FINAL

Remedial Investigation Work Plan

Uniform Federal Policy
Quality Assurance Project Plan

at
Schenectady Air National Guard Base
Scotia, New York

National Guard Bureau,
Logistics and Installations Directorate, Operations Division,
Restoration Branch
NGB/A4OR

Compliance Restoration Program
Project No. ANG2015NEWENGLAND

Contract No. W9133L-14-D-0008, DO 0005

May 2016

Final
Remedial Investigation Work Plan

Uniform Federal Policy
Quality Assurance Project Plan

ZZ007, TU008, and TU009 at
Schenectady Air National Guard Base
Scotia, New York

Prepared for:

National Guard Bureau,

Logistics and Installations Directorate,
Operations Division, Restoration Branch
NGB/A4OR

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903

Contract Number W9133L-14-D-0008, Delivery Order 0005

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EXECUTIVE SUMMARY

This Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) is the Work Plan (WP) for the Remedial Investigation (RI) at the Schenectady Air National Guard Base (ANGB), Scotia, New York. The purpose of the UFP-QAPP is to be the comprehensive site-specific planning and guidance document to govern the field sampling, field analysis, and environmental laboratory analysis for the work contracted under this delivery order (DO) for the Air National Guard (ANG). This document will be utilized by the field sampling team and the laboratory analytical team to ensure this effort meets the specified project quality objectives (PQOs) for the DO. This project is contracted by the National Guard Bureau (NGB), Logistics and Installations Directorate, Operations Division, Restoration Branch (A4OR) under Contract W9133L-14-D-0008, DO 0005 in support of the Newly Eligible Restoration Sites (NERS) Remedial Investigations/Feasibility Studies (RI/FS) at Multiple Air National Guard Installations New England Region. The Accident Prevention Plan (APP) is **Appendix F** of the UFP-QAPP.

The objectives of the RI are to develop a Conceptual Site Model (CSM) in support of a human health and ecological risk assessment (when necessary) that will quantify the risk associated with chemicals that have been released into the environment from Schenectady ANGB activities at ZZ007, TU008 and TU009; and to determine if those risks are acceptable in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and regulations of the New York State Department of Environmental Conservation (NYSDEC). If risks are acceptable, the RI will recommend a No Further Response Action Planned (NFRAP) decision. If the risks are not acceptable, the RI will recommend the development of remedial alternatives in a CERCLA Feasibility Study (FS).

DESCRIPTION OF SITES

The RI will be conducted at three sites, ZZ007, TU008 and TU009 that are a former maintenance building, a building with an underground storage tank (UST), and an UST associated with a former waste water treatment plant (WWTP). Previous investigations at ZZ007 have indicated that groundwater is impacted by metals. Previous investigations at TU008 have indicated that groundwater is impacted by volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Previous investigations at TU009 have indicated that groundwater is impacted by SVOCs and metals.

SUMMARY

This UFP-QAPP outlines the organization, project management and objectives, planned activities, measurement/data acquisition, assessment/oversight, and data review procedures associated with RI activities. This UFP-QAPP specifies requirements for field work related to field operations, the collection of soil and groundwater samples at Schenectady ANGB, and field and laboratory analyses of soil and groundwater. This UFP-QAPP includes the worksheets required by the Uniform Federal Policy for Quality Assurance Project Plans guidance. Appendices include the following:

- Appendix A – Kickoff Meeting Minutes
- Appendix B – Relevant Records Files
- Appendix C – Field Standard Operating Procedures (SOPs)
- Appendix D – Field Forms
- Appendix E – Laboratory SOPs
- Appendix F – Accident Prevention Plan

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ACRONYMS AND ABBREVIATIONS

%	percent
%R	percent recovery
°C	degrees Celsius
µg/kg	microgram per kilogram
µg/L	microgram per liter
>	greater than
<	less than
≥	greater than or equal to
≤	less than or equal to
±	plus or minus
109th CES	109th Civil Engineering Squadron
A4OR	Logistics and Installations Directorate, Operations Division, Restoration Branch
AFCEC	Air Force Civil Engineer Center
amsl	above mean sea level
ANG	Air National Guard
ANGB	Air National Guard Base
AOC	area of concern
APP	Accident Prevention Plan
BB&E	BB&E Consulting Engineers and Professionals
BEM Systems	Balanced Environmental Management Systems
BFB	4-bromofluorobenzene
bgs	below ground surface
CA	Corrective Action
CAS	Chemical Abstract Service
CCB	continuing calibration blank
CCV	continuing calibration verification
CES	Civil Engineering Squadron
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLLE	continuous liquid/liquid extraction
CLP	Contract Laboratory Program
COC	chain-of-custody
COPC	chemical of potential concern
CP-51	Commissioner Policy 51
CPR	Cardiopulmonary Resuscitation

ACRONYMS AND ABBREVIATIONS (Continued)

CRP	Compliance Restoration Program
CSM	Conceptual Site Model
CVAA	Cold Vapor Atomic Absorption
CVOC	chlorinated volatile organic compound
CWET	California Wet Leach Procedure
DCV	daily calibration verification
DER	Division of Environmental Remediation
DDT	dichlorodiphenyl trichloroethane
DFTPP	decafluorotriphenylphosphine
DI	deionized
DL	detection limit
DO	Delivery Order
DoD	Department of Defense
DOT	Department of Transportation
DQI	data quality indicator
DQO	data quality objective
ECL	Environmental Conservation Law
EDD	Electronic Data Deliverable
EICP	Extracted Ion Current Profile
ELAP	Environmental Laboratory Accreditation Program
EM	Environmental Manager
EOS	edible oil substrate
ERPIMS	Environmental Resources Program Information Management System
ERPToolsX	ERPIMS portal application
FER	Final Engineering Report
FID	flame ionization detector
FS	Feasibility Study
ft	feet
GC	Gas Chromatograph
GC/MS	gas chromatography/mass spectrometer
GPR	ground penetrating radar
GW	groundwater
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	hydrochloric acid

ACRONYMS AND ABBREVIATIONS (Continued)

HDPE	High Density Polyethylene
HI	Hazard Index
HNO3	Nitric Acid
HRS	Hazard Ranking System
HSA	hollow-stem-auger
ICAL	initial calibration
ICB	initial calibration blank
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICS	Interference Check Solutions
ICV	initial calibration verification
ID	identifier
IDQTF	Intergovernmental Data Quality Task Force
IDQTF	Intergovernmental Data Quality Task Force
IDW	investigation-derived waste
IRA	Interim Remedial Action
IRP	Installation Restoration Program
IS	Internal Standard
ISCO	in-situ chemical oxidation
L	liter
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LocID	Location Identifier
LOD	limit of detection
LOQ	limit of quantitation
LTCR	Lifetime Cancer Risk
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mL	milliliter
MPC	Measurement Performance Criteria
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MW	monitoring well
N/A	not applicable
NCP	National Contingency Plan
NERS	Newly Eligible Restoration Sites
NFA	no further action

ACRONYMS AND ABBREVIATIONS (Continued)

NFRAP	no further response action planned
NGB	National Guard Bureau
NGB/A4OR	National Guard Bureau Logistics and Installations Directorate, Operations Division, Restoration Branch
No.	Number
NP	not published
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
ORP	oxidation-reduction potential
oz.	ounce
PA/SI	Preliminary Assessment/Site Inspection
PAL	project action limit
PDS	post digestion spike
pH	Measure of acidity/basicity in aqueous solution
PID	photoionization detector
PM	Project Manager
ppb	parts per billion
ppm	parts per million
PQO	project quality objective
PVC	polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QSM	Quality System Manual
r	linear regression value
RAC	Remedial Action Completion
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
Res	residential
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
ROD	Record of Decision
RPD	relative percent difference
RRT	relative retention times

ACRONYMS AND ABBREVIATIONS (Continued)

RSD	relative standard deviation
RSL	regional screening level
S/N	signal to noise
SB	soil boring
SDG	sample delivery group
SI	Site Inspection
SOP	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
SSHP	Site Safety and Health Plan
SVOCs	semivolatile organic compound
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
SWL	static water level
TAD	TestAmerica – Denver
TAGM	Technical and Administrative Guidance Memorandum
TAS	TestAmerica – Seattle
TASL	TestAmerica – St. Louis
TCLP	toxicity characteristic leaching procedure
TEC-Weston JV	TEC-Weston Joint Venture
TestAmerica	TestAmerica Laboratories, Inc.
THQ	target hazard quotient
TOGS	Technical & Operational Guidance Series
TR	target risk level
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
USDA	U.S. Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VMF	Vehicle Maintenance Facility
VOA	volatile organic analysis
VOC	volatile organic compound
WP	Work Plan
WWTP	Wastewater Treatment Plant
ZHE	zero headspace extraction

WORKSHEETS #1 AND #2 TITLE AND APPROVAL PAGE

Remedial Investigation Work Plan
Uniform Federal Policy Quality Assurance Project Plan

at
Schenectady Air National Guard Base
Scotia, New York
Contract No. W9133L-14-D-0008, DO 0005

Prepared for:

National Guard Bureau
Logistics and Installations Directorate,
Operations Division, Restoration Branch
NGB/A4OR

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903

May 2016

Reviewed by: ______________________________

TEC-Weston JV Project Manager Signature/ Date
Joseph P. Gross, P.E., TEC-Weston JV Project Manager

____

TEC-Weston JV Quality Manager Signature/ Date
Jim Brackett, P.E., PMP, TEC-Weston JV Quality Manager

Approved by: ______________________________

National Guard Bureau, Program Manager Signature/Date
Jody Murata, NGB/A4OR Program Manager

Project Name/Number:	Remedial Investigation Work Plan Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Schenectady Air National Guard Base (ANGB) Scotia, New York ANG2015NEWENGLAND
Operable Units:	Former Building 13 Area (ZZ007), Former Heating Oil Underground Storage Tank (UST) #41 at Former Building 4 (TU008), and Wastewater Treatment Plant (WWTP) Bypass UST near Installation Restoration Program (IRP) Site 6 (TU009).
Contractor Name:	TEC-Weston Joint Venture
Contract Number:	W9133L-14-D-0008, Delivery Order 0005

1. This UFP-QAPP was prepared in accordance with the requirements of:	▪ *Uniform Federal Policy for Quality Assurance Project Plans Optimized UFP-QAPP Worksheets* (United States Environmental Protection Agency [USEPA], 2012) ▪ UFP-QAPP *guidance* (USEPA, 2005a; 2005b, 2005c) ▪ *Guidance for Quality Assurance Project Plans, EPA QA/G-5, ,* (USEPA, 2002) ▪ *Environmental Restoration Program Air National Guard Investigation Guidance* (ANG, 2009)
2. Identify regulatory program(s):	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
3. Identify regulatory Agency(ies):	New York State Department of Environmental Conservation
4. This UFP-QAPP is a:	Project-specific document to provide detailed information on the execution of the field program for the Remedial Investigation/Feasibility Study (RI/FS) or Decision Document at Schenectady ANGB, Scotia, New York.
5. List dates of scoping sessions that were or will be held:	November 5, 2015
6. List dates and titles of any UFP-QAPP documents written for previous site work that are relevant to the current investigation:	Not applicable
7. List organization(s):	National Guard Bureau, Logistics and Installations Directorate, Operations Division, Restoration Branch
8. If any required UFP-QAPP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted UFP-QAPP elements and provide an explanation for their exclusion:	All required elements are included in this UFP-QAPP.

WORKSHEETS #3 AND #5 PROJECT ORGANIZATION AND UFP-QAPP DISTRIBUTION

Table 3-1 identifies key project personnel for the lead organization and regulating authorities that will receive a complete copy of the UFP-QAPP, including future updates, change pages and/or addenda.

Table 3-1 Distribution List

Name of UFP-QAPP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Stanley Moore	Contracting Officer's Representative	NGB/A4OR	240-612-8504	stanley.j.moore6.civ@mail.mil
Jody Murata	Program Manager	NGB/A4OR	240-612-8120	jody.a.murata.civ@mail.mil
Jennifer Kotch	Installation Environmental Manager	109th AW Schenectady ANGB	518-344-2341	jennifer.kotch@us.af.mil
Lt. Col. Robert Donaldson	Base Civil Engineer	109th CES Schenectady ANGB	518-344-2568	robert.e.donaldson2.mil@mail.mil
Veronica Allen	Surveillance and Oversight Contractor	BB&E	248-489-9636, ext. 304	vallen@bbande.com
John Swartwout	Section Chief, State Regulator	NYSDEC	518-402-9620	john.swartwout@dec.ny.gov
Brian Jankauskas	State Regulator	NYSDEC	518-402-9626	brian.jankauskas@dec.ny.gov
Kate Bartz	Program Manager	TEC-Weston JV	520-326-0951	kate.bartz@cardno-gs.com
Ken Swain	Remediation Program Manager	TEC-Weston JV	434-295-4446	kenneth.swain@cardno-gs.com
Jim Brackett	Quality Manager	TEC-Weston JV	303-273-0231	jim.brackett@cardno-gs.com
Heather Miner	Project Chemist	TEC-Weston JV	303-273-0231	heather.miner@cardno-gs.com
Joseph Gross	Project Manager	TEC-Weston JV	410-612-5910	joseph.gross@westonsolutions.com
Krista Richardson	Installation Lead	TEC-Weston JV	417-719-4834	krista.richardson@westonsolutions.com
Brenden Beaumont	Field Team Leader	TEC-Weston JV	410-612-5964	brenden.beaumont@westonsolutions.com

