direction changes, the upwind monitoring station will be changed to a new location to re-establish baseline levels. The downwind location will change in accordance with changes in the upwind location.

Table 2-3. Particulate Monitoring.

Location	Frequency
Upwind perimeter of exclusion zone	• Continuously
Downwind perimeter of exclusion zone	• Continuously

Particulate readings will be taken with an instrument that can measure particulate matter less than 10 micrometers in size (PM-10) and be capable of real-time monitoring. PM-10 is measured in micrograms per cubic meter ($\mu g/m^3$). The particulate monitoring equipment will have an audible alarm to indicate when action levels have been exceeded. In addition to particulate monitoring with instrumentation, fugitive dust migration will be visually assessed during all work activities. Further detail on fugitive dust and particulate monitoring can be found in Appendix 1B of DER-10 (NYSDEC, 2010).

2.3 Meteorological Monitoring

Meteorological monitoring will take place on a daily basis. It will consist of temperature, wind direction, and general atmospheric conditions (i.e., rain, snow, etc.). These parameters will be evaluated each morning and recorded in the field documentation. Wind direction will be monitored throughout the day so that upwind and downwind sampling locations can be adjusted, if necessary.

3.0 RESPONSE LEVELS AND ACTIONS

This section describes the VOC and particulate monitoring response levels and actions.

3.1 VOCs

VOC readings obtained from the monitoring described in Section 2.1 should be evaluated based on the criteria in Table 3-1 to determine the appropriate response actions. The resulting readings should be in 15-min averages for comparison purposes.

Table 3-1. VOC Response Levels and Actions.

Response Levels	Actions
Total VOCs at downwind perimeter of work area exceed upwind background levels by 5 parts per million (ppm) (15-minute average).	• Work activities temporarily halted and monitoring continued. • If instantaneous readings readily drop below 5 ppm over background levels, work activities can resume.
Total VOCs at downwind perimeter of work area persistently exceed background levels by between 5 ppm and 25 ppm (15-minute average)	• Work activities halted, source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. • After this occurs, work can continue if total VOCs 200 feet downwind of exclusion zone or ½ the distance to nearest potential receptor or residential/commercial structure, whichever is less, is below 5 ppm (15-minute average); note that this distance cannot be less than 20 feet.
Total VOCs at the perimeter of work area exceed 25 ppm (15-minute average)	• Activities must be shut down

3.2 Particulate Matter

Particulate matter readings obtained from the monitoring described in Section 2.2 should be evaluated based on the criteria in Table 3-2 to determine the appropriate response action. The resulting readings will be conducted in 15-min averages for comparison purposes. Further detail on dust suppression techniques can be found in Appendix 1B of DER-10 (NYSDEC, 2010).

Table 3-2. Particulate Response Levels and Actions.

Response Levels	Actions
PM-10 particulate level at downwind perimeter 100 µg/m^3 greater than upwind perimeter for 15-minute period.	• Employ dust suppression techniques.
Airborne dust observed leaving the work area	• Employ dust suppression techniques.
After implementation of dust suppression techniques, PM-10 particulate level at downwind perimeter over 150 µg/m^3 greater than upwind perimeter.	• Work must be stopped and activities re-evaluated • Work can resume if measures and controls reduce downwind PM-10 concentrations to within 150 µg/m^3 of upwind level and visible dust migration is prevented.

4.0 DOCUMENTATION

During the implementation of the CAMP, the following information will be recorded and maintained:

- Climatological conditions including temperature, wind direction, and other atmospheric conditions (e.g., rain, snow, etc.) along with the date and time of observations;
- Calibration of field instruments;
- VOC 15-minute average readings as well as instantaneous readings, if necessary;
- All particulate readings; and
- Any exceedances to the response levels and the respective corrective actions.

VOC 15-minute average readings will be made available for review by the State (NYSDEC and NYSDOH), if requested. All particulate readings will made available for review by the State (NYSDEC and NYSDOH) and County Health personnel, if requested.

5.0 REFERENCES

New York State Department of Environmental Conservation. May 3, 2010. *DER-10/Technical Guidance for Site Investigation and Remediation.*

APPENDIX K

QC INSPECTION CHECKLISTS AND DQCR

Preparatory Phase Inspection Checklist

Contract No.: **W912WJ-19-D-0006** Date:_____ Rpt. No.:_____

Project Title & Location: **Former Stewart Air Force Base, Newburgh and New Windsor, New York**

Major Definable Segment of Work:

A. Personnel Present

	Name	*Position*	*Company*
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

B. Items Involved

	Item	*Specification or Plan Section*	*Contractor/Government Approval*
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

B-I. Have all items been approved?

(Circle) Yes No

B-II What Items have not been approved?

_____

C. Tests required in accordance with contract requirements

	Test	*Specification or Plan Section*
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

D. Accident Prevention Pre-Planning - Hazard Control Measures

Applicable Site Safety and Health Plan Section

1. _____
2. _____
3. _____
4. _____
5. _____

Initial Phase Inspection Checklist

Contract No.: **W912WJ-19-D-0006** Date:_____ Rpt. No.:_____

Project Title & Location: **Former Stewart Air Force Base, Newburgh and New Windsor, New York**

I. Personnel Present:

	Name	*Position*	*Company*
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____

II. Identify full compliance with procedures identified at preparatory inspection. Coordinate plans, specifications and submittals.

Comments:

III. Preliminary work: Ensure preliminary work is complete and correct. If not, what action is taken?

Actions:

IV. Establish Levels of Workmanship

Comments:

V. Resolve any differences

Comments:

VI. Check Safety: Review job conditions using Site Safety and Health Plan and job hazard analysis.

Comments:

_____

Project CQC Manager/Field Team Leader

TI-SDC JV Former Stewart Air Force Base Newburgh and New Windsor, New York	DAY/DATE: REPORT NO: WEATHER:
CONTRACTOR DAILY QUALITY CONTROL REPORT (DQCR)	PRIMARY TASK:

Personnel present on site:
Summary of field activities:
Significant accomplishments/observations/samples:
Quality control activities performed:
Problems or deficiencies encountered:
Corrective actions taken:
Future field activities:
Additional documentation (test results, checklists, etc.)

APPENDIX L

EVALUATION OF HISTORICAL DETECTIONS OF ANALYTES WITH DETECTION LIMITS ABOVE PROJECT SCEENING LEVELS

Groundwater/Surface Water Analytes for which one or more PSLs is lower than the LOQ.

									Human Health RSLs for Tapwater, USEPA November 2021							
									Noncancer Hazard			*Cancer Risk*				
Analyte	CAS	Human PSL (µg/L)	Ecological PSL for Surface Water (µg/L)	LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)	Detected in Past Investigations	Number of Detections	RSL-NC HI= 0.1	Hazard at LoQ	Hazard at MDL	RSL-C ILCR=10-6	Risk at LoQ	Risk at MDL	Eco HQ at LOQ	Eco HQ at MDL
1,1,2,2-Tetrachloroethane	79-34-5	0.076	200	1	0.6	0.3	No	0	36	2.78E-03	8.33E-04	0.076	1.32E-05	3.95E-06	0.01	0.0015
1,1,2-Trichloroethane	79-00-5	0.041	730	1	0.6	0.3	No	0	0.041	2.44E+00	7.32E-01	0.28	3.57E-06	1.07E-06	0.001	0.00041
1,2,4-Trichlorobenzene	120-82-1	0.4	130	5	1	0.3	No	0	0.4	1.25E+00	7.50E-02	1.2	4.17E-06	2.50E-07	0.04	0.0023
1,2-Dibromo-3-chloropropane	96-12-8	0.00033	NE	5	1	0.3	No	0	0.037	1.35E+01	8.11E-01	0.00033	1.52E-02	9.09E-04		
1,2-Dibromoethane	106-93-4	0.0075	NE	1	0.5	0.2	No	0	1.7	5.88E-02	1.18E-02	0.0075	1.33E-04	2.67E-05		
1,2-Dichloroethane	107-06-2	0.17	2,000	0.2	0.05	0.016	Yes	1	1.3	1.54E-02	1.23E-03	0.17	1.18E-06	9.41E-08	0.0001	0.000008
1,2-Dichloropropane	78-87-5	0.82	520	1	0.6	0.3	No	0	0.82	1.22E-01	3.66E-02	0.85	1.18E-06	3.53E-07	0.002	0.00058
1,4-Dichlorobenzene	106-46-7	0.48	9.4	5	0.6	0.3	Yes	1	57	8.77E-03	5.26E-04	0.48	1.04E-05	6.25E-07	0.53	0.032
2-Hexanone	591-78-6	3.8	99	10	1	0.4	No	0	3.8	2.63E-01	1.05E-02				0.10	0.004
Benzene	71-43-2	0.46	160	1	0.6	0.3	Yes	9	3.3	3.03E-02	9.09E-03	0.46	2.17E-06	6.52E-07	0.01	0.0019
Bromodichloromethane	75-27-4	0.13	340	1	0.5	0.2	No	0	15	6.67E-03	1.33E-03	0.13	7.69E-06	1.54E-06	0.003	0.00059
Bromoform	75-25-2	3.3	230	4	2	1	No	0	38	1.05E-02	2.63E-03	3.3	1.21E-06	3.03E-07	0.02	0.0043
Bromomethane	74-83-9	0.75	16	1	0.6	0.3	No	0	0.75	1.33E-01	4.00E-02				0.06	0.019
Carbon Tetrachloride	56-23-5	0.46	77	1	0.6	0.3	No	0	4.9	2.04E-02	6.12E-03	0.46	2.17E-06	6.52E-07	0.013	0.0039
Dibromochloromethane	124-48-1	0.87	320	1	0.5	0.2	No	0	38	2.63E-03	5.26E-04	0.87	1.15E-06	2.30E-07	0.003	0.00063
Isopropylbenzene	98-82-8	45	4.8	5	0.5	0.2	Yes	2	45	1.11E-02	4.44E-04				1.04	0.042
Vinyl Chloride	75-01-4	0.019	930	0.1	0.05	0.014	Yes	3	4.2	2.38E-03	3.33E-04	0.019	5.26E-06	7.37E-07	0.0001	1.5E-05
1,1'-Biphenyl	92-52-4	0.083	6.5	2	1	0.5	No	0	0.083	2.41E+00	6.02E-01	3.9	5.13E-07	1.28E-07	0.31	0.077
2,4,5-Trichlorophenol	95-95-4	120	1.9	2	1.4	0.7	No	0	120	1.67E-03	5.83E-04				1.05	0.37
2,4,6-Trichlorophenol	88-06-2	1.2	4.9	2	1.2	0.6	No	0	1.2	1.67E-01	5.00E-02	4.1	4.88E-07	1.46E-07	0.41	0.12
2,4-Dinitrophenol	51-28-5	3.9	71	30	20	10	No	0	3.9	7.69E-01	2.56E-01				0.42	0.14
3,3'-Dichlorobenzidine	91-94-1	0.13	4.5	5	4	2	No	0				0.13	3.85E-05	1.54E-05	1.1	0.44
4,6-Dinitro-2-methylphenol	534-52-1	0.15	NE	15	10	5	No	0	0.15	1.00E+01	3.33E+00					
4-Bromophenyl-phenylether	101-55-3	NE	1.5	2	1	0.5	No	0							1.3	0.33
4-Chloro-3-methylphenol	59-50-7	140	1	2	1	0.5	No	0	140	1.43E-03	3.57E-04				2.0	0.5
4-Chloroaniline	106-47-8	0.37	0.8	5	4	2	No	0	0.95	5.26E-01	2.11E-01	0.37	1.35E-05	5.41E-06	6.3	2.5
Anthracene	120-12-7	180	0.02	0.05	0.03	0.01	Yes	1	180	2.78E-05	5.56E-06				2.5	0.5
Atrazine	1912-24-9	0.3	0.03	5	4	2	No	0	5.4	9.26E-02	3.70E-02	0.3	1.67E-05	6.67E-06	167	67
Benzo(a)anthracene	56-55-3	0.03	4.7	0.05	0.03	0.01	Yes	1				0.03	1.67E-06	3.33E-07	0.01	0.0021
Benzo(a)pyrene	50-32-8	0.025	0.06	0.05	0.03	0.01	Yes	1	0.6	8.33E-03	1.67E-03	0.025	2.00E-06	4.00E-07	0.83	0.17
Benzo(g,h,i)perylene*	191-24-2	12	0.012	0.05	0.03	0.01	Yes	1	12	4.17E-04	8.33E-05				4.2	0.83
bis(2-Chloroethyl)ether	111-44-4	0.014	NE	2	1	0.5	No	0				0.014	1.43E-04	3.57E-05		
Dibenz(a,h)anthracene	53-70-3	0.025	0.012	0.05	0.04	0.02	Yes	1				0.025	2.00E-06	8.00E-07	4.2	1.7
Dibenzofuran	132-64-9	0.79	4	2	1	0.5	No	0	0.79	2.53E-01	6.33E-02				0.50	0.13
Hexachlorobenzene	118-74-1	0.0098	0.15	0.5	0.2	0.1	No	0	0.02	2.50E+00	5.00E-01	0.0098	5.10E-05	1.02E-05	3.3	0.67
Hexachlorobutadiene	87-68-3	0.14	1	2	1.2	0.6	No	0	0.65	3.08E-01	9.23E-02	0.14	1.43E-05	4.29E-06	2.0	0.60
Hexachlorocyclopentadiene	77-47-4	0.041	0.45	15	10	5	No	0	0.041	3.66E+01	1.22E+01				33.3	11
Hexachloroethane	67-72-1	0.33	12	5	2	1	No	0	0.62	8.06E-01	1.61E-01	0.33	1.52E-05	3.03E-06	0.42	0.083
Indeno(1,2,3-cd)pyrene	193-39-5	0.25	0.012	0.05	0.04	0.02	Yes	1				0.25	2.00E-07	8.00E-08	4.2	1.7
N-Nitroso-di-n-propylamine	621-64-7	0.011	NE	2	1	0.5	No	0				0.011	1.82E-04	4.55E-05		
Nitrobenzene	98-95-3	0.14	230	2	1.6	0.8	No	0	1.3	1.54E-01	6.15E-02	0.14	1.43E-05	5.71E-06	0.01	0.0035
Pentachlorophenol	87-86-5	0.041	15	5	2	1	No	0	2.3	2.17E-01	4.35E-02	0.041	1.22E-04	2.44E-05	0.33	0.067
Aldrin	309-00-2	0.00092	0.04	0.02	0.01	0.002	Yes	1	0.06	3.33E-02	3.33E-03	0.00092	2.17E-05	2.17E-06	0.50	0.050
Alpha BHC	319-84-6	0.0072	0.01	0.02	0.01	0.003	Yes	3	9.7	2.06E-04	3.09E-05	0.0072	2.78E-06	4.17E-07	2.0	0.30
Dieldrin	60-57-1	0.0018	0.056	0.03	0.02	0.005	Yes	12	0.038	7.89E-02	1.32E-02	0.0018	1.67E-05	2.78E-06	0.54	0.089
Heptachlor	76-44-8	0.0014	0.0038	0.02	0.01	0.002	Yes	1	0.026	7.69E-02	7.69E-03	0.0014	1.43E-05	1.43E-06	5.3	0.53

Groundwater/Surface Water Analytes for which one or more PSLs is lower than the LOQ.