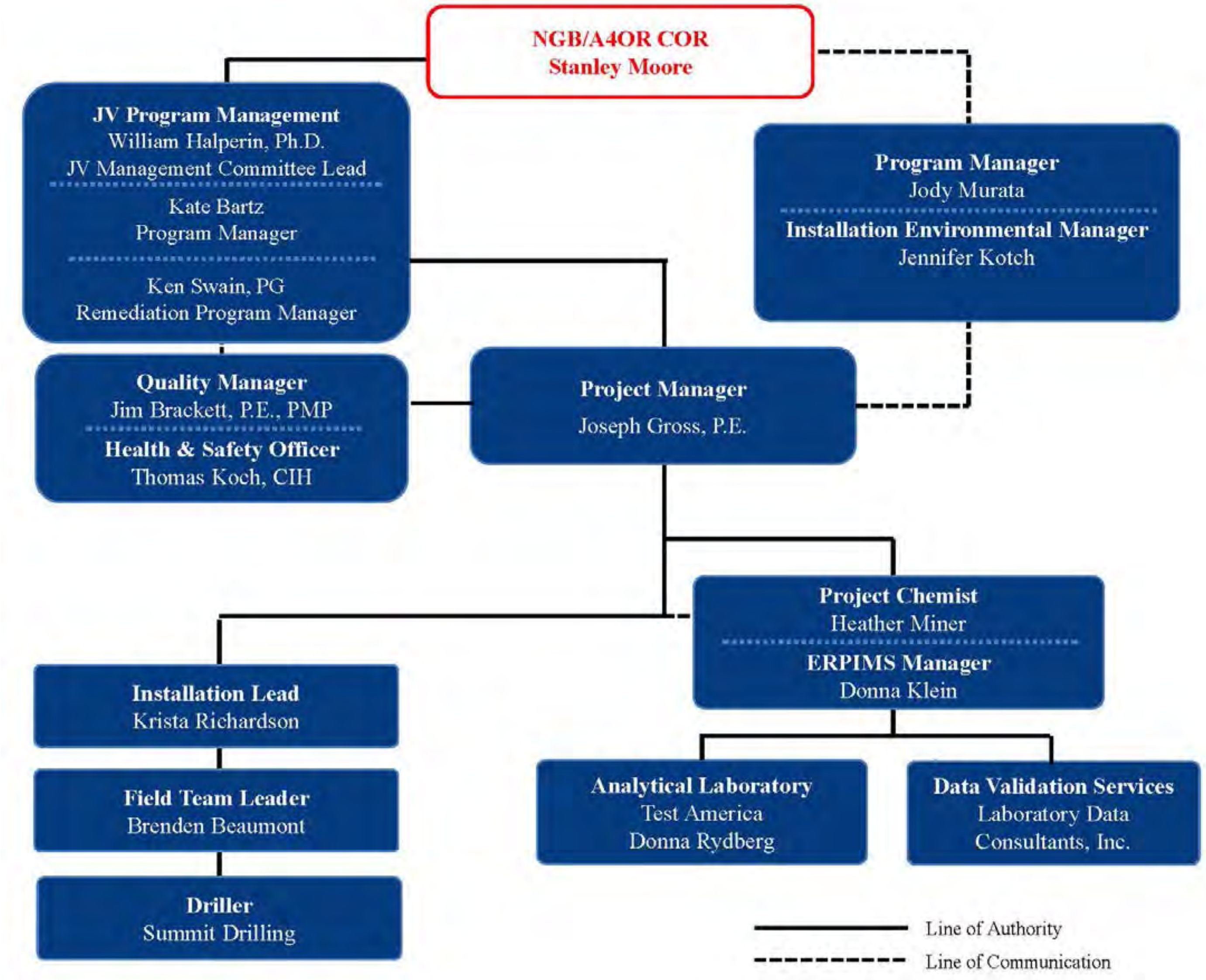
Table 3-1 Distribution List (Continued)

Name of UFP-QAPP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Tom Koch	Health and Safety Officer	TEC-Weston JV	303-273-0231	thomas.koch@cardno-gs.com
Pei Geng	Data Validator	Laboratory Data Consultants, Inc.	760-827-1100	pgeng@lab-data.com
Donna Klein	ERPIMS Database Manager	TEC-Weston JV	210-248-2480	donna.klein@westonsolutions.com
William Cicero	Laboratory Director	TestAmerica	303-736-0123	william.cicero@testamericainc.com
Donna Rydberg	Laboratory Project Manager	TestAmerica	303-736-0192	donna.rydberg@testamericinc.com

Notes:

109th AW – 109th Airlift Wing
109th CES – 109th Civil Engineering Squadron
BB&E – BB&E Consulting Engineers and Professionals
ERPIMS - Environmental Resources Program Information Management System
NGB/A4OR – National Guard Bureau, Logistics and Installations Directorate, Operations Division, Restoration Branch
NYSDEC – New York State Department of Environmental Conservation
TEC-Weston JV – TEC-Weston Joint Venture
TestAmerica – TestAmerica Laboratories, Inc.
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan

The chart below details the organizational structure of the project and includes the lead organization, contractors, and subcontractors involved in the project.



WORKSHEETS #4, #7, AND #8 PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

This worksheet identifies key project personnel, their responsibilities and qualifications, and specialized training/certifications required by the project. The table below documents that all key project personnel performing work have read the applicable sections of this UFP-QAPP and will perform the tasks as described.

Table 4-1 Project Personnel Sign-Off Sheet

Name	Title	Organization	Telephone Number	Signature/Email Receipt	Date UFP-QAPP Reviewed
Jim Brackett	Quality Manager	TEC-Weston JV	303-273-0231		5/17/2016
Kate Bartz	Program Manager	TEC-Weston JV	520-326-0951	Kate Bartz igitally signed by Kate Bartz N: cn=Kate Bartz, o=Cardno, ou=Government Services Division, mail=kate.bartz@cardno-gs.com, c=US ate: 2016.02.09 13:23:29 -07'00'	5/19/2016
Ken Swain	Remediation Program Manager	TEC-Weston JV	434-295-4446	Kenneth W. Swain	5/19/2016
Joseph Gross	Project Manager	TEC-Weston JV	410-612-5910		5/17/2016
Krista Richardson	Installation Lead	TEC-Weston JV	417-719-4834	Krista Richardson	5/17/2016
Brenden Beaumont	Field Team Leader	TEC-Weston JV	410-612-5964		5/17/2016
Heather Miner	Project Chemist	TEC-Weston JV	303-273-0231	Heather	5/19/2016
Pei Geng	Data Validator	Laboratory Data Consultants, Inc.	760-827-1100	Pei Geng	5/18/2016
William Cicero	Laboratory Director	TestAmerica	303-736-0123	William S. Cicero cn=William S. Cicero, o=TestAmerica Laboratories, Inc, ou=Laboratory Director, email=william.cicero@testamericainc.com, c=US 2016.02.10 14:10:29 -07'00'	5/19/2016
Donna Rydberg	Laboratory Project Manager	TestAmerica	303-736-0192	Donna Rydberg	5/19/2016

Notes:

TEC-Weston JV – TEC-Weston Joint Venture
TestAmerica – TestAmerica Laboratories, Inc.
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan

Table 7-1 identifies the responsibilities of each project role. In addition, the education and experience qualifications are described for each assigned personnel.

Table 7-1 Personnel Responsibilities and Qualifications

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Stanley Moore	Contracting Officer's Representative	NGB-A4OR	▪ Primary point of contact on all contractual matters	N/A
Jody Murata	Program Manager	NGB-A4OR	▪ Responsible for overall project execution and for coordination with base representatives, regulatory agencies, and NGB/A4OR management	N/A
Jennifer Kotch	Installation Environmental Manager	109th AW, Schenectady ANGB	▪ Provides installation management and support/insight during data collection and project execution	N/A
Veronica Allen	Surveillance and Oversight Contractor	BB&E	▪ ANG Consulting/Oversight Support	N/A
John Swartwout	State Regulator	NYSDEC	▪ Provides regulatory oversight	N/A
Brian Jankauskas	State Regulator	NYSDEC	▪ Provides regulatory oversight	N/A
William Halperin	JV Management Committee Lead	TEC-Weston JV	▪ Lead for the JV Management Committee ▪ Primary point of contact for NGB programmatic issues	Ph.D. Geography, 29 years of environmental experience
Kate Bartz	Program Manager	TEC-Weston JV	▪ Programmatic Management and Direction ▪ Point of contact for NGB programmatic issues	B.S. Environmental Studies/ M.S. Landscape Architecture & Environmental Planning, 29 years of environmental experience.
Kenneth Swain	Remediation Program Manager	TEC-Weston JV	▪ Programmatic Oversight ▪ Ensure consistency across all project documents ▪ Ensure adherence to ANG Investigation Guidance (ANG 2009)	M.S. Geology, 18 years of ANG experience

Table 7-1 Personnel Responsibilities and Qualifications (Continued)

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jim Brackett	Quality Manager	TEC-Weston JV	▪ Responsible for defining field elements and developing the UFP-QAPP ▪ Monitors field, laboratory, and validation activities to ensure compliance with UFP-QAPP requirements ▪ Identifies non-conformances through QA/QC review activities/audits and recommends corrective action ▪ Prepares reports for submittal	B.S. Mechanical Engineering/M.S. Mechanical Engineering, 34 years of experience
Tom Koch	Health and Safety Officer	TEC-Weston JV	▪ Responsible for development of Environmental Remediation Services Health and Safety Program ▪ Oversees preparation of APP	B.S. Biology/M.S. Environmental Policy and Management, 25 years of experience
Joseph Gross	Project Manager	TEC-Weston JV	▪ Responsible for implementing all activities listed in DO ▪ Prepares or supervises preparation of UFP-QAPP and approves document ▪ Monitors field, laboratory, and validation activities to ensure compliance with UFP-QAPP requirements ▪ Prepares or supervises preparation of reports for submittal	Professional Masters of Engineering/B.S., Civil Engineering, 17 years of environmental experience
Krista Richardson	Installation Lead	TEC-Weston JV	▪ Prepare project reports ▪ Communicates with Project Manager and Installation Lead ▪ Ensure APP is followed	B.S. Agricultural & Biological Engineering, 16 years of environmental experience
Brenden Beaumont	Field Team Leader	TEC-Weston JV	▪ Responsible for implementing all field activities ▪ Communicates with Installation Lead and Project Manager ▪ Monitors field activities to ensure compliance with UFP-QAPP requirements ▪ Ensure APP is followed	B.S., Watershed Management, 13 years of environmental experience

Table 7-1 Personnel Responsibilities and Qualifications (Continued)

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Heather Miner	Project Chemist	TEC-Weston JV	▪ Responsible for defining analytical requirements ▪ Responsible for resolution of laboratory QC issues with Project Manager ▪ Provides program-level QA/QC guidance to installation Points of Contact, TEC-Weston JV Project Manager, and project team ▪ Reviews validation reports before release to the project team	B.S. Chemistry/M.S. Geochemistry, 13 years of environmental experience
Donna Klein	ERPIMS Database Manager	TEC-Weston JV	▪ Provides oversight of ERPIMS deliverables, including field data entry and upload and laboratory data review and upload	More than 20 years of environmental data management and entry into the ERPIMS portal application (ERPToolsX)
Pei Geng	Validator	Laboratory Data Consultants, Inc.	▪ Responsible for adhering to validation requirements per Worksheets #34 through 37	N/A
William Cicero	Laboratory Director	Test America	▪ Responsible for QA and oversight of laboratory operations Responsible for adhering to laboratory SOP requirements	N/A
Donna Rydberg	Laboratory Project Manager	Test America	▪ Point of contact for TEC-Weston JV ▪ Responsible for adhering to laboratory SOP requirements	N/A

Notes:

109th AW – 109th Airlift Wing
ANG – Air National Guard
ANGB – Air National Guard Base
APP – Accident Prevention Plan
BB&E – BB&E Consulting Engineers and Professionals
DO – Delivery Order
ERPIMS - Environmental Resources Program Information Management System
ERPToolsX – ERPIMS Portal
N/A – Not Applicable
NGB/A4OR – National Guard Bureau, Logistics and Installations Directorate, Operations Division, Restoration Branch
NYSDEC – New York State Department of Environmental Conservation
QA/QC – Quality Assurance/Quality Control
SOP – Standard Operating Procedure
TEC-Weston JV – TEC-Weston Joint Venture
TestAmerica – TestAmerica Laboratories, Inc.
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan

Table 8-1 documents specialized training or course certification required on this project.

Table 8-1 Special Personnel Training Requirements

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
Environmental Field Work	40-Hour HAZWOPER Training	Qualified vendor	Various	All TEC-Weston JV and subcontractor personnel that will be on-site	TEC-Weston JV staff, subcontractors	Training records are maintained in the home office for each employee or on-site, as appropriate.
Environmental Field Work	8-Hour HAZWOPER Refresher Training	Qualified vendor	Various	All TEC-Weston JV and subcontractor personnel that will be on-site	TEC-Weston JV staff, subcontractors	
Environmental Field Work	8-Hour HAZWOPER Supervisor Training	Qualified vendor	Various	At least one TEC-Weston JV personnel that will be on-site	TEC-Weston JV staff	
Environmental Field Work	Ongoing training and monitoring to ensure field activities are performed in accordance with the SOPs	TEC-Weston JV	Various	All TEC-Weston JV personnel that will be performing field work	TEC-Weston JV staff	
Environmental Field Work	CPR/Adult Standard First Aid	Various	Various	All TEC-Weston JV personnel that will be on-site performing field work	TEC-Weston JV staff	
ERPIMS Data Management	Acceptable Rules of Behavior, and Federal Information Systems Security Awareness Training Certificate.	AFCEC	Various	All TEC-Weston JV personnel designated to upload data to the ERPIMS portal (ERPToolsX)	TEC-Weston JV staff	

Notes:

AFCEC – Air Force Civil Engineer Center
CPR – Cardiopulmonary Resuscitation
ERPIMS – Environmental Resources Program Information Management System
ERPToolsX – ERPIMS Portal
HAZWOPER – Hazardous Waste Operations and Emergency Response
SOP – Standard Operating Procedure/Practice
TEC-Weston JV – TEC-Weston Joint Venture

WORKSHEET #6 COMMUNICATION PATHWAYS

This worksheet identifies the communication pathways between project personnel.

Table 6-1 Communication Pathways

Communication Drivers	Organization/Title	Name/Email	Phone Number	Procedure
Installation Point of Contact and Manage the Project	Contract Execution NGB/A4OR Contracting Officer's Representative	Stanley Moore stanley.j.moore6.civ@mail.mil	240-612-8504	E-mail/phone communication with TEC-Weston JV PM and Installation Point of Contact.
	NGB/A4OR Program Manager	Jody Murata jody.a.murata.civ@mail.mil	240-612-8120	E-mail/phone communication with NGB/A4OR or their representative, TEC-Weston JV PM, and State Regulator.
Installation Contact	ANGB Environmental Manager	Jennifer Kotch jennifer.kotch@us.af.mil	518-344-2341	E-mail/phone communication with NGB/A4OR, TEC-Weston JV PM, and field crew lead.
Regulatory Compliance	NYSDEC	Brian Jankauskas brian.jankauskas@dec.ny.gov	518-402-9626	E-mail/phone communication with NGB/A4OR Point of Contact.
Manage all Contract Phases	TEC-Weston JV Project Manager	Joseph Gross joseph.gross@westonsolutions.com	410-612-5910	All materials and information about the project will be forwarded by TEC-Weston JV PM to NGB/A4OR, BB&E, and Installation Point of Contact or their representative. TEC-Weston JV PM will notify Installation Point of Contact or their representative of field-related problems by phone, email, or fax by the next business day.
Manage all Fieldwork Phases	TEC-Weston JV Field Leader	Brenden Beaumont brenden.beaumont@westonsolutions.com	410-612-5964	Ensure that field team and TEC-Weston JV PM apprised of field progress and any issues. Coordinate access to site through ANG Installation Lead.
Health and Safety Oversight	TEC-Weston JV Health and Safety Manager	Tom Koch thomas.koch@cardno-gs.com	303-273-0231	Ensure APP addresses safe execution of all field work and designate a site-safety and health officer.

Table 6-1 Communication Pathways (Continued)

Communication Drivers	Organization/Title	Name/Email	Phone Number	Procedure
Field and Analytical Corrective Actions	TEC-Weston JV Installation Lead	Krista Richardson krista.richardson@westonsolutions.com	471-719-4834	TEC-Weston JV Installation Lead (or designee) will e-mail or fax daily field progress reports to TEC-Weston JV PM.
	TEC-Weston JV Field Team Leader	Brenden Beaumont brenden.beaumont@westonsolutions.com	610-701-5964	
Reporting Lab Data Quality Issues	TestAmerica Laboratory Director	William Cicero william.cicero@testamericainc.com	303-736-0123	All QA/QC issues with project field samples will be reported by Laboratory PM to TEC-Weston JV Project Chemist within 2 business days. If corrective measures are required, TEC-Weston JV Project Chemist will notify the Quality Manager and PM.
	TestAmerica Project Manager	Donna Rydberg donna.rydberg@testamericainc.com	303-736-0192	
Release of Analytical Data and UFP-QAPP Amendments	TEC-Weston JV Project Chemist	Heather Miner heather.miner@cardno-gs.com	303-273-0231	TEC-Weston JV Project Chemist will e-mail or fax analytical data as requested by TEC-Weston JV PM or TEC-Weston JV Installation Lead. UFP-QAPP changes to be e-mailed to TEC-Weston JV PM.

Notes:

ANGB –Air National Guard Base
APP – Accident Prevention Plan
NGB/A4OR – National Guard Bureau, Logistics and Installations Directorate, Operations Division, Restoration Branch
NYSDEC – New York State Department of Environmental Conservation
PM – Project Manager
QA/QC – Quality Assurance/Quality Control
TEC-Weston JV – TEC-Weston Joint Venture
TestAmerica – TestAmerica Laboratories, Inc.
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan

WORKSHEET #9 PROJECT PLANNING SESSION SUMMARY

Project Name/Number:	Remedial Investigation Work Plan UFP-QAPP Schenectady ANGB, Scotia, New York ANG2015NEWENGLAND
Operable Units:	Former Building 13 Area (ZZ007), Former Heating Oil UST #41 at Former Building 4 (TU008), and WWTP Bypass UST near IRP Site 6 (TU009)
Projected Date(s) of Sampling:	July 2016 and January 2017
Site Location:	Schenectady ANGB, Scotia, New York
Project Manager:	Joseph Gross, TEC-Weston JV
Date of Session:	November 5, 2015

The TEC-Weston JV team held a teleconference kickoff meeting on 5 November 2015 to discuss general project details, including project team introduction, project execution strategy, and schedule. Meeting attendees are as follows:

Table 9-1 Project Scoping Session Participants

Name of Meeting Attendee	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Jody Murata	Program Manager	NGB/A4OR	240-612-8120	jody.a.murata.civ@mail.mil
Lt. Col. Robert Donaldson	Base Civil Engineer	109th CES, Schenectady ANGB	518-344-2568	robert.e.donaldson2.mil@mail.mil
Veronica Allen	Surveillance and Oversight Contractor	BB&E	248.489.9636, Ext. 304	vallen@bbande.com
Brian Jankauskas	State Regulator	NYSDEC	518-402-9626	brian.jankauskas@dec.ny.gov
John Swartwout	State Regulator	NYSDEC	518-402-9620	john.swartwout@dec.ny.gov
Joseph Gross	Project Manager	TEC-Weston JV	410-612-5910	joseph.gross@westonsolutions.com
Krista Richardson	Installation Lead	TEC-Weston JV	417-719-4834	krista.richardson@westonsolutions.com

Notes:

109th CES – 109th Civil Engineering Squadron
ANGB – Air National Guard Base
BB&E – BB&E Consulting Engineers and Professionals
NYSDEC – New York State Department of Environmental Conservation
NGB/A4OR – National Guard Bureau, Logistics and Installations Directorate, Operations Division, Restoration Branch
TEC-Weston JV – TEC-Weston Joint Venture

Kickoff Meeting Purpose:

The following topics were discussed during the kickoff meeting:

- Introduction
- Project Team
- Execution Strategy
- Schedule
- Points of Contact

Kickoff meeting minutes are provided in **Appendix A.**

WORKSHEET #10 CONCEPTUAL SITE MODEL

The information provided for this worksheet on the facility background and environmental setting was obtained from the Preliminary Assessment /Site Inspection (PA/SI) report prepared by AECOM (AECOM, 2015), and other publically available documents as cited in the following sections.

10.1 FACILITY DESCRIPTION

Schenectady ANGB is located at the Schenectady County Airport in Scotia, New York, approximately 2 miles northeast of Scotia (**Figure 1**) and 3 miles north of Schenectady, New York. The ANGB occupies 124 acres in the southeast portion of Schenectady County Airport and is separated into two sections: New York Air National Guard (NYANG) Main Parcel and NYANG South Parcel (ANG, 2006). The ANG is a tenant (by lease agreement) of the Schenectady County Airport Authority and is responsible only for the operation and maintenance of the ANGB.

Schenectady ANGB began operating at the Schenectady County Airport in 1948 as the 109th Fighter Squadron. The organization was converted to a transport group during 1958 and was activated to full-time status in 1961, flying regular missions to Southeast Asia in support of active duty forces in Vietnam. The 109th Airlift Group received its first C-130s during 1971 and began supporting scientific research programs in 1975. In 1988, they began augmenting the U.S. Navy's support of the U.S. Antarctic Program by supporting operations at the McMurdo and Palmer stations, Antarctica, as well as at other research stations located in Antarctica and Greenland (ECATS, 2003; Hueber et al., 1997, as cited in AECOM, 2015). In 1996, the 109th Airlift Group was re-assigned as an Airlift Wing (ECATS, 2003, as cited in AECOM, 2015).

The main purpose of Schenectady ANGB is to provide organizational and maintenance support to the 109th Airlift Wing, which flies C-130H and ski-equipped LC-130H aircraft to support the Air Mobility Command and polar airlift missions. The major support operations include aircraft fueling, aircraft deicing, aircraft maintenance, aerospace ground equipment maintenance, ground vehicle maintenance, fueling of ground vehicles, and facilities maintenance (ANG, 2006).

The facility also provides general airlift support throughout the ANGB and Air Mobility Command passenger/cargo systems. The unit services other polar customers, such as the North American Aerospace Defense and the Navy, in addition to polar rescue operations. The unit also has a mission to assist New York State in the event of disaster emergencies and civil disturbances. Currently, there are approximately 468 full-time personnel at Schenectady ANGB and approximately 703 part-time personnel (ANG, 2014).

10.2 NATIONAL GUARD BUREAU COMPLIANCE RESTORATION PROGRAM

In 2012, the ANG began an environmental Compliance Restoration Program (CRP) that initiated revisiting ANG installations, evaluating records for areas that were previously excluded from the original Environmental Restoration Program to ensure that all potential environmental sites at the facility had been properly addressed. PA activities were conducted at Schenectady ANGB on 12 November 2013 at six Areas of Concern (AOC):

- ZZ007: Former Building 13 Area
- TU008: Former Heating Oil Underground Storage Tank (UST) #41, Former Building 4
- TU009: Waste Water Treatment Plant (WWTP) Bypass UST near Installation Restoration Program (IRP) Site 6
- TU010: Former JP-8 Reclamation UST at Building 29
- DD011: Building 19 Drains
- DD012: Building 35 Drains

The project objective was to determine the presence or absence of contamination and either (1) obtain a No Further Action (NFA) decision for the AOCs at Schenectady ANGB, with regulatory concurrence from the New York State Department of Environmental Conservation (NYSDEC) or (2) identify the data quality objectives required for conducting a follow-on RI at the AOCs that did not meet the criteria for NFA.

Based on recommendations from previous investigations and the PA, additional SI activities were not warranted for TU010. NFA was previously established for this site based on a spill closure letter from NYSDEC (NYSDEC, 2013) as well as NYSDEC concurrence with the Final Preliminary Assessment/Site Inspection Work Plan (AECOM, 2014). The drain lines of former battery/acid neutralization rooms in Buildings 19 and 35 (DD011 and DD012) were inspected via camera survey as part of the 2014 SI activities. Results showed no discernible corrosion of the drain lines at both facilities, confirming that no further investigation of either AOC was necessary.

SI activities including soil and groundwater sampling were conducted in 2014 for the remaining AOCs. Concentrations of chemicals of potential concern (COPCs) detected in soil and groundwater samples collected from the AOCs during the 2014 SI were compared to the project action limits (PALs) for Schenectady ANGB. The PALs for the soil samples included the NYSDEC Commissioner Policy 51 (CP-51) – Soil Cleanup Guidance for petroleum-based COPCs and the NYSDEC Environmental Conservation Law (ECL) Remedial Program Restricted Use Soil Cleanup Objectives for the Protection of Groundwater for all other COPCs. The PALs for the groundwater samples were the NYSDEC Technical & Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values. Where NYSDEC criteria were not available, U.S. Environmental Protection Agency (USEPA) criteria are used, including maximum contaminant levels (MCLs) for drinking water and regional screening levels (RSLs) for residential soil and tap water.

The SI recommended NFA for the following AOCs:

- TU010 – NFA already approved by NYSDEC.
- DD011 - Based on results of the camera surveys conducted during the 2014 SI activities, the drain was determined to not warrant any further investigation.
- DD012 – Based on results of the camera surveys conducted during the 2014 SI activities, the drain was determined to not warrant any further investigation.

Further investigation was recommended for the following AOCs:

- ZZ007 – Further investigation to address metals in soil and groundwater.
- TU008 – Further investigation to address volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in groundwater.
- TU009 – Further investigation to address SVOCs and metals in soil and groundwater.

A PA is the first step in evaluating a site pursuant to CERCLA, the National Contingency Plan (NCP), and the Hazard Ranking System (HRS). The SI, the second step, is conducted when the PA indicates that further investigation under CERCLA is needed. The USEPA HRS was applied during the SI (AECOM, 2015) and although a site score of 28.50 necessary for the site to be placed on the NPL was not calculated for any of the three sites, further investigation was recommended. ANG is aware that NYSDEC considers an RI as necessary when data indicate that disposal of contaminants at the site has occurred and contamination is potentially present at levels and/or at frequencies sufficient for the Division of Environmental Remediation (DER) to require a full delineation of the nature and extent of the contamination in order to allow a decision by DER regarding any necessary remediation. ANG understands that the sites included in this UFP-QAPP Work Plan may not be classified as sites requiring an RI under NYSDEC guidance and that the RI may not include all of the components necessary for an approved RI. However, ANG follows the CERCLA process and recommends an RI/FS as the next step to follow the PA/SI.

10.3 PREVIOUS INVESTIGATIONS

The sections below describe the previous investigations and activities conducted at ZZ007, TU008, and TU009. These activities were performed to characterize the sites, and included soil and groundwater sampling. Related records files, including data posting maps from these activities, are included in **Appendix B**.

10.3.1 Site ZZ007 - Former Building 13 Area

ZZ007 includes the area of former Building 13 where hazardous materials were used and hazardous waste was generated. Former Building 13 was utilized as a maintenance facility at times with drum storage. Building 13 was demolished in the mid-1990s, and no building is currently in its place (AECOM, 2015). Preliminary plans to construct a building within former Building 13 footprint are in progress. No sampling or closure information could be located for this area (BB&E, 2011). Former Building 13 was located near the current Building 12.

10.3.1.1 Preliminary Assessment/Site Inspection

A PA at ZZ007 was conducted by AECOM in November 2013. During the PA, sampling and closure information for ZZ007 was not identified. Soil and groundwater sampling was recommended to assess potential contamination (AECOM, 2015).

The SI was conducted in November 2014. During the SI, five soil borings (ZZ07SB01 through ZZ07SB05) were advanced at Site ZZ007 in the area of former Building 13. The borings were advanced to refusal, which occurred 7.5 to 9 feet (ft) below ground surface (bgs). One soil sample was collected from the dry soils above the water table interface in borings (ZZ07SB02 and ZZ07SB05) where groundwater samples were also collected. Two soil samples were collected from the remaining three borings; one from the upper portion of the borehole and one from the bottom of each boring. No visual or olfactory or photoionization detector (PID) evidence of contamination was identified in any of the borings. All soil samples were analyzed for VOCs, SVOCs, and metals. Twenty-three metals, 20 VOCs, and two SVOCs were detected in the samples. Detected VOCs and SVOCs did not exceed NYSDEC unrestricted soil cleanup goals. Arsenic, nickel, and zinc were detected in at least one soil sample at concentrations slightly exceeding NYSDEC unrestricted soil cleanup goals. The detected concentrations did not exceed residential soil cleanup goals. Iron was detected in soil at 31,000 to 47,000 mg/kg, which exceeds the CP-51 secondary soil cleanup goal. Appendix A of the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (NYSDEC, 1994; 2000) includes eastern United States background levels for iron of 2,000 to 550,000 mg/kg. Metals may be naturally occurring in the soils since there is no evidence of a source area or release.