									Human Health RSLs for Tapwater, USEPA November 2021							
									Noncancer Hazard			*Cancer Risk*				
Analyte	**CAS**	**Human PSL (µg/L)**	**Ecological PSL for Surface Water (µg/L)**	**LOQ (µg/L)**	**LOD (µg/L)**	**MDL (µg/L)**	**Detected in Past Investigations**	**Number of Detections**	**RSL-NC HI= 0.1**	**Hazard at LoQ**	**Hazard at MDL**	**RSL-C ILCR=10-6**	**Risk at LoQ**	**Risk at MDL**	**Eco HQ at LOQ**	**Eco HQ at MDL**
Heptachlor Epoxide	1024-57-3	0.0014	0.0038	0.02	0.01	0.002	No	0	0.012	1.67E-01	1.67E-02	0.0014	1.43E-05	1.43E-06	5.3	0.53
Methoxychlor	72-43-5	3.7	0.03	0.11	0.1	0.03	No	0	3.7	2.97E-03	8.11E-04				3.7	1.0
p,p-DDD	72-54-8	0.0063	0.01	0.03	0.02	0.005	Yes	11	0.0063	4.76E-01	7.94E-02	0.032	9.38E-07	1.56E-07	3	0.50
p,p-DDT	50-29-3	0.23	0.001	0.03	0.02	0.005	Yes	4	1	3.00E-03	5.00E-04	0.23	1.30E-07	2.17E-08	30	5.0
Toxaphene	8001-35-2	0.071	0.0002	1	0.6	0.3	No	0	0.18	5.56E-01	1.67E-01	0.071	1.41E-05	4.23E-06	5000	1500
PCB-1016	12674-11-2	0.14	NE	0.25	0.2	0.1	No	0	0.14	1.79E-01	7.14E-02	0.22	1.14E-06	4.55E-07		
PCB-1221	11104-28-2	0.0047	NE	0.25	0.2	0.1	No	0				0.0047	5.32E-05	2.13E-05		
PCB-1232	11141-16-5	0.0047	NE	0.25	0.2	0.1	No	0				0.0047	5.32E-05	2.13E-05		
PCB-1242	53469-21-9	0.0078	NE	0.25	0.2	0.1	No	0				0.0078	3.21E-05	1.28E-05		
PCB-1248	12672-29-6	0.0078	NE	0.25	0.2	0.1	No	0				0.0078	3.21E-05	1.28E-05		
PCB-1254	11097-69-1	0.0078	NE	0.25	0.2	0.08	No	0	0.04	6.25E-01	2.00E-01	0.0078	3.21E-05	1.03E-05		
PCB-1260	11096-82-5	0.0078	NE	0.25	0.2	0.08	No	0				0.0078	3.21E-05	1.03E-05		
Total PCBs	1336-36-3	0.044	0.014	0.25	0.2	0.1	No	0				0.044	5.68E-06	2.27E-06	18	7.1
Antimony	7440-36-0	0.78	190	1	0.8	0.4	Yes	39	0.78	1.28E-01	5.13E-02				0.01	0.0021
Arsenic	7440-38-2	0.052	150	2	1.6	0.7	Yes	54	0.6	3.33E-01	1.17E-01	0.052	3.85E-05	1.35E-05	0.01	0.0047
Mercury	7439-97-6	0.063	0.77	0.2	0.2	0.08	Yes	8	0.063	3.17E-01	1.27E-01				0.26	0.10
Silver	7440-22-4	9.4	0.06	0.5	0.4	0.2	Yes	32	9.4	5.32E-03	2.13E-03				8.3	3.3
Thallium	7440-28-0	0.02	6	0.5	0.4	0.1	Yes	14	0.02	2.50E+00	5.00E-01				0.08	0.017
1,3-Dinitrobenzene	99-65-0	0.2	22	1	3.6	0.4	No	0	0.2	5.00E-01	2.00E-01				0.05	0.018
2,4,6-Trinitrotoluene	118-96-7	0.98	13	3.7	3.6	1.8	Yes	1	0.98	3.78E-01	1.84E-01	2.5	1.48E-06	7.20E-07	0.28	0.14
2,4-Dinitrotoluene	121-14-2	0.24	44	0.6	0.5	0.2	Yes	3	3.8	1.58E-02	5.26E-03	0.24	2.50E-06	8.33E-07	0.01	0.0045
2,6-Dinitrotoluene	606-20-2	0.049	81	0.8	0.7	0.4	Yes	1	0.57	1.40E-01	7.02E-02	0.049	1.63E-05	8.16E-06	0.01	0.0049
2-Nitrotoluene	88-72-2	0.31	71	0.9	0.8	0.3	Yes	1	1.6	5.63E-02	1.88E-02	0.31	2.90E-06	9.68E-07	0.01	0.0042
3-Nitrotoluene	99-08-1	0.17	42	0.8	0.7	0.3	Yes	1	0.17	4.71E-01	1.76E-01				0.02	0.0071
4-Amino-2,6-Dinitrotoluene	19406-51-0	0.19	11	2	1.8	0.9	No	0	0.19	1.05E+00	4.74E-01				0.18	0.082
Nitrobenzene	98-95-3	0.14	230	0.9	0.5	0.2	No	0	1.3	6.92E-02	1.54E-02	0.14	6.43E-06	1.43E-06	0.004	0.00087
Nitroglycerin	55-63-0	0.2	18	20	19	8.5	No	0	0.2	1.00E+01	4.25E+00	4.5	4.44E-06	1.89E-06	1.1	0.47
PETN	78-11-5	3.9	NE	23	22	10.8	No	0	17	1.35E-01	6.35E-02	17	1.35E-06	6.35E-07		

NE = Not evaluated; no PSL available for constituent.

Blank cell = no cancer or noncancer-based value available; relevant hazard/ risk not calculated.

*No Regional Screening Level available. Human health PSL based on the RSL for pyrene as surrogate.

Highlighted cells indicate hazard quotient > 1 or cancer risk > 1E-05

Soil/Sediment Analytes for which one or more PSLs is lower than the LOQ.

										Human Health RSLs for Residential Soil, USEPA November 2021							
										Noncancer Hazard			*Cancer Risk*				
Analyte	CAS	Human PSL (µg/kg)	Ecological PSL for Soil (µg/kg)	Ecological PSL for Sediment (µg/kg)	LOQ (µg/kg)	LOD (µg/kg)	MDL (µg/kg)	Detected in Past Investigations	Number of Detections	RSL-NC HI= 0.1 ug/kg	Hazard at LoQ	Hazard at MDL	RSL-C ILCR=10-6 ug/kg	Risk at LoQ	Risk at MDL	Eco Soil HQ at LOQ	Eco Sediment HQ at LOQ
Bromomethane	74-83-9	680	2	6.5	5	2	0.7	No	0	680	7.35E-04	1.03E-04				2.50	0.77
Tetrachloroethene	127-18-4	8,100	60	2	5	2	0.5	No	0	8,100	6.17E-05	6.17E-06	24,000	2.08E-10	2.08E-11	0.08	2.50
2,4-Dinitrophenol	51-28-5	130,000	61		1,000	333	167	No	0	13,000	7.69E-03	1.28E-03				16.4	
2-Nitroaniline	88-74-4	63,000	20		50	33.3	16.7	No	0	63,000	7.94E-05	2.65E-05				2.50	
3,3'-Dichlorobenzidine	91-94-1	1,200	30		167	66.7	33.3	No	0				1,200	1.39E-07	2.78E-08	5.57	
Atrazine	1912-24-9	2,400	0.05		167	133	66.7	No	0	19,000	8.79E-04	3.51E-04	2,400	6.96E-08	2.78E-08	3340	
bis(2-Ethylhexyl)phthalate	117-81-7	39,000	20		167	133	66.7	Yes	46	130,000	1.28E-04	5.13E-05	39,000	4.28E-09	1.71E-09	8.35	
Di-n-butyl phthalate	84-74-2	630,000	11		167	133	66.7	Yes	4	630,000	2.65E-05	1.06E-05				15.2	
Hexachlorobutadiene	87-68-3	1,200	9		50	40	20	No	0	7,800	6.41E-04	2.56E-04	1,200	4.17E-08	1.67E-08	5.56	
Hexachlorocyclopentadiene	77-47-4	180	1		500	333	167	No	0	180	2.78E-01	9.28E-02				500	
Hexachloroethane	67-72-1	1,800	24		167	66.7	33.3	No	0	4,500	3.71E-03	7.40E-04	1,800	9.28E-08	1.85E-08	6.96	
2,4,5-Trichlorophenol	95-95-4	630,000		34	36.7	33.3	16.7	No	0	630,000	5.83E-06	2.65E-06					1.08
2,4-Dinitrophenol	51-28-5	130,000		223	1,000	333	167	No	0	13,000	7.69E-03	1.28E-03					4.48
3,3'-Dichlorobenzidine	91-94-1	1,200		31	167	66.7	33.3	No	0				1,200	1.39E-07	2.78E-08		5.39
4-Chloro-3-methylphenol	59-50-7	630,000		5	50	40	20	No	0	630,000	7.94E-06	3.17E-06					10
4-Chloroaniline	106-47-8	2,700		0.9	167	66.7	33.3	No	0	3,200	5.22E-03	1.04E-03	2,700	6.19E-08	1.23E-08		186
4-Nitrophenol	100-02-7	NE		153	500	333	167	No	0								3.27
Atrazine	1912-24-9	2,400		0.3	167	133	66.7	No	0	19,000	8.79E-04	3.51E-04	2,400	6.96E-08	2.78E-08		557
Benzaldehyde	100-52-7	170,000		59	167	66.7	33.3	No	0	780,000	2.14E-05	4.27E-06	170,000	9.82E-10	1.96E-10		2.83
Butylbenzylphthalate	85-68-7	290,000		100	167	133	66.7	Yes	10	1,300,000	1.28E-05	5.13E-06	290,000	5.76E-10	2.30E-10		1.67
Di-n-butylphthalate	84-74-2	630,000		11	167	133	66.7	No	0	630,000	2.65E-05	1.06E-05					15.2
Di-n-octylphthalate	117-84-0	63,000		39	167	133	66.7	Yes	8	63,000	2.65E-04	1.06E-04					4.28
Hexachlorocyclopentadiene	77-47-4	180		6.5	500	333	167	No	0	180	2.78E-01	9.28E-02					77
Hexachloroethane	67-72-1	1,800		27	167	66.7	33.3	No	0	4,500	3.71E-03	7.40E-04	1,800	9.28E-08	1.85E-08		6.19
Pentachlorophenol	87-86-5	1,000		10	167	133	66.7	No	0	25,000	6.68E-04	2.67E-04	1,000	1.67E-07	6.67E-08		16.7
Alpha BHC	319-84-6	86	0.3	0.3	0.83	0.6	0.17	No	0	51,000	1.63E-06	3.33E-07	86	9.65E-09	1.98E-09	2.77	2.77
Beta BHC	319-85-7	300	0.3	300	1	0.9	0.44	No	0				300	3.33E-09	1.47E-09	3.33	0.0033
Endosulfan II*	33213-65-9	47,000	0.9	0.9	2.3	2.2	1.1	No	0	47,000	4.89E-06	2.34E-06				2.56	2.56
Endosulfan Sulfate	1031-07-8	38,000	6.5	0.7	1.7	1.2	0.33	No	0	38,000	4.47E-06	8.68E-07				0.26	2.43
Endrin Ketone*	53494-70-5	1,900	1.9	2.2	2	1.8	0.6	No	0	1,900	1.05E-04	3.16E-05				1.05	0.91
Heptachlor	76-44-8	130	1.6	0.6	0.83	0.62	0.31	No	0	780	1.06E-04	3.97E-05	130	6.38E-09	2.38E-09	0.52	1.38
Heptachlor Epoxide	1024-57-3	70	0.15	2.5	0.83	0.6	0.17	No	0	100	8.30E-04	1.70E-04	70	1.19E-08	2.43E-09	5.53	0.33
Methoxychlor	72-43-5	32,000	2.1	30	6.7	6.5	1.8	Yes	6	32,000	2.09E-05	5.63E-06				3.19	0.22
p,p-DDE	72-55-9	2,000	21	1.4	1.7	1.2	0.33	Yes	37	2,300	7.39E-05	1.43E-05	2,000	8.50E-10	1.65E-10	0.08	1.21
p,p-DDT	50-29-3	1,900	21	1	1.7	1.6	0.79	Yes	45	3,700	4.59E-05	2.14E-05	1,900	8.95E-10	4.16E-10	0.08	1.70
Toxaphene	8001-35-2	490	0.15	0.1	33	28	14	No	0	570	5.79E-03	2.46E-03	490	6.73E-08	2.86E-08	220	330
PCB-1248	12672-29-6	230	7.3	NE	17	10	5.3	Yes	1				230	7.39E-08	2.30E-08	2.33	
Mercury	7439-97-6	1,100	13	180	83	66	25	No	0	1,100	7.55E-03	2.27E-03				6.38	0.46
1,3,5-Trinitrobenzene	99-35-4	220,000	300	15	120	80	32	No	0	220,000	5.45E-05	1.45E-05				0.40	8.0
1,3-Dinitrobenzene	99-65-0	630	34	40	120	80	20	No	0	630	1.90E-02	3.17E-03				3.53	3.0
2,4,6-Trinitrotoluene	118-96-7	3,600	7,500	27	200	196	83	No	0	3,600	5.56E-03	2.31E-03	21,000	9.52E-09	3.95E-09	0.03	7.41
2-Amino-4,6-Dinitrotoluene	35572-78-2	770	14,000	47	200	196	98	No	0	770	2.60E-02	1.27E-02				0.01	4.26
3-Nitrotoluene	99-08-1	630	130	145	150	148	48	No	0	630	2.38E-02	7.62E-03				1.15	1.03
4-Amino-2,6-Dinitrotoluene	19406-51-0	770	12,000	28	120	80	30	No	0	770	1.56E-02	3.90E-03				0.01	4.29
4-Nitrotoluene	99-99-0	25,000	140	145	150	148	54	No	0	25,000	6.00E-04	2.16E-04	34,000	4.41E-09	1.59E-09	1.07	1.03
HMX	2691-41-0	390,000	16,000	108	200	150	71	No	0	390,000	5.13E-05	1.82E-05				0.01	1.85
Nitroglycerin	55-63-0	630	13,000	10	2,400	2,000	760	No	0	630	3.81E-01	1.21E-01	32,000	7.50E-08	2.38E-08	0.18	240
PETN	78-11-5	13,000	2,200	NE	2,400	2,000	1,000	No	0	57,000	4.21E-03	1.75E-03	130,000	1.85E-08	7.69E-09	1.09	
RDX	121-82-4	8,300	2,300	65	120	100	45	No	0	30,000	4.00E-04	1.50E-04	8,300	1.45E-08	5.42E-09	0.05	1.85
Tetryl	479-45-8	16,000	18	NE	150	148	68	No	0	16,000	9.38E-04	4.25E-04				8.33	

Highlighted cells indicate hazard quotient > 1 or cancer risk > 1E-05

NE = Not evaluated; no PSL available for constituent.

*No USEPA Regional Screening Level available, so surrogate compounds were used as basis for selecting human health PSL. Value for endosulfan used for endosulfan II; value for endrin used for endrin ketone.

Blank cell = no cancer or noncancer-based value available; relevant hazard/risk not calculated.

Soil Gas Analytes for which one or more PSLs is lower than the LOQ.

								Human Health VISL, USEPA May 2022					
								Noncancer Hazard			*Cancer Risk*		
Analyte	**CAS Number**	**PSL (µg/m3)**	**LOQ (µg/m^3)**	**LOD (µg/m^3)**	**MDL (µg/m^3)**	**Detected in Past Investigations**	**Number of Detections**	**RSL-NC HI= 0.1 (µg/m^3)**	**Hazard at LoQ**	**Hazard at MDL**	**RSL-C ILCR=10-6 ug/kg**	**Risk at LoQ**	**Risk at MDL**
1,1,2,2-Tetrachloroethane	79-34-5	1.6	3.4	2.1	0.48						1.6	2.1E-06	3.0E-07
1,1,2-Trichloroethane	79-00-5	0.70	2.7	1.6	0.66			0.70	0.4	0.1	5.8	4.6E-07	1.1E-07
1,2,4-Trichlorobenzene	120-82-1	7.0	15	7.4	1.9			7.0	0.2	0.03			
1,2-Dibromoethane (EDB)	106-93-4	0.16	3.8	2.3	0.69			31	0.01	0.002	0.16	2.4E-05	4.4E-06
3-Chloropropene	107-05-1	3.5	6.3	3.1	1.5			3.5	0.2	0.04	16	4.0E-07	9.6E-08
alpha-Chlorotoluene	100-44-7	1.9	2.6	1.6	0.16			3.5	0.08	0.005	1.9	1.4E-06	8.4E-08
Bromodichloromethane	75-27-4	2.5	3.4	2	0.47						2.5	1.3E-06	1.9E-07
Bromomethane	74-83-9	17	19	3.9	1.7			17	0.1	0.01			
Hexachlorobutadiene	87-68-3	4.3	21	11	2.5						4.3	4.9E-06	5.9E-07

Highlighted cells indicate hazard quotient > 1 or cancer risk > 1E-05

PSL = USEPA Vapor Intrusion Screening Level Calculator – Target Sub-Slab and Near-source Soil Gas Concentration (TCR=1E-06 or THQ=0.1, Residential) Csg,Target (µg/m3)
RSL-NC and RSL-C calculated by dividing the RSL by the default soil gas attenuation factor of 0.03.
(USEPA, May 2022); https://epa-visl.ornl.gov/cgi-bin/visl_search
Blank cell = no cancer or noncancer-based value available; relevant hazard/risk not calculated.