Groundwater was encountered at 2 to 3 ft bgs in two of the borings (ZZSB02 and ZZSB05) and was not encountered in the other three borings or the two additional offset borings. The site groundwater appeared to be perched and intermittent. Fourteen metals in both total and dissolved forms (arsenic, barium, beryllium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, thallium, and zinc), one metal in total form only (cadmium), and one metal in dissolved form only (selenium) exceeded PALs in one or more samples. Groundwater samples collected were turbid. It was concluded that groundwater samples from permanent wells may have lower concentrations of metals (AECOM, 2015).

The USEPA HRS was applied to the groundwater migration pathway. The HRS score represents the risk that a nearby population will be exposed to high concentrations of chemical compounds along a specified exposure pathway. A site score of 28.50 is necessary for the site to be placed on the National Priorities List (NPL). The groundwater migration pathway for ZZ007 received a score of 4.8 and the overall site score was 2.40 (AECOM, 2015).

Further investigation was recommended to address metals in soil and groundwater.

10.3.2 Site TU008 - Former Heating Oil UST #41 at Former Building 4

TU008 includes former Building 4, which was a vehicle maintenance facility, and the associated UST #41, which was a 6,000-gallon heating oil tank. Building 4 was demolished in 1995. UST #41 was likely removed at the time of building demolition; however, records of removal and/or sampling of the tank pit during removal are not available (AECOM, 2015).

10.3.2.1 Preliminary Assessment/Site Inspection

A PA was conducted at TU008 by AECOM in November 2014. During the PA, sampling and closure information for the TU008 were not identified. Former Building 4 was utilized as a vehicle maintenance facility before its removal in the early 1995. UST #41 was a 6,000-gallon heating oil tank associated with the building. Records of removal and/or sampling of the tank pit during removal are not available. Soil and groundwater sampling was recommended to assess potential contamination (AECOM, 2015).

The SI was conducted in November 2014. DGM was used to confirm the absence of the former fuel oil UST prior to field sampling. Five borings were advanced until refusal, which occurred between 7 to 9 ft bgs in each boring. One soil sample was collected from each boring in the dry soils above the water table interface. There was no visual, olfactory, or PID evidence of contamination in three of the borings. Odors and elevated PID measurements were detected in borings TU08SB08 (peak of 178 parts per million [ppm] at 5 ft bgs) and TU08SB09 (peak of 97.1 ppm at 4 ft bgs); measurements decreased with depth in each boring. Samples were analyzed for VOCs and SVOCs. Twenty-one VOCs and 17 SVOCs were detected in the samples. Detected chemicals did not exceed PALs.

One groundwater sample was collected from each boring from 5 to 10 ft bgs. Groundwater samples were analyzed for VOCs and SVOCs with the exception of TU08GW10. SVOCs were not collected at TU08GW10 due to the lack of sufficient groundwater volume. Eleven VOCs and 15 SVOCs were detected in the samples. Four VOCs (naphthalene, n-butylbenzene, sec-butylbenzene, and tert-butylbenzene) and two SVOCs [bis(2-ethylhexyl) phthalate and naphthalene] exceeded PALs in one or more samples.

The USEPA HRS was applied to the groundwater migration pathway. The HRS score represents the risk that a nearby population will be exposed to high concentrations of chemical compounds along a specified exposure pathway. A site score of 28.50 is necessary for the site to be placed on the NPL. The groundwater migration pathway for TU008 received a score of zero and the overall site score was zero (AECOM, 2015).

Further investigation was recommended to address VOCs and SVOCs in groundwater. Although PA/SI soil sample results were below screening criteria, additional soil sampling was recommended to verify groundwater results are related to TU008 and not influenced or impacted by unknown soil impacts beyond the UST footprint.

10.3.3 Site TU009 - WWTP Bypass UST near IRP Site 6

TU009 includes a 7,000-gallon UST used by the wastewater treatment plant (WWTP) as a bypass during 1982 and 1983. The WWTP was demolished in 2002, but the UST remains in place and is reported to be partially filled with sand.

10.3.3.1 Preliminary Assessment/Site Inspection

A PA at TU009 was conducted by AECOM in November 2013. During the PA, sampling and closure information for the TU009 were not identified. A 7,000-gallon UST was utilized by the WWTP for bypass during 1982 – 1983 when the lagoons were being emptied for cleaning. The tank had one inlet pipe and was pumped out daily. The WWTP was demolished in 2002. According to Schenectady ANG personnel, the UST is still in place and partially filled with sand (AECOM, 2015).

The SI was conducted in November 2014. DGM was used to locate the outline of the WWTP bypass UST at TU009 prior to field sampling. The geophysical survey concluded that a single location of a large metal object of representative size of the WWPT Bypass UST was identified, along with two manholes associated with the structure (Appendix C of AECOM, 2015). Four borings (TU09SB11 through TU09SB14) were advanced until refusal was met, which occurred between 7.5 and 8.5 ft bgs. The groundwater table was encountered between 5 to 5.5 ft bgs in two borings only (TU09SB12 and TU09SB13). One soil sample was collected from the dry soils above the water table interface in borings where groundwater was encountered. Two soil samples were collected from the remaining two dry borings (TU09SB11 and TU09SB14); one from the upper portion of the borehole and one from the bottom of each boring. There was no visual, olfactory, or PID evidence of contamination in any of the borings. Soil samples were analyzed for VOCs, SVOCs, and metals. Fifteen VOCs, 12 SVOCs, and 23 metals were detected in the samples. Detected VOCs and SVOCs did not exceed NYSDEC unrestricted soil cleanup goals. Arsenic, copper, and zinc concentrations exceeded PALs in at least one soil sample. The detected concentrations did not exceed residential soil cleanup goals. Iron was detected at 24,000 to 55,000 mg/kg in soil exceeding the CP-51 secondary soil cleanup goal. Appendix A of NYSDEC TAGM 4046 (NYSDEC, 1994; 2000) includes eastern United States background levels for iron of 2,000 to 550,000 mg/kg. Metals may be naturally occurring in the soils since there is no evidence of a source area or release.

Groundwater samples were collected from the two boring where water was encountered. Samples were analyzed for VOCs, SVOCs, and metals. Four SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and bis(2-ethylhexyl) phthalate], four metals in both total and dissolved forms (iron, magnesium, manganese, and sodium,), and nine metals in total form only (arsenic, barium, beryllium, chromium, copper, lead, nickel, thallium, and mercury) exceeded PALs in one or more samples.

The USEPA HRS was applied to the groundwater migration pathway. The HRS score represents the risk that a nearby population will be exposed to high concentrations of chemical compounds along a specified exposure pathway. A site score of 28.50 is necessary for the site to be placed on the NPL. The groundwater migration pathway for TU009 received a score of 4.8 and the overall site score was 2.4 (AECOM, 2015).

Further investigation was recommended to address SVOC and metals groundwater and metals in soil.

10.3.3.2 Remedial Actions, Site 6

Site 6, an active remediation site, is located immediately adjacent to Site TU009 and consists of an area of contaminated soil and groundwater located northwest of the former WWTP and sand filter. Site 6 covers an area of approximately 0.96 acres. An Interim Remedial Action (IRA) was conducted at Site 6 between May and September 2007. Site 6 soils that were previously identified as within the CVOC groundwater 50 parts per billion (ppb) plume were excavated. All of the soil in the area was removed from the ground surface to the top of competent bedrock which was encountered at a depth interval of 5 to 7 ft and field screened. The total volume of soil excavated in Site 6 for field screening of CVOCs was 4,790 cubic yards (yd^3). All 4,790 yd^3 of stockpiled soils were screened, sampled and returned to the excavation as backfill based on the analytical results which indicated all analyzed CVOCs were below NYSDEC soil cleanup goals.

During the soil removal activities at Site 6, a horizontal infusion gallery was constructed to perform in-situ chemical oxidation (ISCO) injections. An enhanced bioremediation pilot test was conducted at Site 6 August 8, 2007. Edible Oil Substrate (EOS) and Vitamin B12 supplement was gravity fed sequentially into each of the 12 vertical riser pipes of the infusion gallery constructed as part of the Site 6 IRA. The objectives of the pilot test were to decrease concentrations of VOCs in the groundwater and prevent CVOC plume migration through increased biological activity through enhanced monitored natural attenuation.

Five groundwater monitoring events were performed to assess groundwater quality. One round of groundwater samples were collected prior to the infusion activities while four quarterly rounds of groundwater samples were collected post-infusion. The overall conclusions were the injection of EOS and the Vitamin B12 Supplement had a beneficial effect on decreasing the concentration of CVOCs in the groundwater at Site 6.

A Final Record of Decision (ROD) 447022 was issued by the ANG on March 14, 2012 for the remediation of soils and groundwater at Site 6. A Remedial Action Work Plan (Balanced Environmental Management Systems [BEM Systems], 2013) and associated Addendum (BEM Systems, 2014) were produced for cleanup of chlorinated volatile organic compound (CVOC) impacted groundwater and tetrachloroethene impacted soils at Site 6.

A Remedial Action Completion/Final Engineering Report (RAC/FER) was completed to document remedial and sampling activities conducted June 10, 2013 through January 13, 2015 (BEM Systems, 2016). The remediation included chemical injection of sodium permanganate and groundwater monitoring. The first injection event took place June 17, 2013 to June 20, 2013 consisting of 9,712 gallons of sodium permanganate injection. Of the 9,712 gallons, 9,012 gallons were injected at a 10% concentration of sodium permanganate into the injection gallery. The remaining 700 gallons was injected at a 5% solution via direct push. The second injection event occurred May 5, 2014 to May 8, 2014 in which 7,504 gallons of sodium permanganate was injected at a 5% concentration. Two groundwater performance sampling events were conducted three months following the injections. In addition, five monthly groundwater monitoring rounds were conducted. The groundwater monitoring data supports that the permanganate injected at Site 6 appears to have reduced site contamination. Based on the results of the remedial action and groundwater monitoring samples collected at Site 6, groundwater contamination is still present at Site 6 above NYSDEC Groundwater Criteria for Unrestricted Use levels. Groundwater remediation is not complete for Site 6, therefore, a Site Management Plan has been prepared to address the remaining contamination.

10.4 ENVIRONMENTAL SETTING

The following section contains general information relative to the environmental setting at Schenectady ANGB. The following base-wide environmental setting and conceptual site model (CSM) information has been summarized from the previously completed August 2015 Final PA/SI Report (AECOM, 2015).

10.4.1 Climate

The climate in Schenectady County is classified as “Moist Continental Mid-Latitude Climate” and is characterized by warm to cool summers and cold winters. Winters are potentially severe with snow storms, strong winds, and extreme cold from Continental Polar or Arctic air masses. Average minimum temperatures range from 13 °F (-9 °C) in January to 60 °F (15 °C) in July; average maximum temperatures range from 31°F (-1 °C) in January to 83°F (28 °C) in July. Average annual precipitation is approximately 36 inches and is dispersed throughout the year (ANG, 2006).

The average annual precipitation is approximately 38 inches rain per year and 62 inches of snow. There are on average. The average number of days with any measurable precipitation a year is 125. On average, there are 177 sunny days per year in Schenectady.

10.4.2 Topography and Surface Water Drainage Patterns

Schenectady ANGB is located north of the Mohawk River in the Mohawk River Valley. The Mohawk River runs in a general northwest to southeast direction through the area. Topographic features in the area include the foothills of the Adirondack Mountains to the north and the Helderberg Escarpment, the northern extreme of the Allegheny Plateau, to the south. Area landforms are relatively flat adjacent to the Mohawk River, where elevations are approximately 210 ft above mean sea level (amsl) along the riverbanks. The elevations at Schenectady ANGB range from approximately 300 to 390 ft amsl. The land on the Base has been predominantly cleared, leveled with little topographic relief, and developed (ANG, 2006).

The Mohawk River drains approximately 65 percent of Schenectady County. Surface water is channeled from Schenectady ANGB through a drainage system of culverts, ditches, and pipes that runs south and east, and eventually drain into the Mohawk River via an unnamed tributary and the rivers tributary Alplaus Kill. The Alplaus Kill flows for approximately 0.75 miles along Glenville’s eastern boundary before emptying into the Mohawk River (ANG, 2006). The river’s flow is regulated during the navigational season by a series of locks, as part of the New York State Barge Canal System.

10.4.3 Geology and Soils

Bedrock units beneath Schenectady ANGB are encountered as shallow as 7.5 ft bgs. The ANGB is underlain by the Ordovician Schenectady Formation and Canajoharie Shale which is shale interbedded with siltstones and sandstones. There are several linear bedrock ridges, aligned in a northeast-southwest direction, located in the vicinity of the ANGB. Glacial till covers bedrock over much of the ANGB and the surrounding area, which is a gray to dark gray, compact, tough, stony, salty to sandy clay with some cobbles and boulders. There are limited areas of thin sand and gravel lenses scattered within the till unit. The overall thickness of the till deposits over the ANGB ranges between approximately 10 and 30 ft. where the thickest areas correspond to the depressions in the bedrock surface. Lake Albany sands and silts, ranging between approximately 45 and 130 ft thick, overly the till deposits on the southern and southwestern portion of the ANGB (ANG, 2006).

Most of the naturally occurring soils at and around Schenectady ANGB have been disturbed and/or removed, making soil classification difficult due to the variable characteristics and alteration from natural conditions. According to the U.S. Department of Agriculture Soil Conservation Service, the majority of the soils at Schenectady ANGB are composed of cut and fill material and *Urban Land - Colonie Complex*. This soil type consists of 70 percent urban land, soils under structures or pavements, and 30 percent Colonie soils. These soils are predominately underlain by sandy material with variable permeability. The Colonie soils are deep, well drained to excessively drained, sandy soils. The other mapped soils beneath the ANGB consist of the following soils (USDA, 2015):

- *Lordstown Gravelly Silt Loam*-A moderately deep, well drained, medium textured soil on hilltops with slopes of 3-8 percent.
- *Hornells Silt Loam*-A moderately deep, moderately well drained, medium textured soil on bedrock controlled uplands with slopes of 3 to 8 percent.
- *Tuller-Brockport Complex*- Consists of 60 percent Tuller soils and 40 percent Brockport soils. The Tuller soils are shallow and somewhat poorly drained to poorly drained with a moderate permeability. The Brockport soils are moderately deep and somewhat poorly drained.
- *Burdette-Scriba Soils*-Consists of 65 percent Burdette soils and 35 percent Scriba soils. The Burdette soils are moderately deep, somewhat poorly drained, and medium texture. The Scriba soils are deep, somewhat poorly drained, and medium textured.
- *Nunda Soils*-These soils are deep, moderately well drained, sloping, medium textured, and extremely stony on calcareous glacial till plains.