APPENDIX M

ANALYTICAL PROJECT LIMITS

Appendix M. Analytical Project Limits

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Groundwater/Surface	Volatile Organic Compounds	8260D_DOD5	5030C	1,1,1-Trichloroethane	71-55-6	1.00	0.600	0.300	µg/L	74	131	20	74	131	20		
				1,1,2,2-Tetrachloroethane	79-34-5	1.00	0.600	0.300	µg/L	71	121	20	71	121	20		
				1,1,2-Trichloroethane	79-00-5	1.00	0.600	0.300	µg/L	80	119	20	80	119	20		
				1,1-Dichloroethane	75-34-3	1.00	0.600	0.300	µg/L	77	125	20	77	125	20		
				1,1-Dichloroethene	75-35-4	1.00	0.600	0.300	µg/L	71	131	20	71	131	20		
				1,2,4-Trichlorobenzene	120-82-1	5.00	1.00	0.300	µg/L	69	130	20	69	130	20		
				1,2-Dibromo-3-Chloropropane	96-12-8	5.00	1.00	0.300	µg/L	62	128	20	62	128	20		
				1,2-Dibromoethane	106-93-4	1.00	0.500	0.200	µg/L	77	121	20	77	121	20		
				1,2-Dichlorobenzene	95-50-1	5.00	0.500	0.200	µg/L	80	119	20	80	119	20		
				1,2-Dichloropropane	78-87-5	1.00	0.600	0.300	µg/L	78	122	20	78	122	20		
				1,3-Dichlorobenzene	541-73-1	5.00	1.40	0.680	µg/L	80	119	20	80	119	20		
				1,4-Dichlorobenzene	106-46-7	5.00	0.600	0.300	µg/L	79	118	20	79	118	20		
				2-Butanone	78-93-3	10.0	1.00	0.500	µg/L	56	143	20	56	143	20		
				2-Hexanone	591-78-6	10.0	1.70	0.850	µg/L	57	139	20	57	139	20		
				4-Methyl-2-pentanone	108-10-1	10.0	1.00	0.500	µg/L	67	130	20	67	130	20		
				Acetone	67-64-1	20.0	2.00	0.700	µg/L	39	160	20	39	160	20		
				Benzene	71-43-2	1.00	0.600	0.300	µg/L	79	120	20	79	120	20		
				Bromodichloromethane	75-27-4	1.00	0.500	0.200	µg/L	79	125	20	79	125	20		
				Bromoform	75-25-2	4.00	2.00	1.00	µg/L	66	130	20	66	130	20		
				Bromomethane	74-83-9	1.00	0.600	0.300	µg/L	53	141	20	53	141	20		
				Carbon disulfide	75-15-0	5.00	0.600	0.300	µg/L	64	133	20	64	133	20		
				Carbon tetrachloride	56-23-5	1.00	0.600	0.300	µg/L	72	136	20	72	136	20		
				Chlorobenzene	108-90-7	1.00	0.600	0.300	µg/L	82	118	20	82	118	20		
				Chloroethane	75-00-3	1.00	0.500	0.200	µg/L	60	138	20	60	138	20		
				Chloroform	67-66-3	1.00	0.600	0.300	µg/L	79	124	20	79	124	20		
				Chloromethane	74-87-3	2.00	1.10	0.550	µg/L	50	139	20	50	139	20		
				cis-1,2-Dichloroethene	156-59-2	1.00	0.600	0.300	µg/L	78	123	20	78	123	20		
				cis-1,3-Dichloropropene	10061-01-5	1.00	0.500	0.200	µg/L	75	124	20	75	124	20		
				Cyclohexane	110-82-7	5.00	2.00	1.00	µg/L	71	130	20	71	130	20		
				Dibromochloromethane	124-48-1	1.00	0.500	0.200	µg/L	74	126	20	74	126	20		
				Dichlorodifluoromethane	75-71-8	1.00	0.500	0.200	µg/L	32	152	20	32	152	20		
				Ethylbenzene	100-41-4	1.00	0.800	0.400	µg/L	79	121	20	79	121	20		
				Freon 113	76-13-1	10.0	0.600	0.300	µg/L	70	136	20	70	136	20		
				Isopropylbenzene	98-82-8	5.00	0.500	0.200	µg/L	72	131	20	72	131	20		
				Methylcyclohexane	108-87-2	5.00	1.00	0.500	µg/L	72	132	20	72	132	20		
				Methyl acetate	79-20-9	5.00	0.600	0.300	µg/L	56	136	20	56	136	20		
				Methyl tertiary butyl ether	1634-04-4	1.00	0.500	0.200	µg/L	71	124	20	71	124	20		
				Methylene Chloride	75-09-2	1.00	0.600	0.300	µg/L	74	124	20	74	124	20		
				Styrene	100-42-5	5.00	0.600	0.300	µg/L	78	123	20	78	123	20		
				Tetrachloroethene	127-18-4	1.00	0.600	0.300	µg/L	74	129	20	74	129	20		
				Toluene	108-88-3	1.00	0.500	0.200	µg/L	80	121	20	80	121	20		
				trans-1,2-Dichloroethene	156-60-5	2.00	1.40	0.700	µg/L	75	124	20	75	124	20		
				trans-1,3-Dichloropropene	10061-02-6	1.00	0.500	0.200	µg/L	73	127	20	73	127	20		
				Trichlorofluoromethane	75-69-4	1.00	0.500	0.200	µg/L	65	141	20	65	141	20		
				Xylenes, Total	1330-20-7	1.00	0.800	0.400	µg/L	79	121	20	79	121	20		
				1,2-Dichloroethane-d4 (Surr)	17060-07-0	5.00	1.00	0.500	µg/L			20			20	81	118
				4-Bromofluorobenzene (Surr)	460-00-4	5.00	1.00	0.500	µg/L			20			20	85	114
				Dibromofluoromethane (Surr)	1868-53-7	5.00	1.00	0.500	µg/L			20			20	80	119
				Toluene-d8 (Surr)	2037-26-5	5.00	1.00	0.500	µg/L			20			20	89	112
Groundwater/Surface Water	Volatile Organic Compounds (GC/MS)	8260D_SIM_DOD5	5030B	Vinyl chloride	75-01-4	0.100	0.0500	0.0140	µg/L	49	150	16	49	150	16		
				1,2-Dichloroethane	107-06-2	0.200	0.0500	0.0160	µg/L	69	123	11	69	123	11		
				Trichloroethene	79-01-6	0.200	0.100	0.0470	µg/L	70	137	10	70	137	10		
				BFB	460-00-4				µg/L								
				Fluorobenzene (IS)	462-06-6				µg/L								
				Toluene-d8 (Surr)	2037-26-5	5.00	0.400	0.130	µg/L							80	120
				1,2-Dichloroethane-d4 (Surr)	17060-07-0	5.00	0.400	0.200	µg/L							65	123
				4-Bromofluorobenzene (Surr)	460-00-4	5.00	0.400	0.170	µg/L							80	120
				Dibromofluoromethane (Surr)	1868-53-7	5.00	0.400	0.190	µg/L							80	120
Groundwater/Surface Water	Semivolatile Organic Compounds (GC/MS)	8270E_DOD5	3510C	1,1'-Biphenyl	92-52-4	2.00	1.00	0.500	µg/L	49	115	20	49	115	20		
				2,2'-oxybis[1-chloropropane]	108-60-1	2.00	1.00	0.500	µg/L	37	130	20	37	130	20		
				2,4,5-Trichlorophenol	95-95-4	2.00	1.40	0.700	µg/L	53	123	20	53	123	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				2,4,6-Trichlorophenol	88-06-2	2.00	1.20	0.600	µg/L	50	125	20	50	125	20		
				2,4-Dichlorophenol	120-83-2	2.00	1.00	0.500	µg/L	47	121	20	47	121	20		
				2,4-Dimethylphenol	105-67-9	2.00	1.00	0.500	µg/L	31	124	20	31	124	20		
				2,4-Dinitrophenol	51-28-5	30.0	20.0	10.0	µg/L	23	143	20	23	143	20		
				2,4-Dinitrotoluene	121-14-2	5.00	2.00	1.00	µg/L	57	128	20	57	128	20		
				2,6-Dinitrotoluene	606-20-2	2.00	1.40	0.700	µg/L	57	124	20	57	124	20		
				2-Chloronaphthalene	91-58-7	1.00	0.800	0.400	µg/L	40	116	20	40	116	20		
				2-Chlorophenol	95-57-8	2.00	1.00	0.500	µg/L	38	117	20	38	117	20		
				2-Methylphenol	95-48-7	2.00	1.40	0.700	µg/L	30	117	20	30	117	20		
				2-Nitroaniline	88-74-4	2.00	1.40	0.700	µg/L	55	127	20	55	127	20		
				2-Nitrophenol	88-75-5	2.00	1.40	0.700	µg/L	47	123	20	47	123	20		
				3,3'-Dichlorobenzidine	91-94-1	5.00	4.00	2.00	µg/L	27	129	20	27	129	20		
				3-Nitroaniline	99-09-2	2.00	1.00	0.500	µg/L	41	128	20	41	128	20		
				4,6-Dinitro-2-methylphenol	534-52-1	15.0	10.0	5.00	µg/L	44	137	20	44	137	20		
				4-Bromophenyl-phenylether	101-55-3	2.00	1.00	0.500	µg/L	55	124	20	55	124	20		
				4-Chloro-3-methylphenol	59-50-7	2.00	1.00	0.500	µg/L	52	119	20	52	119	20		
				4-Chloroaniline	106-47-8	5.00	4.00	2.00	µg/L	33	117	20	33	117	20		
				4-Chlorophenyl-phenyl ether	7005-72-3	2.00	1.00	0.500	µg/L	53	121	20	53	121	20		
				4-Methylphenol	106-44-5	2.00	1.00	0.500	µg/L	25	120	20	25	120	20		
				4-Nitroaniline	100-01-6	2.00	1.20	0.600	µg/L	59	120	30	59	120	30		
				4-Nitrophenol	100-02-7	30.0	20.0	10.0	µg/L	10	121	30	10	121	30		
				Acetophenone	98-86-2	2.00	1.00	0.500	µg/L	46	118	20	46	118	20		
				Atrazine	1912-24-9	5.00	4.00	2.00	µg/L	44	142	20	44	142	20		
				Benzaldehyde	100-52-7	5.00	2.00	1.00	µg/L	58	120	30	58	120	30		
				Butylbenzylphthalate	85-68-7	5.00	4.00	2.00	µg/L	53	134	20	53	134	20		
				Caprolactam	105-60-2	15.0	10.0	5.00	µg/L	16	120	30	16	120	30		
				Carbazole	86-74-8	2.00	1.00	0.500	µg/L	60	122	20	60	122	20		
				Di-n-butyl phthalate	84-74-2	5.00	4.00	2.00	µg/L	59	127	20	59	127	20		
				Di-n-octyl phthalate	117-84-0	5.00	4.00	2.00	µg/L	51	140	20	51	140	20		
				Dibenzofuran	132-64-9	2.00	1.00	0.500	µg/L	53	118	20	53	118	20		
				Diethyl phthalate	84-66-2	5.00	4.00	2.00	µg/L	56	125	20	56	125	20		
				Dimethyl phthalate	131-11-3	5.00	4.00	2.00	µg/L	45	127	20	45	127	20		
				Hexachlorobenzene	118-74-1	0.500	0.200	0.100	µg/L	53	125	20	53	125	20		
				Hexachlorobutadiene	87-68-3	2.00	1.20	0.600	µg/L	22	124	20	22	124	20		
				Hexachlorocyclopentadiene	77-47-4	15.0	10.0	5.00	µg/L	10	83	30	10	83	30		
				Hexachloroethane	67-72-1	5.00	2.00	1.00	µg/L	21	115	20	21	115	20		
				Isophorone	78-59-1	2.00	1.00	0.500	µg/L	42	124	20	42	124	20		
				N-Nitrosodi-n-propylamine	621-64-7	2.00	1.00	0.500	µg/L	49	119	20	49	119	20		
				N-Nitrosodiphenylamine	86-30-6	2.00	1.00	0.500	µg/L	51	123	20	51	123	20		
				Nitrobenzene	98-95-3	2.00	1.60	0.800	µg/L	45	121	20	45	121	20		
				Pentachlorophenol	87-86-5	5.00	2.00	1.00	µg/L	35	138	20	35	138	20		
				Phenol	108-95-2	2.00	1.00	0.500	µg/L	10	132	30	10	132	30		
				Bis(2-chloroethoxy)methane	111-91-1	2.00	1.00	0.500	µg/L	48	120	20	48	120	20		
				Bis(2-chloroethyl)ether	111-44-4	2.00	1.00	0.500	µg/L	43	118	20	43	118	20		
				Bis(2-ethylhexyl) phthalate	117-81-7	5.00	4.00	2.00	µg/L	55	135	20	55	135	20		
				2,4,6-Tribromophenol (Surr)	118-79-6	25.0	20.0	10.0	µg/L			20			20	43	140
				2-Fluorobiphenyl (Surr)	321-60-8	25.0	20.0	10.0	µg/L			20			20	44	119
				2-Fluorophenol (Surr)	367-12-4	25.0	20.0	10.0	µg/L			20			20	19	119
				Nitrobenzene-d5 (Surr)	4165-60-0	25.0	20.0	10.0	µg/L			20			20	44	120
				p-Terphenyl-d14 (Surr)	1718-51-0	25.0	20.0	10.0	µg/L			20			20	50	134
				Phenol-d5 (Surr)	4165-62-2	25.0	20.0	10.0	µg/L			20				10	120
Groundwater/Surface Water	Semivolatile Organic Compounds (GC/MS SIM)	8270E_SIM_DOD5	3510C_LVI	Acenaphthene	83-32-9	0.0500	0.0300	0.0100	µg/L	48	114	20	48	114	20		
				Acenaphthylene	208-96-8	0.0500	0.0300	0.0100	µg/L	35	121	20	35	121	20		
				Anthracene	120-12-7	0.0500	0.0300	0.0100	µg/L	53	119	20	53	119	20		
				Benzo[a]anthracene	56-55-3	0.0500	0.0300	0.0100	µg/L	59	120	20	59	120	20		
				Benzo[b]fluoranthene	205-99-2	0.0500	0.0300	0.0100	µg/L	53	126	20	53	126	20		
				Benzo[k]fluoranthene	207-08-9	0.0500	0.0300	0.0100	µg/L	54	125	20	54	125	20		
				Benzo[g,h,i]perylene	191-24-2	0.0500	0.0300	0.0100	µg/L	44	128	20	44	128	20		
				Benzo[a]pyrene	50-32-8	0.0500	0.0300	0.0100	µg/L	53	120	20	53	120	20		
				Chrysene	218-01-9	0.0500	0.0300	0.0100	µg/L	57	120	20	57	120	20		
				Dibenz(a,h)anthracene	53-70-3	0.0500	0.0400	0.0200	µg/L	44	131	20	44	131	20		
				1,4-Dioxane	123-91-1	0.300	0.200	0.100	µg/L	23	120	20	23	120	20		
				Fluoranthene	206-44-0	0.0500	0.0300	0.0100	µg/L	58	120	20	58	120	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				Fluorene	86-73-7	0.0500	0.0300	0.0100	µg/L	50	118	20	50	118	20		
				Indeno[1,2,3-cd]pyrene	193-39-5	0.0500	0.0400	0.0200	µg/L	48	130	20	48	130	20		
				1-Methylnaphthalene	90-12-0	0.0500	0.0400	0.0200	µg/L	41	115	20	41	115	20		
				2-Methylnaphthalene	91-57-6	0.0500	0.0400	0.0200	µg/L	39	114	20	39	114	20		
				Naphthalene	91-20-3	0.0700	0.0600	0.0300	µg/L	43	114	20	43	114	20		
				Phenanthrene	85-01-8	0.0700	0.0600	0.0300	µg/L	53	115	20	53	115	20		
				Pyrene	129-00-0	0.0500	0.0300	0.0100	µg/L	53	121	20	53	121	20		
				Fluoranthene-d10 (Surr)	93951-69-0	0.200	0.100	0.0250	µg/L			20			20	47	128
				Benzo(a)pyrene-d12 (Surr)	63466-71-7	0.200	0.100	0.0250	µg/L			20			20	10	110
				1-Methylnaphthalene-d10 (Surr)	38072-94-5	0.200	0.100	0.0250	µg/L			20			20	36	111
Groundwater/Surface	Organochlorine Pesticides (GC)	8081B_DOD5	3510C_LVI	Aldrin	309-00-2	0.0200	0.0100	0.00200	µg/L	45	134	30	45	134	30		
				alpha-BHC	319-84-6	0.0200	0.0100	0.00300	µg/L	54	138	30	54	138	30		
				alpha-Chlordane	5103-71-9	0.0200	0.0100	0.00300	µg/L								
				beta-BHC	319-85-7	0.0300	0.0220	0.0110	µg/L	56	136	30	56	136	30		
				delta-BHC	319-86-8	0.0200	0.0100	0.00340	µg/L	52	142	30	52	142	30		
				Dieldrin	60-57-1	0.0300	0.0200	0.00530	µg/L	60	136	30	60	136	30		
				Endosulfan I	959-98-8	0.0200	0.0100	0.00430	µg/L	62	126	30	62	126	30		
				Endosulfan II	33213-65-9	0.0400	0.0200	0.0150	µg/L	52	135	30	52	135	30		
				Endosulfan sulfate	1031-07-8	0.0300	0.0200	0.00580	µg/L	62	133	30	62	133	30		
				Endrin	72-20-8	0.0300	0.0200	0.00810	µg/L	60	138	30	60	138	30		
				Endrin aldehyde	7421-93-4	0.100	0.0600	0.0200	µg/L	51	132	30	51	132	30		
				Endrin ketone	53494-70-5	0.0300	0.0200	0.00500	µg/L	58	134	30	58	134	30		
				gamma-BHC (Lindane)	58-89-9	0.0200	0.0100	0.00200	µg/L	59	134	30	59	134	30		
				gamma-Chlordane	5103-74-2	0.0400	0.0300	0.00700	µg/L								
				Heptachlor	76-44-8	0.0200	0.0100	0.00200	µg/L	54	130	30	54	130	30		
				Heptachlor epoxide	1024-57-3	0.0200	0.0100	0.00230	µg/L	61	133	30	61	133	30		
				Methoxychlor	72-43-5	0.110	0.100	0.0300	µg/L	54	145	30	54	145	30		
				Toxaphene	8001-35-2	1.00	0.600	0.300	µg/L								
				p,p'-DDD	72-54-8	0.0300	0.0200	0.00500	µg/L	56	143	30	56	143	30		
				p,p'-DDE	72-55-9	0.0300	0.0200	0.00500	µg/L	57	135	30	57	135	30		
				p,p'-DDT	50-29-3	0.0300	0.0200	0.00520	µg/L	51	143	30	51	143	30		
				DCB Decachlorobiphenyl (Surr)	2051-24-3	0.0400	0.0300	0.0150	µg/L							32	149
				Tetrachloro-m-xylene (Surr)	877-09-8	0.0400	0.0300	0.0150	µg/L							29	129
Groundwater/Surface Water	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	8082A_DOD5	3510C_LVI	PCB-1016	12674-11-2	0.250	0.200	0.100	µg/L	46	129	30	46	129	30		
				PCB-1221	11104-28-2	0.250	0.200	0.100	µg/L								
				PCB-1232	11141-16-5	0.250	0.200	0.100	µg/L								
				PCB-1242	53469-21-9	0.250	0.200	0.100	µg/L								
				PCB-1248	12672-29-6	0.250	0.200	0.100	µg/L								
				PCB-1254	11097-69-1	0.250	0.200	0.0780	µg/L								
				PCB-1260	11096-82-5	0.250	0.200	0.0780	µg/L	45	134	30	45	134	30		
				DCB Decachlorobiphenyl (Surr)	2051-24-3	0.0400	0.0300	0.0150	µg/L							10	148
				Tetrachloro-m-xylene	877-09-8	0.0400	0.0300	0.0150	µg/L							33	137
Groundwater/Suface	Metals (ICP/MS)	6020B_DOD5	3005A	Aluminum	7429-90-5	30.0	24.0	12.0	µg/L	84	117	20	84	117	20		
				Antimony	7440-36-0	1.00	0.500	0.200	µg/L	85	117	20	85	117	20		
				Arsenic	7440-38-2	2.00	1.70	0.680	µg/L	84	116	20	84	116	20		
				Barium	7440-39-3	2.00	1.60	0.746	µg/L	86	114	20	86	114	20		
				Beryllium	7440-41-7	0.500	0.300	0.119	µg/L	83	121	20	83	121	20		
				Cadmium	7440-43-9	0.500	0.400	0.151	µg/L	87	115	20	87	115	20		
				Calcium	7440-70-2	120	100	50.0	µg/L	87	118	20	87	118	20		
				Chromium	7440-47-3	2.00	0.800	0.334	µg/L	85	116	20	85	116	20		
				Cobalt	7440-48-4	0.500	0.400	0.156	µg/L	85	118	20	86	115	20		
				Copper	7440-50-8	1.00	0.900	0.362	µg/L	85	118	20	85	118	20		
				Iron	7439-89-6	50.0	40.0	20.0	µg/L	87	118	20	87	118	20		
				Lead	7439-92-1	0.500	0.200	0.0710	µg/L	88	115	20	88	115	20		
				Magnesium	7439-95-4	50.0	32.0	16.0	µg/L	83	118	20	83	118	20		
				Manganese	7439-96-5	2.00	1.90	0.950	µg/L	87	115	20	87	115	20		
				Nickel	7440-02-0	1.50	0.800	0.400	µg/L	85	117	20	85	117	20		
				Potassium	7440-09-7	200	180	65.0	µg/L	87	115	20	87	115	20		
				Selenium	7782-49-2	1.00	0.600	0.278	µg/L	80	120	20	80	120	20		
				Silver	7440-22-4	0.500	0.300	0.100	µg/L	85	116	20	85	116	20		
				Sodium	7440-23-5	200	180	90.0	µg/L	85	117	20	85	117	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				Thallium	7440-28-0	0.500	0.300	0.130	µg/L	82	116	20	82	116	20		
				Zinc	7440-66-6	15.0	8.00	4.00	µg/L	83	119	20	83	119	20		
				Vanadium	7440-62-2	4.00	2.00	0.794	µg/L	86	115	20	86	115	20		
Groundwater/Suface	Mercury (CVAA)	7470A_DOD5	7470A_Prep	Mercury	7439-97-6	0.200	0.160	0.0790	µg/L	82	119	20	82	119	20		
Groundwater/Surface Water	Nitroaromatics and Nitramines (HPLC)	8330B_DOD5	8330_P_SPE	HMX	2691-41-0	1.60	1.40	0.700	µg/L	65	135	20	65	135	20		
				RDX	121-82-4	1.40	1.30	0.637	µg/L	68	130	20	68	130	20		
				1,3,5-Trinitrobenzene	99-35-4	1.00	0.920	0.460	µg/L	73	125	20	73	125	20		
				Tetryl	479-45-8	1.60	0.800	0.398	µg/L	64	128	20	64	128	20		
				1,3-Dinitrobenzene	99-65-0	1.00	0.800	0.400	µg/L	78	120	20	78	120	20		
				Nitroglycerin	55-63-0	20.0	15.0	7.54	µg/L	74	127	20	74	127	20		
				2,4,6-Trinitrotoluene	118-96-7	3.70	3.60	1.80	µg/L	71	123	20	71	123	20		
				Nitrobenzene	98-95-3	0.900	0.840	0.400	µg/L	65	134	20	65	134	20		
				4-Amino-2,6-dinitrotoluene	19406-51-0	2.00	1.80	0.920	µg/L	79	125	20	79	125	20		
				2-Amino-4,6-dinitrotoluene	35572-78-2	0.850	0.840	0.426	µg/L	79	120	20	79	120	20		
				2,6-Dinitrotoluene	606-20-2	0.800	0.700	0.350	µg/L	77	127	20	77	127	20		
				2,4-Dinitrotoluene	121-14-2	0.700	0.660	0.330	µg/L	78	120	20	78	120	20		
				PETN	78-11-5	23.0	20.0	10.1	µg/L	73	127	20	73	127	20		
				2-Nitrotoluene	88-72-2	0.900	0.840	0.429	µg/L	70	127	20	70	127	20		
				4-Nitrotoluene	99-99-0	0.900	0.880	0.438	µg/L	71	127	20	71	127	20		
				3-Nitrotoluene	99-08-1	0.800	0.740	0.378	µg/L	73	125	20	73	125	20		
				2-Nitro-m-xylene	81-20-9	5.00	4.00	2.00	µg/L			20			20	68	122
Groundwater	Total Hardness (as CaCO3) by calculation	SM2340B		Hardness as calcium carbonate	STL00009	0.911	0.800	0.405	mg/L								
				Mg	7439-95-4	0.100	0.0751	0.0400	mg/L								
				Ca	7440-70-2	0.200	0.152	0.0960	mg/L								
Groundwater/Surface Water	Alkalinity	2320B		Total Alkalinity as CaCO3 to pH 4.5	STL00171	8.00	6.00	2.60	mg/L	82	106	10	82	106	10		
Groundwater/Surface Water	Sulfide, Total	SM4500_S2_D		Sulfide	18496-25-8	0.300	0.250	0.100	mg/L	90	110	29	90	110	29		
Groundwater/Surfae Water	Anions, Ion Chromatography	9056A_OF_28D_D5		Chloride	16887-00-6	1.50	1.20	0.600	mg/L	87	111	4.0	87	111	4.0		
				Sulfate	14808-79-8	1.50	1.00	0.500	mg/L	87	112	4.1	87	112	4.1		
Groundwater/Surface Water	Organic Carbon, Dissolved (DOC)	SM5310_DOC_C	FIELD_FLTRD	Dissolved Organic Carbon	7440-44-0	1.00	0.900	0.500	mg/L	86	114	10	86	114	20		
				DOC Result 1	STL00345	1.00	0.900	0.500	mg/L								
				DOC Result 2	STL00346	1.00	0.900	0.500	mg/L								
Soil/Sediment	Volatile Organic Compounds	8260D_DOD5	5035FP_Calc	1,1,1-Trichloroethane	71-55-6	5.00	2.00	0.600	µg/Kg	73	130	20	73	130	20		
				1,1,2,2-Tetrachloroethane	79-34-5	5.00	1.00	0.400	µg/Kg	70	124	20	70	124	20		
				1,1,2-Trichloroethane	79-00-5	5.00	2.00	0.500	µg/Kg	78	121	20	78	121	20		
				1,1-Dichloroethane	75-34-3	5.00	2.00	0.500	µg/Kg	76	125	20	76	125	20		
				1,1-Dichloroethene	75-35-4	5.00	2.00	0.500	µg/Kg	70	131	20	70	131	20		
				1,2,4-Trichlorobenzene	120-82-1	10.0	8.00	5.00	µg/Kg	67	129	20	67	129	20		
				1,2-Dibromo-3-Chloropropane	96-12-8	5.00	1.00	0.500	µg/Kg	61	132	20	61	132	20		
				1,2-Dibromoethane	106-93-4	5.00	1.00	0.400	µg/Kg	78	122	20	78	122	20		
				1,2-Dichlorobenzene	95-50-1	5.00	2.00	0.500	µg/Kg	78	121	20	78	121	20		
				1,2-Dichloroethane	107-06-2	5.00	2.00	0.600	µg/Kg	73	128	20	73	128	20		
				1,2-Dichloropropane	78-87-5	5.00	2.00	0.500	µg/Kg	76	123	20	76	123	20		
				1,3-Dichlorobenzene	541-73-1	5.00	2.00	0.500	µg/Kg	77	121	20	77	121	20		
				1,4-Dichlorobenzene	106-46-7	5.00	1.00	0.400	µg/Kg	75	120	20	75	120	20		
				2-Butanone	78-93-3	10.0	4.00	2.00	µg/Kg	51	148	20	51	148	20		
				2-Hexanone	591-78-6	10.0	4.00	1.00	µg/Kg	53	145	20	53	145	20		
				4-Methyl-2-pentanone	108-10-1	10.0	4.00	1.00	µg/Kg	65	135	20	65	135	20		
				Acetone	67-64-1	20.0	16.0	6.00	µg/Kg	36	164	20	36	164	20		
				Benzene	71-43-2	5.00	2.00	0.500	µg/Kg	77	121	20	77	121	20		
				Bromodichloromethane	75-27-4	5.00	1.00	0.400	µg/Kg	75	127	20	75	127	20		
				Bromoform	75-25-2	10.0	8.00	5.00	µg/Kg	67	132	20	67	132	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				Bromomethane	74-83-9	5.00	2.00	0.700	µg/Kg	53	143	20	53	143	20		
				Carbon disulfide	75-15-0	5.00	2.00	0.600	µg/Kg	63	132	20	63	132	20		
				Carbon tetrachloride	56-23-5	5.00	2.00	0.500	µg/Kg	70	135	20	70	135	20		
				Chlorobenzene	108-90-7	5.00	2.00	0.500	µg/Kg	79	120	20	79	120	20		
				Chloroethane	75-00-3	5.00	4.00	1.00	µg/Kg	59	139	20	59	139	20		
				Chloroform	67-66-3	5.00	2.00	0.600	µg/Kg	78	123	20	78	123	20		
				Chloromethane	74-87-3	5.00	2.00	0.600	µg/Kg	50	136	20	50	136	20		
				cis-1,2-Dichloroethene	156-59-2	5.00	2.00	0.500	µg/Kg	77	123	20	77	123	20		
				cis-1,3-Dichloropropene	10061-01-5	5.00	1.00	0.400	µg/Kg	74	126	20	74	126	20		
				Cyclohexane	110-82-7	5.00	2.00	0.500	µg/Kg	67	131	20	67	131	20		
				Dibromochloromethane	124-48-1	5.00	1.00	0.500	µg/Kg	74	126	20	74	126	20		
				Dichlorodifluoromethane	75-71-8	5.00	2.00	0.600	µg/Kg	29	149	20	29	149	20		
				Ethylbenzene	100-41-4	5.00	1.00	0.400	µg/Kg	76	122	20	76	122	20		
				Freon 113	76-13-1	10.0	2.00	0.600	µg/Kg	66	136	20	66	136	20		
				Isopropylbenzene	98-82-8	5.00	1.00	0.400	µg/Kg	68	134	20	68	134	20		
				Methylcyclohexane	108-87-2	5.00	2.00	0.600	µg/Kg	66	133	20	66	133	20		
				Methyl acetate	79-20-9	5.00	4.00	1.00	µg/Kg	53	144	20	53	144	20		
				Methyl tertiary butyl ether	1634-04-4	5.00	2.00	0.500	µg/Kg	73	125	20	73	125	20		
				Methylene Chloride	75-09-2	5.00	4.00	2.00	µg/Kg	70	128	20	70	128	20		
				Styrene	100-42-5	5.00	1.00	0.400	µg/Kg	76	124	20	76	124	20		
				Tetrachloroethene	127-18-4	5.00	2.00	0.500	µg/Kg	73	128	20	73	128	20		
				Toluene	108-88-3	5.00	2.00	0.600	µg/Kg	77	121	20	77	121	20		
				trans-1,2-Dichloroethene	156-60-5	5.00	2.00	0.500	µg/Kg	74	125	20	74	125	20		
				trans-1,3-Dichloropropene	10061-02-6	5.00	1.00	0.500	µg/Kg	71	130	20	71	130	20		
				Trichloroethene	79-01-6	5.00	2.00	0.500	µg/Kg	77	123	20	77	123	20		
				Trichlorofluoromethane	75-69-4	5.00	2.00	0.700	µg/Kg	62	140	20	62	140	20		
				Vinyl chloride	75-01-4	5.00	2.00	0.600	µg/Kg	56	135	20	56	135	20		
				Xylenes, Total	1330-20-7	10.0	2.00	1.40	µg/Kg	78	124	20	78	124	20		
				1,2-Dichloroethane-d4 (Surr)	17060-07-0	5.00	1.00	1.00	µg/Kg							71	136
				4-Bromofluorobenzene (Surr)	460-00-4	5.00	2.00	1.00	µg/Kg							79	119
				Dibromofluoromethane (Surr)	1868-53-7	5.00	2.00	1.00	µg/Kg							78	119
				Toluene-d8 (Surr)	2037-26-5	5.00	2.00	1.00	µg/Kg							85	116
Soil	Semivolatile Organic Compounds (GC/MS)	8270E_DOD5	3546	1,1'-Biphenyl	92-52-4	36.7	33.3	16.7	µg/Kg	40	117	20	40	117	20		
				1,4-Dioxane	123-91-1	333.3	200	100	µg/Kg	15	120	20	15	120	20		
				1-Methylnaphthalene	90-12-0	33.3	20	10	µg/Kg	43	111	20	43	111	20		
				2,2'-oxybis[1-chloropropane]	108-60-1	43.3	40.0	20.0	µg/Kg	33	131	20	33	131	20		
				2,4,5-Trichlorophenol	95-95-4	36.7	33.3	16.7	µg/Kg	41	124	20	41	124	20		
				2,4,6-Trichlorophenol	88-06-2	36.7	33.3	16.7	µg/Kg	39	126	20	39	126	20		
				2,4-Dichlorophenol	120-83-2	43.3	40.0	20.0	µg/Kg	40	122	20	40	122	20		
				2,4-Dimethylphenol	105-67-9	36.7	33.3	16.7	µg/Kg	30	127	20	30	127	20		
				2,4-Dinitrophenol	51-28-5	1000	333	167	µg/Kg	44	109	30	44	109	30		
				2,4-Dinitrotoluene	121-14-2	167	66.7	33.3	µg/Kg	48	126	20	48	126	20		
				2,6-Dinitrotoluene	606-20-2	36.7	33.3	16.7	µg/Kg	46	124	20	46	124	20		
				2-Chloronaphthalene	91-58-7	33.3	26.7	13.3	µg/Kg	41	114	20	41	114	20		
				2-Chlorophenol	95-57-8	36.7	33.3	16.7	µg/Kg	34	121	20	34	121	20		
				2-Methylnaphthalene	91-57-6	16.7	9.99	5.00	µg/Kg	38	122	20	38	122	20		
				2-Methylphenol	95-48-7	50.0	40.0	20.0	µg/Kg	32	122	20	32	122	20		
				2-Nitroaniline	88-74-4	50.0	33.3	16.7	µg/Kg	44	127	20	44	127	20		
				2-Nitrophenol	88-75-5	50.0	40.0	20.0	µg/Kg	36	123	20	36	123	20		
				3,3'-Dichlorobenzidine	91-94-1	167	66.7	33.3	µg/Kg	22	121	20	22	121	20		
				3-Nitroaniline	99-09-2	167	66.7	33.3	µg/Kg	33	119	20	33	119	20		
				4,6-Dinitro-2-methylphenol	534-52-1	500	333	167	µg/Kg	29	132	20	29	132	20		
				4-Bromophenyl-phenylether	101-55-3	36.7	33.3	16.7	µg/Kg	46	124	20	46	124	20		
				4-Chloro-3-methylphenol	59-50-7	50.0	40.0	20.0	µg/Kg	45	122	20	45	122	20		
				4-Chloroaniline	106-47-8	167	66.7	33.3	µg/Kg	17	106	20	17	106	20		
				4-Chlorophenyl-phenyl ether	7005-72-3	36.7	33.3	16.7	µg/Kg	45	121	20	45	121	20		
				4-Methylphenol	106-44-5	50.0	33.3	16.7	µg/Kg	42	126	20	42	126	20		
				4-Nitroaniline	100-01-6	167	66.7	33.3	µg/Kg	59	101	30	59	101	30		
				4-Nitrophenol	100-02-7	500	333	167	µg/Kg	30	132	20	30	132	20		
				Acenaphthene	83-32-9	16.7	6.66	3.33	µg/Kg	40	123	20	40	123	20		
				Acenaphthylene	208-96-8	16.7	8.00	4.00	µg/Kg	32	132	20	32	132	20		
				Acetophenone	98-86-2	50.0	33.3	16.7	µg/Kg	33	115	20	33	115	20		
				Anthracene	120-12-7	16.7	6.66	3.33	µg/Kg	47	123	20	47	123	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				Atrazine	1912-24-9	167	133	66.7	µg/Kg	47	127	20	47	127	20		
				Benzaldehyde	100-52-7	167	66.7	33.3	µg/Kg	25	95	30	25	95	30		
				Benzo[a]anthracene	56-55-3	16.7	13.3	3.33	µg/Kg	49	126	20	49	126	20		
				Benzo[a]pyrene	50-32-8	16.7	6.66	3.33	µg/Kg	45	129	20	45	129	20		
				Benzo[b]fluoranthene	205-99-2	16.7	6.66	3.33	µg/Kg	45	132	20	45	132	20		
				Benzo[g,h,i]perylene	191-24-2	16.7	6.66	3.33	µg/Kg	43	134	20	43	134	20		
				Benzo[k]fluoranthene	207-08-9	16.7	6.66	3.33	µg/Kg	47	132	20	47	132	20		
				Bis(2-chloroethoxy)methane	111-91-1	36.7	33.3	16.7	µg/Kg	36	121	20	36	121	20		
				Bis(2-chloroethyl)ether	111-44-4	36.7	33.3	16.7	µg/Kg	31	120	20	31	120	20		
				Bis(2-ethylhexyl) phthalate	117-81-7	167	133	66.7	µg/Kg	51	133	20	51	133	20		
				Butylbenzylphthalate	85-68-7	167	133	66.7	µg/Kg	48	132	20	48	132	20		
				Caprolactam	105-60-2	167	66.7	33.3	µg/Kg	46	117	20	46	117	20		
				Carbazole	86-74-8	36.7	33.3	16.7	µg/Kg	50	123	20	50	123	20		
				Chrysene	218-01-9	16.7	6.66	3.33	µg/Kg	50	124	20	50	124	20		
				Dibenz(a,h)anthracene	53-70-3	16.7	13.3	6.67	µg/Kg	45	134	20	45	134	20		
				Dibenzofuran	132-64-9	36.7	33.3	16.7	µg/Kg	44	120	20	44	120	20		
				Diethyl phthalate	84-66-2	167	133	66.7	µg/Kg	50	124	20	50	124	20		
				Dimethyl phthalate	131-11-3	167	133	66.7	µg/Kg	48	124	20	48	124	20		
				Di-n-butyl phthalate	84-74-2	167	133	66.7	µg/Kg	51	128	20	51	128	20		
				Di-n-octyl phthalate	117-84-0	167	133	66.7	µg/Kg	45	140	20	45	140	20		
				Fluoranthene	206-44-0	16.7	6.66	3.33	µg/Kg	50	127	20	50	127	20		
				Fluorene	86-73-7	16.7	6.66	3.33	µg/Kg	43	125	20	43	125	20		
				Hexachlorobenzene	118-74-1	16.7	13.3	6.67	µg/Kg	45	122	20	45	122	20		
				Hexachlorobutadiene	87-68-3	50.0	40.0	20.0	µg/Kg	32	123	20	32	123	20		
				Hexachlorocyclopentadiene	77-47-4	500	333	167	µg/Kg	43	118	30	43	118	30		
				Hexachloroethane	67-72-1	167	66.7	33.3	µg/Kg	28	117	20	28	117	20		
				Indeno[1,2,3-cd]pyrene	193-39-5	16.7	8.00	4.00	µg/Kg	45	133	20	45	133	20		
				Isophorone	78-59-1	66.7	33.3	16.7	µg/Kg	30	122	20	30	122	20		
				Naphthalene	91-20-3	16.7	13.3	6.67	µg/Kg	35	123	20	35	123	20		
				Nitrobenzene	98-95-3	36.7	33.3	16.7	µg/Kg	34	122	20	34	122	20		
				N-Nitrosodi-n-propylamine	621-64-7	66.7	50.0	33.3	µg/Kg	36	120	20	36	120	20		
				N-Nitrosodiphenylamine	86-30-6	36.7	33.3	16.7	µg/Kg	38	127	20	38	127	20		
				Pentachlorophenol	87-86-5	167	133	66.7	µg/Kg	25	133	20	25	133	20		
				Phenanthrene	85-01-8	16.7	8.00	4.00	µg/Kg	50	121	20	50	121	20		
				Phenol	108-95-2	36.7	33.3	16.7	µg/Kg	34	121	20	34	121	20		
				Pyrene	129-00-0	16.7	6.66	3.33	µg/Kg	47	127	20	47	127	20		
				2,4,6-Tribromophenol (Surr)	118-79-6	208	167	83.3	µg/Kg			20			20	39	132
				2-Fluorobiphenyl (Surr)	321-60-8	208	167	83.3	µg/Kg			20			20	44	115
				2-Fluorophenol (Surr)	367-12-4	208	167	83.3	µg/Kg			20			20	35	115
				Nitrobenzene-d5 (Surr)	4165-60-0	208	167	83.3	µg/Kg			20			20	37	122
				Phenol-d5 (Surr)	4165-62-2	208	167	83.3	µg/Kg						20	33	122
				p-Terphenyl-d14 (Surr)	1718-51-0	208	167	83.3	µg/Kg			20			20	54	127
Sediment	Semivolatile Organic Compounds (GC/MS)	8270E_DOD5	3546	1,1'-Biphenyl	92-52-4	36.7	33.3	16.7	µg/Kg	40	117	20	40	117	20		
				2,2'-oxybis[1-chloropropane]	108-60-1	43.3	40.0	20.0	µg/Kg	33	131	20	33	131	20		
				2,4,5-Trichlorophenol	95-95-4	36.7	33.3	16.7	µg/Kg	41	124	20	41	124	20		
				2,4,6-Trichlorophenol	88-06-2	36.7	33.3	16.7	µg/Kg	39	126	20	39	126	20		
				2,4-Dichlorophenol	120-83-2	43.3	40.0	20.0	µg/Kg	40	122	20	40	122	20		
				2,4-Dimethylphenol	105-67-9	36.7	33.3	16.7	µg/Kg	30	127	20	30	127	20		
				2,4-Dinitrophenol	51-28-5	1000	333	167	µg/Kg	44	109	30	44	109	30		
				2,4-Dinitrotoluene	121-14-2	167	66.7	33.3	µg/Kg	48	126	20	48	126	20		
				2,6-Dinitrotoluene	606-20-2	36.7	33.3	16.7	µg/Kg	46	124	20	46	124	20		
				2-Chloronaphthalene	91-58-7	33.3	26.7	13.3	µg/Kg	41	114	20	41	114	20		
				2-Chlorophenol	95-57-8	36.7	33.3	16.7	µg/Kg	34	121	20	34	121	20		
				2-Methylphenol	95-48-7	50.0	40.0	20.0	µg/Kg	32	122	20	32	122	20		
				2-Nitroaniline	88-74-4	50.0	33.3	16.7	µg/Kg	44	127	20	44	127	20		
				2-Nitrophenol	88-75-5	50.0	40.0	20.0	µg/Kg	36	123	20	36	123	20		
				3,3'-Dichlorobenzidine	91-94-1	167	66.7	33.3	µg/Kg	22	121	20	22	121	20		
				3-Nitroaniline	99-09-2	167	66.7	33.3	µg/Kg	33	119	20	33	119	20		
				4,6-Dinitro-2-methylphenol	534-52-1	500	333	167	µg/Kg	29	132	20	29	132	20		
				4-Bromophenyl-phenylether	101-55-3	36.7	33.3	16.7	µg/Kg	46	124	20	46	124	20		
				4-Chloro-3-methylphenol	59-50-7	50.0	40.0	20.0	µg/Kg	45	122	20	45	122	20		
				4-Chloroaniline	106-47-8	167	66.7	33.3	µg/Kg	17	106	20	17	106	20		
				4-Chlorophenyl-phenyl ether	7005-72-3	36.7	33.3	16.7	µg/Kg	45	121	20	45	121	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				4-Methylphenol	106-44-5	50.0	33.3	16.7	µg/Kg	42	126	20	42	126	20		
				4-Nitroaniline	100-01-6	167	66.7	33.3	µg/Kg	59	101	30	59	101	30		
				4-Nitrophenol	100-02-7	500	333	167	µg/Kg	30	132	20	30	132	20		
				Acetophenone	98-86-2	50.0	33.3	16.7	µg/Kg	33	115	20	33	115	20		
				Atrazine	1912-24-9	167	133	66.7	µg/Kg	47	127	20	47	127	20		
				Benzaldehyde	100-52-7	167	66.7	33.3	µg/Kg	25	95	30	25	95	30		
				Bis(2-chloroethoxy)methane	111-91-1	36.7	33.3	16.7	µg/Kg	36	121	20	36	121	20		
				Bis(2-chloroethyl)ether	111-44-4	36.7	33.3	16.7	µg/Kg	31	120	20	31	120	20		
				Bis(2-ethylhexyl) phthalate	117-81-7	167	133	66.7	µg/Kg	51	133	20	51	133	20		
				Butylbenzylphthalate	85-68-7	167	133	66.7	µg/Kg	48	132	20	48	132	20		
				Caprolactam	105-60-2	167	66.7	33.3	µg/Kg	46	117	20	46	117	20		
				Carbazole	86-74-8	36.7	33.3	16.7	µg/Kg	50	123	20	50	123	20		
				Dibenzofuran	132-64-9	36.7	33.3	16.7	µg/Kg	44	120	20	44	120	20		
				Diethyl phthalate	84-66-2	167	133	66.7	µg/Kg	50	124	20	50	124	20		
				Dimethyl phthalate	131-11-3	167	133	66.7	µg/Kg	48	124	20	48	124	20		
				Di-n-butyl phthalate	84-74-2	167	133	66.7	µg/Kg	51	128	20	51	128	20		
				Di-n-octyl phthalate	117-84-0	167	133	66.7	µg/Kg	45	140	20	45	140	20		
				Hexachlorobenzene	118-74-1	16.7	13.3	6.67	µg/Kg	45	122	20	45	122	20		
				Hexachlorobutadiene	87-68-3	50.0	40.0	20.0	µg/Kg	32	123	20	32	123	20		
				Hexachlorocyclopentadiene	77-47-4	500	333	167	µg/Kg	43	118	30	43	118	30		
				Hexachloroethane	67-72-1	167	66.7	33.3	µg/Kg	28	117	20	28	117	20		
				Isophorone	78-59-1	66.7	33.3	16.7	µg/Kg	30	122	20	30	122	20		
				Nitrobenzene	98-95-3	36.7	33.3	16.7	µg/Kg	34	122	20	34	122	20		
				N-Nitrosodi-n-propylamine	621-64-7	66.7	50.0	33.3	µg/Kg	36	120	20	36	120	20		
				N-Nitrosodiphenylamine	86-30-6	36.7	33.3	16.7	µg/Kg	38	127	20	38	127	20		
				Pentachlorophenol	87-86-5	167	133	66.7	µg/Kg	25	133	20	25	133	20		
				Phenol	108-95-2	36.7	33.3	16.7	µg/Kg	34	121	20	34	121	20		
				2,4,6-Tribromophenol (Surr)	118-79-6	208	167	83.3	µg/Kg			20			20	39	132
				2-Fluorobiphenyl (Surr)	321-60-8	208	167	83.3	µg/Kg			20			20	44	115
				2-Fluorophenol (Surr)	367-12-4	208	167	83.3	µg/Kg			20			20	35	115
				Nitrobenzene-d5 (Surr)	4165-60-0	208	167	83.3	µg/Kg			20			20	37	122
				Phenol-d5 (Surr)	4165-62-2	208	167	83.3	µg/Kg						20	33	122
				p-Terphenyl-d14 (Surr)	1718-51-0	208	167	83.3	µg/Kg			20			20	54	127
Sediment	Semivolatile Organic Compounds (GC/MS SIM)	8270E_SIM_DOD5	3546	Acenaphthene	83-32-9	1.67	1.33	0.667	µg/Kg	44	111	20	44	111	20		
				Acenaphthylene	208-96-8	1.67	1.33	0.333	µg/Kg	39	116	20	39	116	20		
				Anthracene	120-12-7	1.67	1.33	0.667	µg/Kg	50	114	20	50	114	20		
				Benzo[a]anthracene	56-55-3	1.67	1.33	0.667	µg/Kg	54	122	20	54	122	20		
				Benzo[b]fluoranthene	205-99-2	1.67	1.33	0.667	µg/Kg	53	128	20	53	128	20		
				Benzo[k]fluoranthene	207-08-9	1.67	1.33	0.667	µg/Kg	56	123	20	56	123	20		
				Benzo[g,h,i]perylene	191-24-2	1.67	1.33	0.667	µg/Kg	49	127	20	49	127	20		
				Benzo[a]pyrene	50-32-8	1.67	1.33	0.667	µg/Kg	50	125	20	50	125	20		
				Chrysene	218-01-9	1.67	1.33	0.333	µg/Kg	57	118	20	57	118	20		
				Dibenz(a,h)anthracene	53-70-3	1.67	1.33	0.667	µg/Kg	50	129	20	50	129	20		
				1,4-Dioxane	123-91-1	3.33	2.67	1.33	µg/Kg	15	120	20	15	120	20		
				Fluoranthene	206-44-0	1.67	1.33	0.667	µg/Kg	55	119	20	55	119	20		
				Fluorene	86-73-7	1.67	1.33	0.667	µg/Kg	47	114	20	47	114	20		
				Indeno[1,2,3-cd]pyrene	193-39-5	1.67	1.33	0.667	µg/Kg	49	130	20	49	130	20		
				1-Methylnaphthalene	90-12-0	1.67	1.33	0.667	µg/Kg	43	111	20	43	111	20		
				2-Methylnaphthalene	91-57-6	3.33	2.67	1.33	µg/Kg	39	114	20	39	114	20		
				Naphthalene	91-20-3	3.33	2.67	1.33	µg/Kg	38	111	20	38	111	20		
				Phenanthrene	85-01-8	2.33	2.00	1.00	µg/Kg	49	113	20	49	113	20		
				Pyrene	129-00-0	1.67	1.33	0.667	µg/Kg	55	117	20	55	117	20		
				Fluoranthene-d10 (Surr)	93951-69-0	1.67	0.833	0.208	µg/Kg			20			20	22	152
				Benzo(a)pyrene-d12 (Surr)	63466-71-7	1.67	0.833	0.208	µg/Kg			20			20	19	133
				1-Methylnaphthalene-d10 (Surr)	38072-94-5	1.67	0.833	0.208	µg/Kg			20			20	26	123
Soil/Sediment	Organochlorine Pesticides (GC)	8081B_DOD5	3546	Aldrin	309-00-2	0.830	0.600	0.170	µg/Kg	45	136	30	45	136	30		
				alpha-BHC	319-84-6	0.830	0.600	0.170	µg/Kg	45	137	30	45	137	30		
				alpha-Chlordane	5103-71-9	0.830	0.600	0.170	µg/Kg								
				beta-BHC	319-85-7	1.00	0.900	0.440	µg/Kg	50	136	30	50	136	30		
				delta-BHC	319-86-8	1.00	0.900	0.450	µg/Kg	47	137	30	47	137	30		
				Dieldrin	60-57-1	1.70	1.20	0.330	µg/Kg	56	136	30	56	136	30		
				Endosulfan I	959-98-8	0.830	0.600	0.220	µg/Kg	53	132	30	53	132	30		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				Endosulfan II	33213-65-9	2.30	2.20	1.10	µg/Kg	53	134	30	53	134	30		
				Endosulfan sulfate	1031-07-8	1.70	1.20	0.330	µg/Kg	55	136	30	55	136	30		
				Endrin	72-20-8	1.70	1.20	0.680	µg/Kg	57	140	30	57	140	30		
				Endrin aldehyde	7421-93-4	1.70	1.20	0.330	µg/Kg	35	137	30	35	137	30		
				Endrin ketone	53494-70-5	2.00	1.80	0.600	µg/Kg	55	136	30	55	136	30		
				gamma-BHC (Lindane)	58-89-9	0.830	0.600	0.210	µg/Kg	49	135	30	49	135	30		
				gamma-Chlordane	5103-74-2	0.830	0.600	0.250	µg/Kg								
				Heptachlor	76-44-8	0.830	0.620	0.310	µg/Kg	47	136	30	47	136	30		
				Heptachlor epoxide	1024-57-3	0.830	0.600	0.170	µg/Kg	52	136	30	52	136	30		
				Methoxychlor	72-43-5	6.70	5.90	1.80	µg/Kg	52	143	30	52	143	30		
				Toxaphene	8001-35-2	33.0	28.0	14.0	µg/Kg								
				p,p'-DDD	72-54-8	1.70	1.60	0.330	µg/Kg	56	139	30	56	139	30		
				p,p'-DDE	72-55-9	1.70	1.20	0.330	µg/Kg	56	134	30	56	134	30		
				p,p'-DDT	50-29-3	1.70	1.20	0.790	µg/Kg	50	141	30	50	141	30		
				DCB Decachlorobiphenyl (Surr)	2051-24-3				µg/Kg							46	152
				Tetrachloro-m-xylene (Surr)	877-09-8				µg/Kg							19	136
Soil/Sediment	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	8082A_DOD5	3546	PCB-1016	12674-11-2	17.0	10.0	5.30	µg/Kg	47	134	30	47	134	30		
				PCB-1221	11104-28-2	17.0	10.0	5.30	µg/Kg								
				PCB-1232	11141-16-5	17.0	10.0	5.30	µg/Kg								
				PCB-1242	53469-21-9	17.0	10.0	5.30	µg/Kg								
				PCB-1248	12672-29-6	17.0	10.0	5.30	µg/Kg								
				PCB-1254	11097-69-1	17.0	10.0	6.40	µg/Kg								
				PCB-1260	11096-82-5	17.0	10.0	6.40	µg/Kg	53	140	30	53	140	30		
				DCB Decachlorobiphenyl (Surr)	2051-24-3	2.00	2.00	1.00	µg/Kg			30			30	66	130
				Tetrachloro-m-xylene	877-09-8	2.00	2.00	1.00	µg/Kg			30			30	44	130
Soil/Sediment	Metals (ICP/MS)	6020B_DOD5	3050B	Aluminum	7429-90-5	10.0	9.00	4.37	mg/Kg	78	124	20	78	124	20		
				Antimony	7440-36-0	0.100	0.0800	0.0400	mg/Kg	72	124	20	72	124	20		
				Arsenic	7440-38-2	0.200	0.160	0.0669	mg/Kg	82	118	20	82	118	20		
				Barium	7440-39-3	0.200	0.180	0.0915	mg/Kg	86	116	20	86	116	20		
				Beryllium	7440-41-7	0.0500	0.0250	0.0119	mg/Kg	80	120	20	80	120	20		
				Cadmium	7440-43-9	0.0500	0.0400	0.0200	mg/Kg	84	116	20	84	116	20		
				Calcium	7440-70-2	20.0	19.6	9.80	mg/Kg	86	118	20	86	118	20		
				Chromium	7440-47-3	0.200	0.150	0.0769	mg/Kg	83	119	20	83	119	20		
				Cobalt	7440-48-4	0.100	0.0500	0.0200	mg/Kg	84	115	20	84	115	20		
				Copper	7440-50-8	0.200	0.150	0.0440	mg/Kg	84	119	20	84	119	20		
				Iron	7439-89-6	10.0	9.00	4.61	mg/Kg	81	124	20	81	124	20		
				Lead	7439-92-1	0.100	0.0800	0.0380	mg/Kg	84	118	20	84	118	20		
				Magnesium	7439-95-4	5.00	4.00	1.57	mg/Kg	80	123	20	80	123	20		
				Manganese	7439-96-5	0.250	0.200	0.106	mg/Kg	85	116	20	85	116	20		
				Nickel	7440-02-0	0.200	0.160	0.0814	mg/Kg	84	119	20	84	119	20		
				Potassium	7440-09-7	20.0	16.0	9.52	mg/Kg	85	119	20	85	119	20		
				Selenium	7782-49-2	0.200	0.100	0.0500	mg/Kg	80	119	20	80	119	20		
				Silver	7440-22-4	0.0500	0.0400	0.0203	mg/Kg	83	118	20	83	118	20		
				Sodium	7440-23-5	25.0	20.0	10.0	mg/Kg	79	125	20	79	125	20		
				Thallium	7440-28-0	0.0500	0.0400	0.0196	mg/Kg	83	118	20	83	118	20		
				Zinc	7440-66-6	15.0	4.00	2.00	mg/Kg	82	119	20	82	119	20		
				Vanadium	7440-62-2	0.400	0.200	0.100	mg/Kg	82	119	20	82	116	20		
Soil/Sediment	Mercury (CVAA)	7471B_DOD5	7471B_Prep	Mercury	7439-97-6	0.0600	0.0400	0.0200	mg/Kg	80	124	20	80	124	20		
Soil/Sediment	Nitroaromatics and Nitramines (HPLC)	8330B_D5_DryWt	8330_P_Sonc	HMX	2691-41-0	200	150	71.0	µg/Kg	74	124	20	74	124	20		
				RDX	121-82-4	120	100	45.0	µg/Kg	67	129	20	67	129	20		
				1,3,5-Trinitrobenzene	99-35-4	120	80.0	32.0	µg/Kg	80	116	20	80	116	20		
				Tetryl	479-45-8	150	148	68.0	µg/Kg	68	135	20	68	135	20		
				1,3-Dinitrobenzene	99-65-0	120	80.0	20.0	µg/Kg	73	119	20	73	119	20		
				Nitroglycerin	55-63-0	2400	2000	760	µg/Kg	73	124	20	73	124	20		
				2,4,6-Trinitrotoluene	118-96-7	200	196	83.0	µg/Kg	71	120	20	71	120	20		
				Nitrobenzene	98-95-3	120	80.0	22.0	µg/Kg	67	129	20	67	129	20		
				4-Amino-2,6-dinitrotoluene	19406-51-0	120	80.0	30.0	µg/Kg	64	127	20	64	127	20		
				2-Amino-4,6-dinitrotoluene	35572-78-2	200	196	98.0	µg/Kg	71	123	20	71	123	20		
				2,6-Dinitrotoluene	606-20-2	150	148	47.0	µg/Kg	79	117	20	79	117	20		