10.4.4 Groundwater and Hydrogeology

Schenectady ANGB does not have high potential availability of large groundwater resources, although it lies close to the recharge zone of the Schenectady-Niskayuna Aquifer System. The Schenectady Aquifer consists of a complex and extensive bed of stratified drift and glacial outwash gravel deposits underlying the Mohawk River channel. These aquifer deposits are underlain by glacial till. Bedrock formations in the Schenectady area have a low permeability. The groundwater in the bedrock primarily flows within the fractures and joints in the rock and within the weathered or fractured zone within the upper few feet of the bedrock surface. The Schenectady Aquifer supplies potable water to approximately 84 percent of the population of Schenectady County through municipal and private wells. Groundwater depths reported in monitoring wells screened at the soil/bedrock interface ranged between 6 and 11 ft bgs. Hydraulic conductivity tests conducted in monitoring wells at the base reported groundwater flow velocities estimated between 2 and 25 ft per year consistent with typical groundwater flow velocities found in fractured bedrock (BEM, 2012) or a silt/clayey fine sand. The water table in the Schenectady area generally mimics the topography of the land surface and, therefore, groundwater moves in the direction of land-surface slope. Regional groundwater flow at the ANGB is southeast toward the Mohawk River (ANG, 2006).

10.4.5 Vegetation/Critical Habitats/Threatened or Endangered Species

Site ZZ007 is paved and a building is planned for the footprint of Former Building 13. Vegetation at TU008 and TU009 is limited to landscaped areas with grass. There is a ditch located directly west of TU009 that is a designated trout stream per the NYSDEC. Investigative and remedial activities will be coordinated with NYSDEC as to not adversely affect the habitat of the ditch.

According to the U.S. Fish and Wildlife Service (USFWS), there are two endangered species found in Schenectady County: one insect (the karner blue butterfly, *Lycaeides melissa samuelis*) and one mammal (the northern long-eared bat, *Myotis septentrionalis*) (USFWS, 2016). The karner blue butterfly is listed as endangered status, while the northern log-eared bat is listed as threatened. However, since the area around the Base is developed, and both species have specific forested habitat requirements, it is unlikely to find any of these species in the project area.

10.5 CONCEPTUAL SITE MODEL AND PRELIMINARY EXPOSURE ASSESSMENT

10.5.1 Site ZZ007 - Former Building 13 Area

10.5.1.1 Sources of Known or Suspected Contamination

The source of contaminants at ZZ007 consist of former hazardous waste generated and stored in the former building area. Maintenance activities took place in the former building. The specific source of contamination has not been investigated.

10.5.1.2 Primary Release Mechanisms

The primary release mechanism at ZZ007 consisted of leaks (unspecified types) from drum storage or from chemical storage and use in the former maintenance facility into the surrounding soil. The volume of any potential release was not recorded nor estimated.

10.5.1.3 Human Receptors/Potential Exposure Pathways

Potential human receptors include current and future workers (e.g., Schenectady ANGB personnel and authorized contractors). Due to the developed aspects of the areas surrounding the site, there is no surface water, or sediment at the sites and those pathways are considered incomplete. The environmental media is limited to the subsurface soil at this time, but the CSMs will be updated based on the results of the soil investigation. Primary exposure pathways for soil include:

- Incidental subsurface soil ingestion;
- Inhalation of fugitive dust from subsurface soil; and
- Dermal contact with subsurface soil.

The primary exposure pathways for groundwater include:

- Incidental groundwater ingestion;
- Inhalation of groundwater vapor; and
- Dermal contact with groundwater.

10.5.1.4 Ecological Receptors/Potential Exposure Pathways

Site ZZ007 does not contain habitat to support ecological receptors. The affected media is subsurface soil and groundwater. There is no surface water within the site, and the groundwater is not connected to surface water on or off-site. The soil within the site when exposed is regularly maintained through mowing or landscaping. The site is surrounded by developed areas. Since ecological habitat is not present within the site, completed ecological exposure pathways are not present.

10.5.1.5 Nature and Extent of Contamination

Arsenic, iron, nickel, and zinc were detected in at least one soil sample at concentrations exceeding unrestricted soil cleanup goals during the SI (AECOM, 2015). Metals concentrations in soil are likely naturally occurring since there is no evidence of a source area or release; detected concentrations of arsenic, nickel, and zinc were below residential soil cleanup goals and iron concentrations were on the low end of published background ranges. Since other contaminants of concern (i.e., VOCs and SVOCs) were not detected at the site that would have been indicative of a release to site soil, soil is not deemed impacted at Site ZZ007.

Fourteen metals in both total and dissolved forms (arsenic, barium, beryllium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, thallium, and zinc), one metal in total form only (cadmium), and one metal in dissolved form only (selenium) exceeded PALs in one or more samples during the SI (AECOM, 2015). Groundwater samples collected were turbid. It was concluded that groundwater samples from permanent wells may have lower concentrations of metals. The presence of the impact to groundwater needs to be confirmed and the extent of the potential contamination is unknown. Data from groundwater sampling from the permanent monitoring wells proposed for ZZ007 will be used to verify and delineate groundwater contamination.

10.5.2 Site TU008 - Former Heating Oil UST #41 at Former Building 4

10.5.2.1 Sources of Known or Suspected Contamination

The source of contaminants at TU008 are from the former vehicle maintenance facility formerly located at the location and the 6,000 gallon heating oil UST #41 associated with the building. Records of the tank removal are not available, and the specific source of contamination is unknown.

10.5.2.2 Primary Release Mechanisms

The primary release mechanism at TU008 consisted of leaks (unspecified types) from the UST and maintenance facility into the surrounding soil. The volumes of the potential releases were not recorded nor estimated.

10.5.2.3 Human Receptors/Potential Exposure Pathways

Potential human receptors include current and future workers (e.g., Schenectady ANGB personnel and authorized contractors). Due to the developed aspects of the areas surrounding the site, there is no surface water, or sediment at the sites and those pathways are considered incomplete. The environmental media is limited to the subsurface soil at this time, but the CSMs will be updated based on the results of the soil investigation. Primary exposure pathways for soil include:

- Incidental subsurface soil ingestion;
- Inhalation of fugitive dust from subsurface soil; and
- Dermal contact with subsurface soil.

The primary exposure pathways for groundwater include:

- Incidental groundwater ingestion;
- Inhalation of groundwater vapor; and
- Dermal contact with groundwater.

10.5.2.4 Ecological Receptors/Potential Exposure Pathways

Site TU008 does not contain habitat to support ecological receptors. The affected media is subsurface soil and groundwater. There is no surface water within the site, and the groundwater is not connected to surface water on or off-site. The soil within the site when exposed is regularly maintained through mowing or landscaping. The site is surrounded by developed areas. Since ecological habitat is not present within the site, completed ecological exposure pathways are not present.

10.5.2.5 Nature and Extent of Contamination

Chemicals were not detected in soil at concentrations above PALs during the SI. The soil sampling proposed for the RI will evaluate current concentrations of COPCs in the vadose zone to determine if source area soils are present that may be contributing to groundwater contamination and to delineate the extent of identified potential impacts. VOCs and SVOCs exceeded PALs in groundwater samples during the SI. The presence of the impact to groundwater needs to be confirmed and the extent of the potential contamination is unknown. Data from groundwater sampling from the permanent monitoring wells proposed for TU008 will be used to verify and delineate groundwater contamination.

10.5.3 Site TU009 - WWTP Bypass UST near IRP Site 6

10.5.3.1 Sources of Known or Suspected Contamination

The source of contaminants at TU009 are from the 7,000 gallon UST used by the WWTP for bypass while the WWTP lagoons were emptied in 1982. Records of the tank removal are unavailable, and according to the personnel on site, the UST is still in place.

10.5.3.2 Primary Release Mechanisms

The primary release mechanism at TU009 consisted of potential leaks (unspecified types) from the UST and related piping into the surrounding soil. The volumes of potential releases were not recorded nor estimated.

10.5.3.3 Human Receptors/Potential Exposure Pathways

Potential human receptors include current and future workers (e.g., Schenectady ANGB personnel and authorized contractors). Due to the developed aspects of the areas surrounding the site, there is no surface water, or sediment at the sites and those pathways are considered incomplete. The environmental media is limited to the subsurface soil at this time, but the CSMs will be updated based on the results of the soil investigation. Primary exposure pathways for soil include:

- Incidental subsurface soil ingestion;
- Inhalation of fugitive dust from subsurface soil; and
- Dermal contact with subsurface soil.

The primary exposure pathways for groundwater include:

- Incidental groundwater ingestion;
- Inhalation of groundwater vapor; and
- Dermal contact with groundwater.

10.5.3.4 Ecological Receptors/Potential Exposure Pathways

Site TU009 does not contain habitat to support ecological receptors. The affected media is subsurface soil and groundwater. There is no surface water within the site, and the groundwater is not connected to surface water. The soil within the site when exposed is regularly maintained through mowing or landscaping. The site is surrounded by developed areas. Since ecological habitat is not present within the site, completed ecological exposure pathways are not present.

10.5.3.5 Nature and Extent of Contamination

Arsenic, copper, iron, and zinc were detected in at least one soil sample at concentrations exceeding unrestricted soil cleanup goals during the SI (AECOM, 2015). Metals concentrations in soil are likely naturally occurring; detected concentrations of arsenic, copper, and zinc were below residential soil cleanup goals and iron concentrations were within published background ranges. Since other contaminants of concern (i.e., VOCs and SVOCs) were not detected at the site that would have been indicative of a release to site soil, soil is not deemed impacted at SiteTU009.

SVOCs and metals exceeded PALs in one or more groundwater samples collected during the SI. The presence of the impact to groundwater needs to be confirmed and the extent of the potential contamination is unknown. Data from groundwater sampling from the permanent monitoring wells proposed for TU009 will be used to verify and delineate groundwater contamination.

WORKSHEET #11 PROJECT/DATA QUALITY OBJECTIVES

11.1 PROBLEM STATEMENT

11.1.1 Site ZZ007 - Former Building 13 Area

The results from the sampling data reported in the PA/SI identified the presence of total and dissolved metals in groundwater near former Building 13 at concentrations that exceeded the PALs. Additional groundwater water sampling is warranted to confirm the presence of metals in groundwater that may be attributed to turbid groundwater collected during the SI, to define the nature and extent of potential contamination, and to determine if corrective actions are necessary.

This RI will evaluate current concentrations of COPCs in groundwater by the installation of monitoring wells at the potential source areas of the former building and in upgradient and downgradient positions and collection of groundwater samples for metals analysis. The results from the sampling data reported in the SI have identified the presence of low levels of metals in soil near former Building 13, but not at concentrations indicative of a release. This RI will evaluate current concentrations of COPCs in the subsurface soil at the monitoring well locations by the collection of soil samples for metals analysis to confirm the presence of chemicals in subsurface soil and to determine if concentrations may be contributing to potential groundwater contamination.

The results of sampling will be used to determine the type of corrective measures, if any, which are necessary for mitigating COPCs.

11.1.2 Site TU008 - Former Heating Oil UST #41 at Former Building 4

The results from the sampling data reported in the PA/SI did not identify the presence of any chemicals in soil exceeding the PALs. Soil samples concurrent with groundwater sampling will assist in evaluating the source of the chemicals in groundwater.

This RI will evaluate current concentrations of COPCs in the vadose zone by the collection of soil samples for VOC and SVOC analysis to determine if source area soils are present that may be contributing to groundwater contamination. The results of sampling will be used to determine the type of corrective measures, if any, which are necessary for mitigating COPCs.

The results from the sampling data reported in the PA/SI identified the presence of VOCs and SVOCs in groundwater at concentrations exceeding PALs. Additional groundwater sampling is warranted to confirm the presence of contaminants, define the nature and extent of potential contamination, and to determine if corrective actions are necessary

This RI will evaluate current concentrations of COPCs in groundwater by the installation of monitoring wells at the source area of the former UST and in upgradient and downgradient positions and collection of groundwater samples for VOC and SVOC analysis. The results of sampling will be used to determine the type of corrective measures, if any, which are necessary for mitigating COPCs.

11.1.3 Site TU009 - WWTP Bypass UST near IRP Site 6

The PA/SI identified the presence of SVOCs and metals in groundwater at concentrations exceeding PALs. Additional groundwater sampling is warranted to define the nature and extent of potential contamination and to determine if corrective actions are necessary.

This RI will evaluate current concentrations of COPCs in groundwater by the installation of monitoring wells at the potential source area of the former UST and in upgradient and downgradient positions and collection of groundwater samples for SVOC and metals analysis. The results from the sampling data reported in the SI have identified the presence of low levels of metals in soil in the vicinity of the former UST but not at concentrations indicative of a release. This RI will evaluate current concentrations of

COPCs in the subsurface soil at the monitoring well locations by the collection of soil samples for metals analysis to confirm the presence of chemicals in subsurface soil and to determine if concentrations may be contributing to potential groundwater contamination.

The results of sampling will be used to determine the type of corrective measures, if any, which are necessary for mitigating COPCs.

11.2 GOALS OF THE STUDY

The main goals of this project are to determine:

1. Do detected results from previous investigations exceed the PALs?
    a. All PA/SI results for each site/matrix are discussed in Worksheet #10.
2. What is the magnitude and extent of COPCs in soil and groundwater in the vicinity of each site?
    a. ZZ007
        i. Metals were identified as COPCs in groundwater during the PA/SI. Metals present in groundwater during the PA/SI may be attributed to turbid samples from temporary monitoring wells.
    b. TU008
        i. NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation specifies for investigations of known petroleum releases, sample analysis must be for the suite of contaminants shown in the fuel oil and gasoline tables (tables 2 and 3) contained in the Commissioner Policy on Soil Cleanup Guidance which includes VOCs and SVOCs. As such, COPCs are identified as VOCs and SVOCs in subsurface soil and VOCs and SVOCs in groundwater.
        ii. COPCs were not identified in soil during the PA/SI. VOC and SVOC analysis will determine if source area soils are present that may be contributing to groundwater contamination.
        iii. VOCs and SVOCs were identified as COPCs during the PA/SI.
    c. TU009
        i. SVOCs and metals were identified as COPCs in groundwater during the PA/SI.
3. Is additional action warranted at the site to protect human health and the environment, or is NFA required?