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				2,4-Dinitrotoluene	121-14-2	120	80.0	36.0	µg/Kg	75	121	20	75	121	20		
				PETN	78-11-5	2400	2000	1000	µg/Kg	72	128	20	72	128	20		
				2-Nitrotoluene	88-72-2	150	148	74.0	µg/Kg	70	124	20	70	124	20		
				4-Nitrotoluene	99-99-0	150	148	54.0	µg/Kg	71	124	20	71	124	20		
				3-Nitrotoluene	99-08-1	150	148	48.0	µg/Kg	67	129	20	67	129	20		
				2-Nitro-m-xylene	81-20-9	600	500	250	µg/Kg			20			20	79	149
Soil/Sediment	Dioxins and Furans (HRGC/HRMS)	8290A_DOD5	8290_P_Sox	1,2,3,4,6,7,8-HpCDD	35822-46-9	0.005	0.004	0.002	µg/Kg	76	125	20	76	125	20		
				1,2,3,4,6,7,8-HpCDF	67562-39-4	0.005	0.004	0.002	µg/Kg	73	135	20	73	135	20		
				1,2,3,4,7,8-HxCDD	39227-28-6	0.005	0.004	0.002	µg/Kg	72	131	20	72	131	20		
				1,2,3,4,7,8-HxCDF	70648-26-9	0.005	0.004	0.002	µg/Kg	77	130	20	77	130	20		
				1,2,3,4,7,8,9-HpCDF	55673-89-7	0.005	0.004	0.002	µg/Kg	72	131	20	72	131	20		
				1,2,3,6,7,8-HxCDD	57653-85-7	0.005	0.004	0.002	µg/Kg	74	134	20	74	134	20		
				1,2,3,6,7,8-HxCDF	57117-44-9	0.005	0.004	0.002	µg/Kg	73	134	20	73	134	20		
				1,2,3,7,8-PeCDD	40321-76-4	0.005	0.004	0.002	µg/Kg	74	125	20	74	125	20		
				1,2,3,7,8-PeCDF	57117-41-6	0.005	0.004	0.002	µg/Kg	77	131	20	77	131	20		
				1,2,3,7,8,9-HxCDD	19408-74-3	0.005	0.004	0.002	µg/Kg	71	138	20	71	138	20		
				1,2,3,7,8,9-HxCDF	72918-21-9	0.005	0.004	0.002	µg/Kg	74	135	20	74	135	20		
				2,3,4,6,7,8-HxCDF	60851-34-5	0.005	0.004	0.002	µg/Kg	74	133	20	74	133	20		
				2,3,4,7,8-PeCDF	57117-31-4	0.005	0.004	0.002	µg/Kg	75	128	20	75	128	20		
				2,3,7,8-TCDD	1746-01-6	0.001	0.0008	0.0002	µg/Kg	70	128	20	70	128	20		
				2,3,7,8-TCDF	51207-31-9	0.001	0.0008	0.0002	µg/Kg	75	135	20	75	135	20		
				OCDD	3268-87-9	0.01	0.008	0.002	µg/Kg	73	135	20	73	135	20		
				OCDF	39001-02-0	0.01	0.008	0.002	µg/Kg	66	144	20	66	144	20		
				Total HxCDD	34465-46-8	0.005	0.004	0.002	µg/Kg								
				Total HxCDF	55684-94-1	0.005	0.004	0.002	µg/Kg								
				Total HpCDD	37871-00-4	0.005	0.004	0.002	µg/Kg								
				Total HpCDF	38998-75-3	0.005	0.004	0.002	µg/Kg								
				Total PeCDD	36088-22-9	0.005	0.004	0.002	µg/Kg								
				Total PeCDF	30402-15-4	0.005	0.004	0.002	µg/Kg								
				Total TCDD	41903-57-5	0.001	0.0008	0.0002	µg/Kg								
				Total TCDF	30402-14-3	0.001	0.0008	0.0002	µg/Kg								
				Total PCDD/PCDF	STL02693	0.001	0.0008	0.0002	µg/Kg								
				Total PCDD	STL02731	0.001	0.0008	0.0002	µg/Kg								
				Total PCDF	STL02732	0.001	0.0008	0.0002	µg/Kg								
				13C-OCDF	109719-78-0	0.4	0.2	0.1	µg/Kg								
				13C-OCDD	114423-97-1	0.4	0.2	0.1	µg/Kg								
				13C-2,3,7,8-TCDF	89059-46-1	0.2	0.1	0.05	µg/Kg								
				13C-2,3,7,8-TCDD	76523-40-5	0.2	0.1	0.05	µg/Kg								
				13C-2,3,4,7,8-PeCDF	116843-02-8	0.2	0.1	0.05	µg/Kg								
				13C-2,3,4,6,7,8-HxCDF	116843-05-1	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,7,8,9-HxCDF	116843-04-0	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,7,8,9-HxCDD	109719-82-6	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,7,8-PeCDF	109719-77-9	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,7,8-PeCDD	109719-79-1	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,6,7,8-HxCDF	116843-03-9	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,6,7,8-HxCDD	109719-81-5	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,4,7,8,9-HpCDF	109719-94-0	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,4,7,8-HxCDF	114423-98-2	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,4,7,8-HxCDD	109719-80-4	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,4,6,7,8-HpCDF	109719-84-8	0.2	0.1	0.05	µg/Kg								
				13C-1,2,3,4,6,7,8-HpCDD	109719-83-7	0.2	0.1	0.05	µg/Kg								
				13C-1,2,7,8-TCDD	STL02690	0.2	0.1	0.05	µg/Kg								
Soil/Sediment	Grain Size	D422		Gravel	STL00581				%								
				Sand	STL00582				%								
				Silt	STL00586				%								
				Clay	STL00587				%								
				75 mm	STL00567				% Passing								
				37.5 mm	STL00569				% Passing								
				19 mm	STL00571				% Passing								
				4.75 mm	STL00573				% Passing								
				3.35 mm	STL02756				% Passing								
				2.36 mm	STL02755				% Passing								
				1.18 mm	STL02754				% Passing								