The principal decisions to be addressed by the analytical data collected from the investigation are provided below.

- Are the results of adequate quality and quantity to be used for decision-making?
- Do COPC concentrations exceed the PALs listed in Worksheet #15?
- Do statistically determined reasonable maximum exposure (RME) values exceed USEPA risk levels (cumulative Hazard Index [HI] of 1; cumulative Lifetime Cancer Risk [LTCR] of 10^{-4})?

The decision statements that relate to the principal study questions are:

- If the concentration of any COPC in soil or groundwater exceeds its respective PAL, step-out samples may be collected for COPCs of concern to delineate the extent of contamination.
- If concentrations of COPCs do not exceed PALs in soil and groundwater, no further samples will be collected. NFA will be recommended, and a No Further Response Action Planned (NFRAP) Decision Document will be prepared.

- If the concentration of any COPC in soil or groundwater exceeds its respective PAL, a risk assessment will be completed to quantify the potential risks to human health and the environment.
- If unacceptable risks are calculated, a FS will be completed to identify and evaluate remedial action alternatives.

Worksheet #17 outlines the samples to be collected to meet the decision statements described above.

11.3 INFORMATION INPUTS

Information needed to meet project quality objectives is presented below:

- Accurate groundwater potentiometric maps to display groundwater elevations and flow directions so that hydraulic gradients and flow velocities can be calculated.
- Accurate bore logs to evaluate subsurface migration pathways in the vadose and saturated zones.
- Accurate survey data to produce site maps and potentiometric surfaces.
- Rigorous sampling procedures to ensure results accurately represent field concentrations.
- Rigorous analytical methods to ensure laboratory result accurately measure and represent field concentrations.
- Previous soil and groundwater data collected during the PA/SI and the data acquired during this investigation will be included in a human health risk assessment.

This RI is being conducted to further evaluate the nature and extent of the contaminants at each site and to assess risk to human health and the environment. COPCs in environmental matrices will be screened and evaluated in the risk assessment using the PALs. Target analytes, analytical methods, and PALs are shown in Worksheet #15.

11.4 STUDY BOUNDARIES

The proposed sample locations are selected based on results from previous investigations. Samples will be collected from within each site boundary and where appropriate, may be collected external to the site boundary. **Figures 2** through **4** show the respective spatial boundaries for Sites ZZ007, TU008 and TU009.

11.5 ANALYTICAL APPROACH

Analytical data to be gathered at each site will augment data provided in the SI phase of the CERCLA process. The SI sampling focused on source areas with a limited number of soil borings and temporary wells, which are no longer available to sample, to determine presence or absence of COPCs. SI results, in conjunction with RI soil results, will be used in calculating the exposure point concentrations for soil during the risk assessment. Maximum RI results will be used to determine exposure point concentrations for groundwater.

Soil and groundwater data will be collected, analyzed, and validated in accordance with ANG Investigation Guidance (ANG, 2009) to define the nature and extent of contamination and for inclusion in the risk assessment. Definitive data associated with the RI will include soil and groundwater analytical results for VOCs by Method 8260C, SVOCs by Method 8270D, and metals by Method 6010C/7470A/7471A. All samples will be analyzed by TestAmerica; TestAmerica holds Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) accreditation and certification in the State of New York. TestAmerica will deliver environmental data in compliance with the DoD Quality System Manual (QSM) v5.0 (DoD, 2013), and electronic data deliverables (EDDs) will adhere to the latest specifications and structure of the Environmental Resources Program Information Management System (ERPIMS). Samples will be shipped to TestAmerica with the preservative and chain of custody (COC) requirements specified in Worksheet #27. Preservation requirements including temperature requirements for each analytical method are presented in Worksheet #19/#30.

The data and information collected during the RI will be electronically scanned, or otherwise duplicated, and archived in the project electronic file. Electronic data and documents will be stored on secure file servers that are backed up daily. Laboratory EDDs will be downloaded to an ERPToolsX database for preparation of an electronic ERPIMS deliverable and accessed for preparation of reporting tables and figures. During data validation, a data validator will enter the data validation qualifiers to the ERPToolsX database electronic file. The database records will be stored as part of the permanent project data file as indicated above.

All definitive data results provided by the laboratory will be validated. The data will be reviewed in accordance with requirements (in priority order) of the DoD QSM v5.0 and the analytical method. Validation flags will be applied pursuant to the USEPA's National Functional Guidelines (USEPA 2014a, 2014b). All definitive data will be validated according to the data validation procedures specified in Worksheet #35.

11.6 PERFORMANCE AND ACCEPTANCE CRITERIA

There are two types of decision errors: sampling design errors and measurement errors. Sampling design errors are a function of the selection of sample locations or analytical methods used to characterize the sites. Measurement errors are a function of the procedures used to collect and analyze the samples. The possible decision errors are:

- Concluding that a contaminant is present when it is not actually present. This type of error could result in investigating or cleaning up a non-impacted site.
- Concluding that a contaminant is not present when it is actually present. This type of error could result in not investigating or cleaning up an impacted site.

The following measures will reduce the uncertainty associated with these errors:

- The sampling design will be based on historical and current site reconnaissance, previous soil and groundwater investigations, and the site's environmental setting (e.g., topography and geology).
- Procedures for all field and reporting activities will follow Standard Operating Procedures (SOPs) (**Appendix C**) that follow ANG requirements and NYSDEC DER-10/Technical Guidance for Site Investigation and Remediation.
- Analytical laboratories are DoD ELAP accredited and state certified and will follow the DoD QSM v5.0.
- All definitive data will be compared to the measurement performance criteria specified in Worksheet #12 to determine acceptability of analytical laboratory results provided by the laboratory.

11.7 DESIGN FOR OBTAINING DATA

The sampling design for the site was developed to optimize resources and generate data to satisfy the project-specific DQOs. The sampling design and rationale is detailed in Worksheet #17 and #18. Worksheets #19, 20, 24–28, and 30 specify analytical requirements.

WORKSHEET #12 MEASUREMENT PERFORMANCE CRITERIA

Project Measurement Performance Criteria (MPC) are summarized in this worksheet to provide a data set that will achieve DQOs and support technically defensible project decisions. The criteria are related to the Data Quality Indicators (DQIs) of precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity. The criteria for each matrix and analytical group are consolidated from the DoD QSM v5.0 and the analytical methods, where applicable. The following parameters will be used to measure outliers associated with project results:

12.1 PRECISION

For each field duplicate and laboratory duplicate pair (including laboratory control sample [LCS]/laboratory control sample duplicate [LCSD] and matrix spike [MS]/matrix spike duplicate [MSD]), the relative percent difference (RPD) will be calculated for each analyte whose original and duplicate values are both greater than, or equal to, the limit of quantitation (LOQ). The RPDs will be checked against the measurement performance criteria presented on Tables 12-1 through 12-4. The RPDs exceeding criteria will be identified in the RI Report. Conclusions about the precision of the analyses and limitations on the use of the data will be described in the RI Report. Precision is most often expressed in terms of RPD:

$$RPD = 100 \times \left(\frac{C_R - C_D}{{[C_R + C_D]}/{2}} \right);$$

Where:

RPD = Relative Percent Difference
C_R = Measured concentration of the original sample result
C_D = Measured concentration of the duplicate sample result

12.2 ACCURACY/BIAS CONTAMINATION

Results for all laboratory method blanks and field blanks (e.g., trip blanks, field equipment rinsate blanks, and ambient field blanks) will be reviewed by the data validator. In addition, LCS/LCSDs, MS/MSDs, surrogates, post-digestion spikes, and serial dilutions will be reviewed. The results for each analyte will be checked against the measurement performance criteria presented on Tables 12-1 through 12-4 of Worksheet #12. Results for analytes that exceed criteria will be identified in the data validation report. A discussion will summarize the results of the laboratory accuracy/bias. Conclusions about the accuracy/bias of the analyses based on contamination or outlying recoveries and limitations on the use of the data will be described in the RI Report.

Bias values are commonly expressed as Percent Recovery (%R), which is calculated as follows:

$$\%R = \frac{C_S - C_R}{C_{Sknown}} \times 100;$$

Where:

%R = Percent Recovery
C_R = Measured concentration of the original sample result
C_S = Measured concentration of the spiked sample result
C_{Sknown} = Known concentration of the spike added

12.3 REPRESENTATIVENESS

As described by the Intergovernmental Data Quality Task Force (IDQTF) UFP-QAPP Manual (USEPA, 2005a), representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental condition of the site, and takes into consideration the magnitude of the site area represented by one sample and indicates the feasibility and reasonableness of that design rationale. Representativeness also reflects the ability of the sampling team to collect samples and the ability of the laboratory to analyze those samples so that the generated data accurately and precisely reflect site conditions.

Field and laboratory sampling and subsampling techniques will follow sampling and laboratory SOPs that specify premixing/homogenization procedures to ensure that all sub-samples taken from a given sample or sampling point are representative of the sample as a whole. Soil samples requiring volatile analysis (VOCs) will not undergo any premixing or homogenization. Representativeness will be assessed by a review of the precision obtained by analysis of field and laboratory duplicate samples. Representativeness will also be assessed through documentation of proper sample handling techniques and the use of field blanks (e.g., equipment rinsate blanks and trip blanks) and laboratory method blanks. Previous project data may be employed to assess the representativeness of a population by defining the continuity of data from point to point.

12.4 COMPARABILITY

Sample data will be comparable for similar samples and sample conditions. This goal will be achieved using standard techniques to collect representative samples, consistent application of analytical method protocols, and reporting analytical results with appropriate units.

12.5 COMPLETENESS

A completeness check will be done on all of the data generated by the laboratory. Completeness criteria are presented on Tables 12-1 through 12-4. As described by the IDQTF UFP-QAPP Manual (USEPA, 2005a), completeness is a measure of the amount of valid data collected using a measurement system and is expressed as a percentage of the number of measurements that are specified in the UFP-QAPP.

The percentage of valid data points will be calculated by dividing the number of valid (i.e., non-rejected) data points by the total number of data points expected. Analytical results qualified as rejected during data validation are not considered “valid.” A discussion summarizing data completeness will be included in the RI Report. Conclusions about the completeness of the data and limitations on the use of the data will be described in the RI report.

12.6 SENSITIVITY

As defined by the IDQTF UFP-QAPP Manual (USEPA, 2005a), sensitivity is the ability of the method or instrument to detect target analytes at the level of interest. As defined by DoD QSM 5.0, the LOQ is the smallest concentration that produces a quantitative result with known and recorded precision and bias. The DoD LOQ is set at or above the concentration of the lowest initial calibration standard and is within the calibration range. The DoD QSM 5.0 defines the Limit of Detection (LOD) as the smallest concentration that must be present in order to be detected with 99% confidence. Non-detections are reported at the LOD.

Worksheet #15 includes the LODs and LOQs as well as the site PALs for each analyte The project team will compare the LODs against the site PALs for each analyte to ensure, wherever possible, that the selected analytical method will achieve the site PALs. In the event that the PAL cannot be achieved by the method, the RI Report will discuss the limitations on the use of the data with respect to laboratory sensitivity.

In accordance with DoD QSM 5.0 requirements, the laboratory is required to run quarterly LOQ standards and quarterly LOD standards except for analyses that are used on an infrequent basis, for which LOQ and LOD verification may be performed on a batch basis. The results of the LOQ and LOD verification standards are typically not included in the data packages, but results are retained by the laboratory and are available for review upon request.

A discussion in the RI report will summarize the results of the laboratory sensitivity. Conclusions about the sensitivity of the analyses and will be described in the RI Report.

Measurement Performance Criteria for each matrix and analytical group are compiled in Tables 12-1 through 12-4.

Table 12-1 Measurement Performance Criteria Table for VOCs

Matrix	**Water, Soil**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference[1]	**SW8260C**

Data Quality Indicator (DQI)	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**
Accuracy/Bias (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). For common laboratory contaminants, no analytes detected > LOQ.
Accuracy/Bias	LCS and LCSD	Water: QSM 5.0 Appendix C Table 24 control limits Soil: QSM 5.0 Appendix C Table 23 control limits
Accuracy/Bias (matrix)	MS and MSD	Water: QSM 5.0 Appendix C Table 24 control limits Soil: QSM 5.0 Appendix C Table 23 control limits
Precision	Internal Standards (IS)	Retention times ± 10 seconds from retention time of midpoint standard in the ICAL; and EICP area within -50 to + 100% of ICAL midpoint standard
Accuracy/Bias	Surrogates	Soil: 1,2-Dichloroethane-d4: 71-136%R; 4- Bromofluorobenzene: 79-119%R Dibromofluoromethane: 78-119%; Toluene-d8: 85-116%R Water: 1,2-Dichloroethane-d4: 81-118%R; 4- Bromofluorobenzene: 85-114%R; Dibromofluoromethane: 80-119%R; Toluene-d8: 89-112%R
Precision (laboratory)	LCS/LCSD[2]	RPD ≤ 20%
Precision (matrix interference)	MS/MSD	RPD ≤ 20%
Overall Precision	Field duplicates	Water RPD ≤ 30% when analytes are detected in both samples ≥ LOQ Soil RPD ≤ 50% when analytes are detected in both samples ≥ LOQ
Accuracy/Bias (Overall 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). For common laboratory contaminants, no analytes detected > LOQ.
Accuracy/Bias (Overall Contamination)	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). For common laboratory contaminants, no analytes detected > LOQ.
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a blank matrix at 2 to 4 times the DL. The apparent signal to noise (S/N) ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification.

Table 12-1 Measurement Performance Criteria Table for VOCs (Continued)

Matrix	**Water, Soil**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference[1]	**SW8260C**

Data Quality Indicator (DQI)	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Sensitivity	LOQ Determination and Verification	Ideally the LOQ should be at least 3 to 10 times less than the PAL. The laboratory LOQ is to be within the calibration range of the instrument. The LOQ must be greater than the LOD.
Completeness	Data completeness check	≥ 95%

Table 12-2 Measurement Performance Criteria Table for SVOCs

Matrix	**Water, Soil**	
Analytical Group	**SVOCs**	
Analytical Method/ SOP Reference[1]	**SW8270D**	
Data Quality Indicator (DQI)	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**
Accuracy/Bias (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). For common laboratory contaminants, no analytes detected > LOQ.
Accuracy/Bias	LCS and LCSD	Water: QSM 5.0 Appendix C Table 26 control limits Soil: QSM 5.0 Appendix C Table 25 control limits
Accuracy/Bias	MS/MSD	Water: QSM 5.0 Appendix C Table 26 control limits Soil: QSM 5.0 Appendix C Table 25 control limits
Precision	Internal Standards (IS)	Retention times ± 10 seconds from retention time of midpoint standard in the ICAL; and EICP area within -50 to + 100% of ICAL midpoint standard
Accuracy/Bias	Surrogates	Soil: 2-Fluorobiphenyl: 44-115%R; Terphenyl-d14: 54-127%R 2-Fluorophenol: 35-115%R; 2,4,6-Tribromophenol: 39-132%R Phenol-d5: 33-122%R; Nitrobenzene-d5: 37-122%R Water: 2-Fluorobiphenyl: 44-119%R; Terphenyl-d14: 50-134%R 2-Fluorophenol: 19-119%R; 2,4,6-Tribromophenol: 43-140%R Phenol-d5: 10-115%R; Nitrobenzene-d5: 44-120%R
Precision (laboratory)	LCS/LCSD[2]	RPD ≤ 20%
Precision (matrix interference)	MS/MSD	RPD ≤ 20%
Overall Precision	Field duplicates	Water RPD ≤ 30% when analytes are detected in both samples ≥ LOQ Soil RPD ≤ 50% when analytes are detected in both samples ≥ LOQ
Accuracy/Bias (Overall Contamination)	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). For common laboratory contaminants, no analytes detected > LOQ.
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a blank matrix at 2 to 4 times the DL. The apparent signal to noise (S/N) ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification.
Sensitivity	LOQ Determination and Verification	Ideally the LOQ should be at least 3 to 10 times less than the PAL. The laboratory LOQ is to be within the calibration range of the instrument. The LOQ must be greater than the LOD.
Completeness	Data completeness check	≥ 95%

Table 12-3 Measurement Performance Criteria Table for Metals by ICP-AES Metals

Matrix	**Water, Soil**
Analytical Group	**Metals**
Analytical Method/ SOP Reference[1]	**SW6010C**

Data Quality Indicator (DQI)	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Accuracy/Bias (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). For common laboratory contaminants, no analytes detected > LOQ.
Accuracy/Bias	LCS/LCSD	Water: QSM 5.0 Appendix C Table 4 control limits Soil: QSM 5.0 Appendix C Table 3 control limits
Accuracy/Bias	MS/MSD	Water: QSM 5.0 Appendix C Table 4 control limits Soil: QSM 5.0 Appendix C Table 3 control limits
Precision (laboratory)	LCS/LCSD[2]	RPD ≤ 20%
Precision (matrix interference)	MS/MSD	RPD ≤ 20%
Overall Precision	Field duplicates	Water RPD ≤ 30% when analytes are detected in both samples ≥ LOQ Soil RPD ≤ 50% when analytes are detected in both samples ≥ LOQ
Accuracy/Bias (Overall Contamination)	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). For common laboratory contaminants, no analytes detected > LOQ.
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a blank matrix at 2 to 4 times the DL. The apparent signal to noise (S/N) ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification.
Sensitivity	LOQ Determination and Verification	Ideally the LOQ should be at least 3 to 10 times less than the PAL. The laboratory LOQ is to be within the calibration range of the instrument. The LOQ must be greater than the LOD.
Completeness	Data completeness check	≥ 95%

Table 12-4 Measurement Performance Criteria Table for Mercury

Matrix	**Water, Soil**
Analytical Group	**Metals**
Analytical Method/ SOP Reference[1]	**SW7470A or SW7471A**

Data Quality Indicator (DQI)	QC Sample or Measurement Performance activity	Measurement Performance Criteria
Accuracy/Bias (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). For common laboratory contaminants, no analytes detected > LOQ.
Accuracy/Bias	LCS/LCSD	Water: QSM 5.0 Appendix C Table 12 control limits Soil: QSM 5.0 Appendix C Table 11 control limits
Accuracy/Bias	MS/MSD	Water: QSM 5.0 Appendix C Table 12 control limits Soil: QSM 5.0 Appendix C Table 11 control limits
Precision (laboratory)	LCS/LCSD[2]	RPD ≤ 20%
Precision (matrix interference)	MS/MSD	RPD ≤ 20%
Overall Precision	Field duplicates	Water RPD ≤ 30% when analytes are detected in both samples ≥ LOQ Soil RPD ≤ 50% when analytes are detected in both samples ≥ LOQ
Accuracy/Bias (Overall Contamination)	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). For common laboratory contaminants, no analytes detected > LOQ.
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a blank matrix at 2 to 4 times the DL. The apparent signal to noise (S/N) ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification.
Sensitivity	LOQ Determination and Verification	Ideally the LOQ should be at least 3 to 10 times less than the PAL. The laboratory LOQ is to be within the calibration range of the instrument. The LOQ must be greater than the LOD.
Completeness	Data completeness check	≥ 95%

Notes for all Worksheet #12 tables:

[1] – Laboratory SOPs are listed on Worksheet #23

[2] - LCS/LCSD may be performed for precision in lieu of MS/MSD.

%R – Percent recovery
> – Greater Than
≥ – Greater Than or Equal To
≤ – Less Than or Equal To
± – Plus or Minus
DL – Detection Limit
DQI – Data Quality Indicator
EICP – Extracted Ion Current Profile
ICAL – Initial Calibration
ICP-AES - Inductively Coupled Plasma-Atomic Emission Spectroscopy
IS – Internal Standards
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LOD – Limit of Detection
LOQ – Limit of Quantitation
MS – Matrix Spike
MSD – Matrix Spike Duplicate
PAL – Project Action Limit
QC – Quality Control
QSM – Quality System Manual
RPD – Relative Percent Difference
SOP – Standard Operating Procedure
S/N – Signal to Noise
SVOC – Semivolatile Organic Compound
SW-846 – Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
VOC – Volatile Organic Compound
USEPA – Environmental Protection Agency, refers to the EPA’s Methods for Chemical Analysis of Water and Wastes

WORKSHEET #13 SECONDARY DATA CRITERIA AND LIMITATIONS

This worksheet identifies sources of historical data pertinent to project decisions. For each data source, the following considerations were evaluated: whether the data were validated or reviewed, whether the analytical methodologies or technical protocols are comparable to current data handling procedures, and if limitations on use of the data can be identified.

Table 13-1 Secondary Data Criteria and Limitations

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Site history and soil and groundwater sample analytical data	AECOM Final Regional Compliance Restoration Program Preliminary Assessment/Site Inspection Report Schenectady Air National Guard Base, Scotia, New York. August 2015.	AECOM Advancement of five soil borings at ZZ007 (ZZ07SB01 – ZZ07SB05); collection of 8 total soil samples. Collection of groundwater samples from temporary monitoring wells installed in boreholes ZZ07SB02 and ZZ07SB05. Advancement of five soil borings at TU008 (TU08SB06 – TU08SB10); collection of five soil samples; and collection of groundwater from a temporary monitoring well installed all boreholes (TU08SB06 – TU08SB10). Advancement of four soil borings at TU009 (TU09SB11 – TU09SB14); collection of six soil samples; and collection of groundwater from a temporary monitoring well installed all boreholes (TU09SB12 and TU09SB13). Samples collected in November 2014	▪ -General site history. ▪ -Historical media analysis results. ▪ -Locate current/RI sampling locations and to determine COPCs.	Data were collected using USEPA methods, and all data were validated. As a result of the data validation performed for the PA/SI, the quality of the SI data was determined as acceptable for the preparation of technically defensible documents. Soil data will be used for site characterization, delineation, and risk assessment in the RI. SI groundwater samples were collected as grab or temporary well samples; SI groundwater data was used to optimize the sampling design for the RI but will not be used in the risk assessment

Notes:

COPC – Chemicals of Potential Concern
PA – Preliminary Assessment
RI – Remedial Investigation
SI – Site Inspection
USEPA – United States Environmental Protection Agency

WORKSHEETS #14 AND #16 PROJECT TASKS AND SCHEDULE

14.1 PROJECT TASKS

The implementation of the RI will consist of several project tasks including, but not limited to: securing access to the installation and obtaining digging permits; utility clearance; investigation-derived waste (IDW) staging, management, and disposal; surveying; groundwater monitoring well installation, photoionization detector (PID) monitoring; soil sampling; groundwater sampling; data management; and documentation and record keeping. SOPs have been developed to cover all aspects of field operations, environmental sampling, field measurements, and record keeping. SOPs are included in **Appendix C**.

14.2 MOBILIZATION TASKS

Mobilization tasks will occur prior to initiating sampling tasks.

14.2.1 Installation Access and Digging Permits

Installation access permits will be obtained prior to the field team arriving at the Schenectady ANGB. This task includes preparing a “Contractor Request Letter for Access to Schenectady ANGB” that will be provided to the Installation Environmental Manager (EM) and following any installation-specific instructions for access.

Digging permit requests will be completed prior to any digging or intrusive work in accordance with the procedures outlined in the SOP G-8 “Utility Location” (**Appendix C**).

14.2.2 Utility Clearance

As required by the Digging Permit, prior to any intrusive investigation, the Schenectady ANGB EM will be notified and locations of all utilities will be verified within 10 ft of each /drilling location. Each drilling/boring location will be marked and then screened for utilities using geophysical techniques, such as ground penetrating radar (GPR). If anything indicates that utilities may be present, the boring location will be moved to an area that is definitively cleared.

14.2.3 Investigation-Derived Waste

Prior to intrusive activities, a staging area for solid and liquid waste will be determined that will allow storage of 55-gallon metal drums for solid (soil) waste and 55-gallon close-top drums for storage of liquid waste. Waste containers will include soil cuttings and water from well development/purging activities and decontamination activities. All drums will be labeled to identify locations and contents, as well as the contract and DO as described in Subsection 14.2.3.1 and in SOP G-7, “Management of Investigation Derived Waste” (**Appendix C**). All IDW storage containers and contents will be removed within the appropriate timeframe, after the contents have been categorized for disposal.

14.2.3.1 Investigation-Derived Waste Management

A Waste Inventory Tracking Log will be kept by the Field Team Leader during sampling events (**Appendix D**). Non-investigative waste, such as litter and household garbage, will be collected on an as-needed basis to maintain each site in a clean and orderly manner. This waste will be containerized and transported to the designated sanitary landfill or collection bin. The containers will be sealed boxes or plastic garbage bags.

IDW will be properly containerized and temporarily stored at a central staging area, prior to transportation for off-site disposal. IDW will be properly labeled, containerized, and stored. The number of containers will be estimated on an as-needed basis. Acceptable containers will be sealed, Department of Transportation

(DOT)-approved metals drums (solid) and polyurethane close-top drums (liquid). Containers will be transported in such a manner to prevent spillage or particulate loss to the atmosphere.

The IDW will be segregated at the site according to matrix (solid or liquid). Each container will be properly labeled. Label information will be placed directly on the container with indelible ink pen and on a plastic-coated adhesive label with indelible marker (Sharpie™). All containers will be labeled with the following information:

1. Container number.
2. Contract and DO number.
3. Contents (development water and well identifiers).
4. Dates of development activities.
5. ANG EM name and phone number.

Information for drums will be recorded on the Waste Inventory Tracking Log (**Appendix D**).

All containerized waste will be staged in an area designated by the Schenectady ANGB representative. The waste may require staging for up to 90 days while waiting for analytical results and proper profiling before shipping the waste off-site.

The ANG CEV Policy 05-1 for IDW/RDW (ANG, 2005) or Environmental Restoration Program Investigation Guidance, Appendix B (ANG, 2009) will be used to assist in IDW management where necessary. SOPs for handling and sampling IDW are provided in **Appendix C** as SOP G-7.

14.2.3.2 Investigation-Derived Waste Sampling

Soil cuttings generated during soil sampling and well installations will be sampled and analyzed in accordance with local landfill requirements.

For soil cuttings placed in drums, each drum will be opened and scanned using a PID. A soil column from each drum will be removed, and a composite sample will be collected from grab samples from all drums using the following methods when required for waste characterization:

- For volatile analyses, four aliquots will be randomly collected from each drum. The aliquots will be composited in a separate 4-ounce jar for IDW analysis of Resource Conservation and Recovery Act (RCRA) VOCs by toxicity characteristic leaching procedure (TCLP).
- For nonvolatile analyses, sample aliquots will be collected and placed in a clean plastic baggie or stainless steel bowl and homogenized for one minute. One sample will then be collected directly into the sample container for each analysis, as defined by the analytical method in Worksheet #19, UFP-QAPP.
- Samples will be analyzed for RCRA VOCs, RCRA SVOCs, and RCRA metals by TCLP or parameters in accordance with local landfill requirements. Samples will also be analyzed for corrosivity (pH) and flashpoint if required by the disposal facility.

IDW soil samples will be collected into containers specific for each analysis, as defined in Worksheet #19.

Investigation-derived water will be containerized into 30-gallon polyurethane closed-top drums. Laboratory analytical data collected as part of the groundwater investigation will be utilized for compliance with disposal facility requirements.

The TEC-Weston JV will provide a preliminary waste characterization for the containerized IDW based on RCRA characteristics, pH, and flashpoint for soil and investigative analytical results for groundwater. The analytical data will be reviewed to determine if the waste exhibits a hazardous waste characteristic as identified at 40 *Code of Federal Regulations*, Part 261, Subpart C, and recommend a disposal option. The preliminary waste characterization will be submitted to the Schenectady ANGB EM for review and for waste determination (including determination on whether the IDW is regulated as a listed hazardous waste).