Appendix M. Analytical Project Limits

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				0.6 mm	STL02753				% Passing								
				0.3 mm	STL02752				% Passing								
				0.15 mm	STL01175				% Passing								
				0.064 mm	STL02829				% Passing								
				0.05 mm	STL02830				% Passing								
				0.02 mm	STL02831				% Passing								
				0.005 mm	STL02832				% Passing								
				0.002 mm	STL02833				% Passing								
				0.001 mm	STL02834				% Passing								
				0.075 mm	STL00579				% Passing								
Soil/Sediment	Organic Carbon, Total (TOC)	9060A		Total Organic Carbon	7440-44-0	300	200	100	mg/Kg	50	153	20	50	153	20		
Soil/Sediment - Cation Exchange Capacity (Sub)	Cation Exchange Capacity (CEC)	9081	9081_Prep	Cation Exchange Capacity	STL00090	0.0500			meq/100gm								
Soil/Sediment	Oxidation-Reduction Potential	D1498_14	DI_LEACH_NP	Oxidation Reduction Potential	STL00289	10.0	10.0	10.0	mV	98	102	20					
Soil/Sediment	pH	9045D	DI_LEACH_NP	pH	STL00204	0.0100	0.0100	0.0100	S.U.	95	105	4					
Soil/Sediment	Total, Fixed, and Volatile Solids	2540G		Percent Moisture	STL00177	0.100	0.100	0.100	%	94	108						
				Total Solids	STL00291	0.100	0.100	0.100	%	94	108						
				Fixed Solids	STL00072	0.100	0.100	0.100	%	94	108						
				Total Volatile Solids	STL00236	0.100	0.100	0.100	%	94	108						
				Percent Solids	STL00234	0.100	0.100	0.100	%	94	108						
Air/Vapor	Volatile Organic Compounds	TO-15		1,1,1-Trichloroethane	71-55-6	2.7	1.6	0.33	µg/m^3								
				1,1,2,2-Tetrachloroethane	79-34-5	3.4	2.1	0.48	µg/m^3								
				1,1,2-Trichloroethane	79-00-5	2.7	1.6	0.66	µg/m^3								
				1,1-Dichloroethane	75-34-3	2	1.2	0.32	µg/m^3								
				1,1-Dichloroethene	75-35-4	2	1.2	0.52	µg/m^3								
				1,2,4-Trichlorobenzene	120-82-1	15	7.4	1.9	µg/m^3								
				1,2,4-Trimethylbenzene	95-63-6	2.4	1.5	0.44	µg/m^3								
				1,2-Dibromoethane (EDB)	106-93-4	3.8	2.3	0.69	µg/m^3								
				1,2-Dichlorobenzene	95-50-1	3	1.8	0.42	µg/m^3								
				1,2-Dichloroethane	107-06-2	2	1.2	0.32	µg/m^3								
				1,2-Dichloropropane	78-87-5	2.3	1.4	0.79	µg/m^3								
				1,3,5-Trimethylbenzene	108-67-8	2.4	1.5	0.25	µg/m^3								
				1,3-Butadiene	106-99-0	1.1	0.66	0.24	µg/m^3								
				1,3-Dichlorobenzene	541-73-1	3	1.8	0.6	µg/m^3								
				1,4-Dichlorobenzene	106-46-7	3	1.8	0.42	µg/m^3								
				1,4-Dioxane	123-91-1	7.2	3.6	1.2	µg/m^3								
				2,2,4-Trimethylpentane	540-84-1	2.3	1.4	0.6	µg/m^3								
				2-Butanone (Methyl Ethyl Ketone)	78-93-3	5.9	2.9	1.12	µg/m^3								
				2-Hexanone	591-78-6	8.2	4.1	1.52	µg/m^3								
				2-Propanol	67-63-0	4.9	2.5	0.81	µg/m^3								
				3-Chloropropene	107-05-1	6.3	3.1	1.5	µg/m^3								
				4-Ethyltoluene	622-96-8	2.4	1.5	0.44	µg/m^3								
				4-Methyl-2-pentanone	108-10-1	2	1.2	0.7	µg/m^3								
				Acetone	67-64-1	12	2.4	1	µg/m^3								
				alpha-Chlorotoluene	100-44-7	2.6	1.6	0.16	µg/m^3								
				Benzene	71-43-2	1.6	0.96	0.064	µg/m^3								
				Bromodichloromethane	75-27-4	3.4	2	0.47	µg/m^3								
				Bromoform	75-25-2	5.2	3.1	0.62	µg/m^3								
				Bromomethane	74-83-9	19	3.9	1.7	µg/m^3								
				Carbon Disulfide	75-15-0	6.2	3.1	0.7	µg/m^3								
				Carbon Tetrachloride	56-23-5	3.1	1.9	0.38	µg/m^3								
				Chlorobenzene	108-90-7	2.3	1.4	0.32	µg/m^3								
				Chloroethane	75-00-3	5.3	2.6	0.87	µg/m^3								
				Chloroform	67-66-3	2.4	1.5	0.39	µg/m^3								

Appendix M. Analytical Project Limits

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				Chloromethane	74-87-3	10	2.1	0.93	µg/m^3								
				cis-1,2-Dichloroethene	156-59-2	2	1.2	0.63	µg/m^3								
				cis-1,3-Dichloropropene	10061-01-5	2.3	1.4	0.36	µg/m^3								
				Cumene	98-82-8	2.4	1.5	0.3	µg/m^3								
				Cyclohexane	110-82-7	1.7	1	0.52	µg/m^3								
				Dibromochloromethane	124-48-1	4.2	2.6	0.68	µg/m^3								
				Ethanol	64-17-5	3.8	1.9	1.9	µg/m^3								
				Ethyl Benzene	100-41-4	2.2	1.3	0.13	µg/m^3								
				Freon 11	75-69-4	2.8	1.7	0.67	µg/m^3								
				Freon 113	76-13-1	3.8	2.3	0.61	µg/m^3								
				Freon 114	76-14-2	3.5	2.1	0.42	µg/m^3								
				Freon 12	75-71-8	2.5	1.5	0.4	µg/m^3								
				Heptane	142-82-5	2	1.2	0.53	µg/m^3								
				Hexachlorobutadiene	87-68-3	21	11	2.5	µg/m^3								
				Hexane	110-54-3	1.8	1.1	0.25	µg/m^3								
				m,p-Xylene	108-38-3	2.2	1.3	0.17	µg/m^3								
				Methyl tert-butyl ether	1634-04-4	7.2	3.6	0.69	µg/m^3								
				Methylene Chloride	75-09-2	17	3.5	0.66	µg/m^3								
				o-Xylene	95-47-6	2.2	1.3	0.22	µg/m^3								
				Propylbenzene	103-65-1	2.4	1.5	0.55	µg/m^3								
				Styrene	100-42-5	2.1	1.3	0.09	µg/m^3								
				Tetrachloroethene	127-18-4	3.4	2	0.75	µg/m^3								
				Tetrahydrofuran	109-99-9	1.5	0.88	0.32	µg/m^3								
				Toluene	108-88-3	1.9	1.1	0.08	µg/m^3								
				trans-1,2-Dichloroethene	156-60-5	2	1.2	0.71	µg/m^3								
				trans-1,3-Dichloropropene	10061-02-6	2.3	1.4	0.36	µg/m^3								
				Trichloroethene	79-01-6	2.7	1.6	0.7	µg/m^3								
				Vinyl Chloride	75-01-4	1.3	0.77	0.33	µg/m^3								
Air/Vapor	Methane and Helium	ASTM 1946		Methane	74-82-8	0.0001	0.00005	0.000028	%								
				Helium	7440-59-7	0.05	0.0039	0.0012	%								
Liquid IDW	PFAS for QSM 5.4, Table B-15	PFC_IDA_D5.3	3535_PFC	Perfluorohexanoic acid	307-24-4	0.002	0.001	0.0005	µg/L	72	129	30	72	129	30		
				Perfluoroheptanoic acid	375-85-9	0.002	0.001	0.0005	µg/L	72	130	30	72	130	30		
				Perfluorooctanoic acid	335-67-1	0.002	0.001	0.0005	µg/L	71	133	30	71	133	30		
				Perfluorononanoic acid	375-95-1	0.002	0.001	0.0005	µg/L	69	130	30	69	130	30		
				Perfluorodecanoic acid	335-76-2	0.002	0.001	0.0005	µg/L	71	129	30	71	129	30		
				Perfluorotridecanoic acid	72629-94-8	0.002	0.001	0.0005	µg/L	65	144	30	65	144	30		
				Perfluorotetradecanoic acid	376-06-7	0.002	0.001	0.0005	µg/L	71	132	30	71	132	30		
				Perfluorobutanesulfonic acid	375-73-5	0.002	0.001	0.0005	µg/L	72	130	30	72	130	30		
				Perfluorohexanesulfonic acid	355-46-4	0.002	0.001	0.0005	µg/L	68	131	30	68	131	30		
				Perfluorooctanesulfonic acid	1763-23-1	0.0021	0.00	0.00	µg/L	65	140	30	65	140	30		
				NEtFOSAA	2991-50-6	0.003	0.001	0.0005	µg/L	61	135	30	61	135	30		
				NMeFOSAA	2355-31-9	0.002	0.0012	0.0006	µg/L	65	136	30	65	136	30		
				M2-4:2 FTS	STL02395	0.002	0.001	0.0005	µg/L			30			30		
				M2-8:2 FTS	STL02280	0.003	0.002	0.001	µg/L			30			30		
				M2-6:2 FTS	STL02279	0.005	0.004	0.002	µg/L			30			30		
				Perfluoropentanesulfonic acid	2706-91-4	0.002	0.001	0.0005	µg/L	71	127	30	71	127	30		
				Perfluoroheptanesulfonic acid	375-92-8	0.002	0.001	0.0005	µg/L	69	134	30	69	134	30		
				Perfluorononanesulfonic acid	68259-12-1	0.002	0.001	0.0005	µg/L	69	127	30	69	127	30		
				Perfluorodecanesulfonic acid	335-77-3	0.002	0.001	0.0005	µg/L	53	142	30	53	142	30		
				Perfluorooctanesulfonamide	754-91-6	0.002	0.0014	0.0007	µg/L	67	137	30	67	137	30		
				Perfluorobutanoic acid	375-22-4	0.005	0.004	0.002	µg/L	73	129	30	73	129	30		
				Perfluoropentanoic acid	2706-90-3	0.002	0.001	0.0005	µg/L	72	129	30	72	129	30		
				13C5 PFHxA	STL02577	0.002	0.001	0.0005	µg/L			30			30		
				13C4 PFHpA	STL01892	0.002	0.001	0.0005	µg/L			30			30		
				13C8 PFOA	STL01052	0.002	0.001	0.0005	µg/L			30			30		
				13C9 PFNA	STL02578	0.002	0.001	0.0005	µg/L			30			30		
				13C6 PFDA	STL02579	0.002	0.001	0.0005	µg/L			30			30		
				13C7 PFUnA	STL02580	0.002	0.001	0.0005	µg/L			30			30		
				13C2-PFDoDA	STL02703	0.002	0.001	0.0005	µg/L			30			30		
				13C2 PFTeDA	STL02116	0.003	0.001	0.0005	µg/L			30			30		

Appendix M. Analytical Project Limits

Limits for Project: 41006018 - Former Stewart Air Force Base

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	LOQ	LOD	MDL	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
				13C3 PFBS	STL02337	0.002	0.001	0.0005	µg/L			30			30		
				13C3 PFHxS	STL02581	0.002	0.001	0.0005	µg/L			30			30		
				13C8 PFOS	STL01054	0.002	0.001	0.0005	µg/L			30			30		
				d3-NMeFOSAA	STL02118	0.002	0.0012	0.0006	µg/L			30			30		
				d5-NEtFOSAA	STL02117	0.003	0.001	0.0005	µg/L			30			30		
				13C8 FOSA	STL01056	0.002	0.001	0.0005	µg/L			30			30		
				13C4 PFBA	STL00992	0.005	0.004	0.002	µg/L			30			30		
				13C5 PFPeA	STL01893	0.002	0.001	0.0005	µg/L			30			30		
				Perfluoroundecanoic acid	2058-94-8	0.002	0.001	0.0005	µg/L	69	133	30	69	133	30		
				Perfluorododecanoic acid	307-55-1	0.002	0.001	0.0005	µg/L	72	134	30	72	134	30		
				6:2 Fluorotelomer sulfonic acid	27619-97-2	0.0081	0.008	0.004	µg/L	64	140	30	64	140	30		
				8:2 Fluorotelomer sulfonic acid	39108-34-4	0.003	0.002	0.001	µg/L	67	138	30	67	138	30		
				4:2 Fluorotelomer sulfonic acid	757124-72-4	0.002	0.001	0.0005	µg/L	63	143	30	63	143	30		
Solid IDW	PFAS for QSM 5.4, Table B-15	PFC_IDA_D5.3	Extract_Aliquot/Shake_SonicBath	Perfluorohexanoic acid	307-24-4	0.0006	0.0004	0.0002	mg/Kg	70	132	30	70	132	30		
				Perfluoroheptanoic acid	375-85-9	0.0006	0.0004	0.0002	mg/Kg	71	131	30	71	131	30		
				Perfluorooctanoic acid	335-67-1	0.0006	0.0004	0.0002	mg/Kg	69	133	30	69	133	30		
				Perfluorononanoic acid	375-95-1	0.0006	0.0004	0.0002	mg/Kg	72	129	30	72	129	30		
				Perfluorodecanoic acid	335-76-2	0.0006	0.0004	0.0002	mg/Kg	69	133	30	69	133	30		
				Perfluorotridecanoic acid	72629-94-8	0.0006	0.0004	0.0002	mg/Kg	66	139	30	66	139	30		
				Perfluorotetradecanoic acid	376-06-7	0.0006	0.0004	0.0002	mg/Kg	69	133	30	69	133	30		
				Perfluorobutanesulfonic acid	375-73-5	0.002	0.0016	0.0004	mg/Kg	72	128	30	72	128	30		
				Perfluorohexanesulfonic acid	355-46-4	0.0006	0.0004	0.0002	mg/Kg	67	130	30	67	130	30		
				Perfluorooctanesulfonic acid	1763-23-1	0.0006	0.0004	0.0002	mg/Kg	68	136	30	68	136	30		
				NEtFOSAA	2991-50-6	0.002	0.0004	0.0002	mg/Kg	61	139	30	61	139	30		
				NMeFOSAA	2355-31-9	0.002	0.0004	0.0002	mg/Kg	63	144	30	63	144	30		
				M2-4:2 FTS	STL02395	0.0022	0.0018	0.0006	mg/Kg								
				M2-8:2 FTS	STL02280	0.0033	0.0018	0.0006	mg/Kg								
				M2-6:2 FTS	STL02279	0.0022	0.0018	0.0006	mg/Kg								
				Perfluoropentanesulfonic acid	2706-91-4	0.003	0.0004	0.0002	mg/Kg	73	123	30	73	123	30		
				Perfluoroheptanesulfonic acid	375-92-8	0.0006	0.0004	0.0002	mg/Kg	70	132	30	70	132	30		
				Perfluorononanesulfonic acid	68259-12-1	0.0006	0.0004	0.0002	mg/Kg	69	125	30	69	125	30		
				Perfluorodecanesulfonic acid	335-77-3	0.0006	0.0004	0.0002	mg/Kg	59	134	30	59	134	30		
				Perfluorooctanesulfonamide	754-91-6	0.0006	0.0004	0.0002	mg/Kg	67	137	30	67	137	30		
				Perfluorobutanoic acid	375-22-4	0.002	0.0016	0.0006	mg/Kg	71	135	30	71	135	30		
				Perfluoropentanoic acid	2706-90-3	0.0006	0.0004	0.0002	mg/Kg	69	132	30	69	132	30		
				13C5 PFHxA	STL02577	0.0006	0.0004	0.0002	mg/Kg								
				13C4 PFHpA	STL01892	0.0006	0.0004	0.0002	mg/Kg								
				13C8 PFOA	STL01052	0.0006	0.0004	0.0002	mg/Kg								
				13C9 PFNA	STL02578	0.0006	0.0004	0.0002	mg/Kg								
				13C6 PFDA	STL02579	0.0006	0.0004	0.0002	mg/Kg								
				13C7 PFUnA	STL02580	0.0006	0.0004	0.0002	mg/Kg								
				13C2-PFDoDA	STL02703	0.0006	0.0004	0.0002	mg/Kg								
				13C2 PFTeDA	STL02116	0.0006	0.0004	0.0002	mg/Kg								
				13C3 PFBS	STL02337	0.0022	0.0018	0.0004	mg/Kg								
				13C3 PFHxS	STL02581	0.0006	0.0004	0.0002	mg/Kg								
				13C8 PFOS	STL01054	0.0006	0.0004	0.0002	mg/Kg								
				d3-NMeFOSAA	STL02118	0.0022	0.0004	0.0002	mg/Kg								
				d5-NEtFOSAA	STL02117	0.0022	0.0004	0.0002	mg/Kg								
				13C8 FOSA	STL01056	0.0006	0.0004	0.0002	mg/Kg								
				13C4 PFBA	STL00992	0.0022	0.0018	0.0006	mg/Kg								
				13C5 PFPeA	STL01893	0.0006	0.0004	0.0002	mg/Kg								
				Perfluoroundecanoic acid	2058-94-8	0.0006	0.0004	0.0002	mg/Kg	64	136	30	64	136	30		
				Perfluorododecanoic acid	307-55-1	0.0006	0.0004	0.0002	mg/Kg	69	135	30	69	135	30		
				6:2 Fluorotelomer sulfonic acid	27619-97-2	0.002	0.0016	0.0006	mg/Kg	64	140	30	64	140	30		
				8:2 Fluorotelomer sulfonic acid	39108-34-4	0.003	0.0016	0.0006	mg/Kg	65	137	30	65	137	30		
				4:2 Fluorotelomer sulfonic acid	757124-72-4	0.002	0.0016	0.0006	mg/Kg	62	145	30	62	145	30		