After the manifest(s) and other appropriate documentation is signed by a Schenectady ANGB representative, the TEC-Weston JV will coordinate the pickup and provide the transporter with the relevant portions of the manifest on behalf of the Schenectady ANGB. Off-site disposal of IDW was be coordinated as soon as possible after the completion of work; drums will be removed from the site before winter so they are not damaged by freezing. The TEC-Weston JV will provide the Schenectady ANGB EM with the original generator copy of the waste manifest subsequent to release of the shipment. The treatment/disposal facility-signed generator copy should be returned directly to the TEC-Weston JV PM by the treatment/disposal facility within 30 days of shipment. The TEC-Weston JV PM will forward the required copy to the Schenectady ANGB and, on behalf of the Schenectady ANGB, to the appropriate agency contacts.

14.3 GROUNDWATER MONITORING WELL INSTALLATION

Permanent groundwater monitoring wells (MWs) will be installed using hollow-stem-auger (HSA) techniques. Three new permanent MWs will be installed at ZZ007 in the shallow aquifer to a depth of approximately 7 to 8 ft bgs above the bedrock to assess COPC concentrations in upgradient, suspected source, and downgradient positions. Four new permanent MWs will be installed at TU008 in the shallow aquifer to a depth of approximately 7 to 10 ft bgs above the bedrock to assess COPC concentrations in upgradient, suspected source, and downgradient positions. Three new permanent MWs will be installed at TU009 in the shallow aquifer to a depth of approximately 7 to 10 ft bgs above the bedrock to assess COPC concentrations in upgradient, suspected source, and downgradient positions.

All groundwater MWs will be:

- Completed as flush mounts;
- Constructed with 2-inch schedule 40 polyvinyl chloride (PVC) blank casing and 5-ft (as feasible) 0.010 slot size screen;
- Screened at the unconsolidated soil/bedrock interface, not above it. The bottom of the well below the screen will likely be set into the bedrock as to allow the screen to capture the water interface directly above the bedrock.
- Developed in accordance with the SOP W-2 “Well Development” in **Appendix C** to remove sediments and ensure representative aquifer samples; and
- Surveyed for vertical and horizontal location by a state-certified surveyor, including a groundwater measurement datum located at the north point of the top of casing (as marked), with precision/accuracy of ± 0.1-ft horizontal and ± 0.01-ft vertical.

Groundwater MW construction details are further described in the SOP W-1 “Monitoring Well Installation” included in **Appendix C.**

14.3.1 Groundwater Elevation Measurements

Groundwater elevations will be measured at each groundwater MW that is surveyed to the accuracy described above at least twice during each sampling event, in accordance with the following procedures and the SOP W-3 “Water Level and Depth Measurements” in **Appendix C**:

- Groundwater elevations will be measured immediately before sample purging, following release of cap pressure and before any sampling activities that will have the potential to affect water levels within the well to be unrepresentative of the surrounding static water level of the aquifer.
- Groundwater elevations will be measured in a single water level collection event, prior to any site well purging, where the water levels in all wells in the sampling network are gaged uninterruptedly

least likely to show temporal changes, such as barometric pressure induced water level changes. These events will be used to a develop potentiometric surface.

14.3.2 Hydraulic Conductivity Testing

Hydraulic conductivity testing (slug testing) will be completed, when determined to be necessary after the first groundwater monitoring event and as feasible, at the newly installed monitoring wells to estimate horizontal hydraulic conductivity values, in accordance with the following procedures and the SOP W-6 “Slug Test Aquifer Testing” in **Appendix C**. Hydraulic conductivity testing will not be necessary for the site conditions that will lead to NFRAP at a site.

- The depth to water in each well will be measured with an electronic water level meter prior to initiating testing activities.
- An appropriate pressure transducer will then be lowered into the monitoring well to approximately 1 to 2 ft from the bottom of the well and allowed to stabilize. The transducer data will be accessed prior to initiating each test to confirm that the equipment is functioning properly.
- A slug will be used to create the necessary water displacements within each well during the falling and rising head tests. For the falling head test, the slug will be introduced to the water column, as quickly as possible, until it is fully submerged.
- A data logger will continuously record water level displacement values using a logarithmic setting for the initial 10 minutes of each test, followed by a linear setting for the remainder of each test. A test will be considered complete when the water level in the well has recovered a minimum of 75% from the initial displacement, as indicated from the real-time data logger readings.
- For the subsequent rising head test, the slug will be removed from the water column, as quickly as possible, and the resulting displacements continuously recorded with the data logger using the same frequency of readings as the falling head test. Upon completion of the rising head test and following re-stabilization of the water table, these falling and rising head test procedures will be immediately repeated in each monitoring well utilizing the same slug.

14.4 SAMPLING TASKS

The locations of the soil borings and new MWs to be sampled are described in Worksheet #17. The samples to be collected are outlined in Worksheet #18, and the sampling requirements for each type of analysis (e.g., bottle ware, preservation, and holding time) are listed in Worksheet #19.

14.4.1 Soil Samples

Subsurface soil samples will be collected continuously to the total depth of each boring using a hollow stem auger. Formation samples for lithologic description will be obtained at 5-foot intervals. Soil will be monitored using an organic vapor analyzer (e.g., PID). Soil cuttings will be examined for color, odor, and PID readings and will be containerized in accordance with state and local requirements.

Soil samples will be collected from the HSA system (e.g., inner drill rods with a sampler barrel or wireless latching system with a core barrel) in accordance with the SOP SS-1 “Soil Sampling” and SOP SS-3 “Soil Sampling Using Hollow Stem Auger Technology” included in **Appendix C**. For each boring, the borehole location, lithology, drilling information, sample intervals, and sample description will be logged on a drill log form (**Appendix D**).

Soil samples for analysis will be collected from each of the Schenectady ANGB sites as identified in Worksheet #17.

14.4.2 Groundwater Samples

Groundwater samples will be collected from new groundwater MWs and one existing MW (identified as MWUNK) at ZZ007. A minimum of 24 hours will be allowed to elapse between development and sampling to ensure the groundwater surrounding the well has had sufficient time to equilibrate. Monitoring wells will be purged and sampled using low-flow techniques using a bladder, variable- or low-speed submersible, or peristaltic pump with an adjustable flow rate in accordance with the SOP W-4 “Low Stress (Low Flow) Groundwater Purging and Sampling” included in **Appendix C**. In each well, the pump will be positioned in the middle of the water bearing portion of the well screen interval. The purge water discharge will be monitored via a flow through cell for the water quality indicator parameters of temperature, pH, specific conductivity, turbidity, oxidation-reduction potential (ORP), and dissolved oxygen. Samples will be collected after water quality parameters have stabilized, as described in SOP W-4 in **Appendix C**, or after a maximum of three hours of low-flow purging. For each well, the water quality readings for parameter stabilization will be recorded on the groundwater sample log sheet.

Groundwater samples for analysis will be collected from each of the Schenectady ANGB sites as identified in Worksheet #17.

14.5 ANALYSIS TASKS

Chemical analysis will be performed by TestAmerica Denver and TestAmerica St. Louis (VOCs only) Laboratories. Chemical analyses will be performed in accordance with this UFP-QAPP, the DoD QSM 5.0, and the analytical methods. The laboratory will meet the LODs specified in Worksheet #15.

14.6 QUALITY CONTROL SAMPLES

The following QC samples will be collected for all methods and matrices: field duplicates and MS/MSDs. Field duplicates will be collected from areas known or suspected to be contaminated. Triple sample volume will be collected for MS/MSDs from relatively clean sampling locations (e.g., upgradient) to capture effects of the matrix sampled.

Trip blanks, prepared by the laboratory using water demonstrated to be free of COPCs, will be placed in the cooler used to ship volatile samples (e.g., VOCs). Disposable sampling equipment (i.e., plastic scoops, disposable tubing, disposable macro-core liners, etc.) will be utilized to the extent practical in the field to minimize cross contamination and the need for equipment blanks. If non-dedicated sampling equipment is used, equipment blanks will be collected at a frequency of one per event and analyzed for the same analytes as the samples. A temperature blank will be placed in each cooler to ensure that samples are preserved at or below six degrees Celsius during shipment.

Worksheet #20 specifies the number and type of QC sample as well as the frequency of collection.

14.7 SECONDARY DATA

Secondary data summarized in Worksheet #13 will be reviewed and evaluated for project use. As a result of the data validation performed for the SI (AECOM, 2015), the quality of the SI data was determined as acceptable for the preparation of technically defensible documents. The SI soil data will be used for site characterization, delineation, and included in the risk assessment in the RI. SI groundwater samples were collected as grab or temporary well samples; SI groundwater data was used to optimize the sampling design for the RI. Only RI groundwater data will be used in the risk assessment.

14.8 DATA MANAGEMENT TASKS

Field forms will be electronically generated and reviewed by the Field Team Leader prior to sample shipment. The sample handling and custody requirements, including field logs, sample collection paperwork, sample labels, and custody seals as described in Worksheets #26 and #27 will be followed. To facilitate the use of the ERPIMS database, the ERPIMS Data Manager will provide the laboratory with an electronic file which contains project sampling event information, the ANG base, the contract and task order number, the beginning and ending sampling dates, and type of sampling for all samples collected.

The Project Chemist will track the samples during analysis and through data validation. All final laboratory data will be submitted in a format consistent with Contract Laboratory Program-like deliverables. Data validation will be performed by TEC-Weston JV validators or a subcontracted validation firm in accordance with the procedures described in Worksheets #35 and #36. The validator will review all definitive analytical data (VOCs and SVOCs results) and will note any validation findings in data validation reports. Data validation reports will be submitted as an appendix of the RI Report. Validation qualifiers will be entered into an ERPIMS-compatible spreadsheet by the data validator. A 100 percent QC check will be performed by TEC-Weston JV project chemist (or designee) to ensure accuracy of all hand-entered data (e.g., validation flags). Sample locations, field measurements, and laboratory analytical data will be uploaded into the ERPIMS database after validation.

14.9 DOCUMENTATION AND RECORDS

Information regarding field tasks will be recorded in the on-site field logs in accordance with SOP G-1 “Field Documentation”. Sample collection information will be recorded on individual sample field forms. Any changes that are made to the field logs or the field forms will be initialed and dated. Documents will be maintained in project files and will be submitted as an appendix to the RI Report. Chain-of-custody forms and airbills will also be completed for each sampling event. SOPs for general recordkeeping and logbook are provided in **Appendix C** in SOP G-1**.** Field Forms are provided in **Appendix D**.

14.10 BASELINE RISK ASSESSMENT

A human health risk assessment will be conducted to assist risk managers with the decision-making process in determining the cleanup or other exit strategies to be implemented at Schenectady ANGB Sites ZZ007, TU008 and TU009. The risk assessment will be conducted in accordance with the most current USEPA, NGB/A4OR guidance (ANG, 2009), and NYSDEC DER-10 Technical Guidance. Consistent with Superfund human health risk assessment guidance (USEPA, 1989), the risk assessment will include the following items:

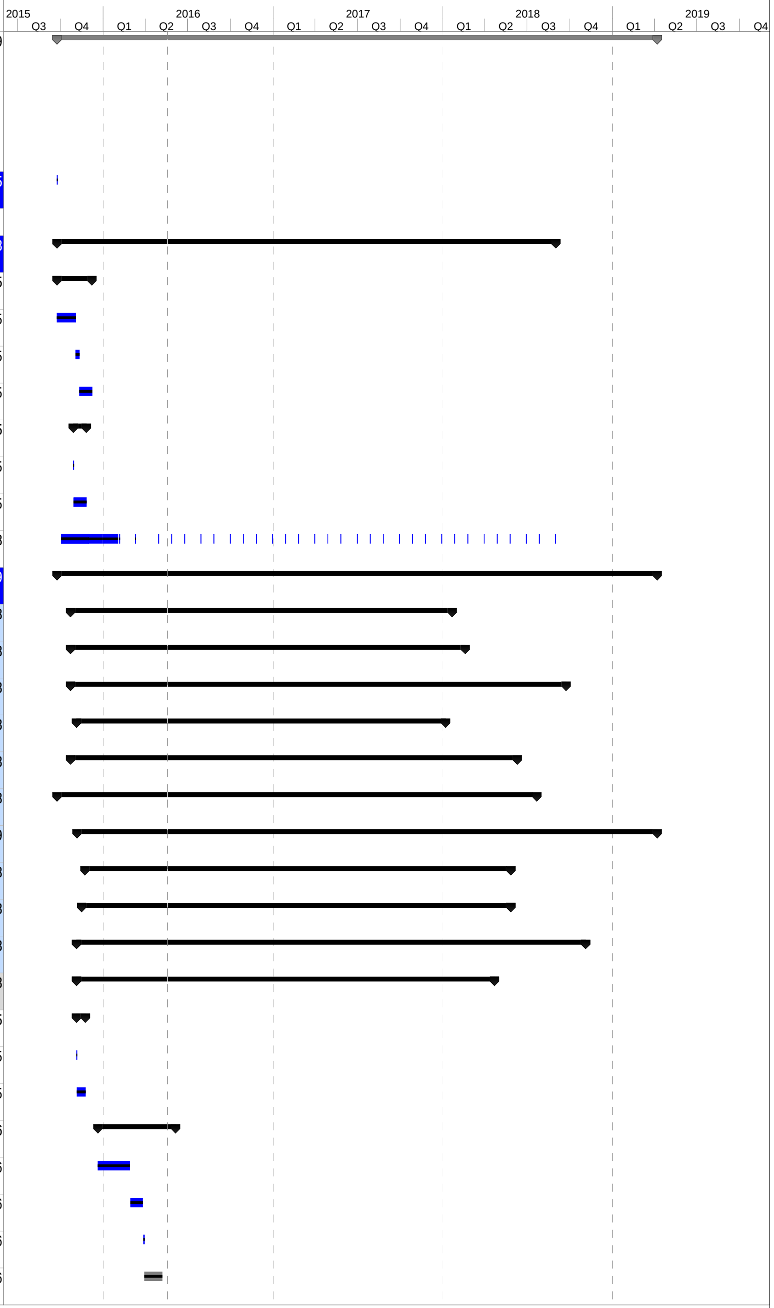
- Selection of Exposure Pathways and Receptors;
- Occurrence, Distribution, and Selection of COPCs;
- Exposure Point Selection and Concentration Summaries;
- Values Used for Daily Intake Calculations;
- Toxicity Values, a list of published toxicity values;
- Calculation of Chemical Cancer Risks and Non-Cancer Hazards; and
- Summary of Receptor Risks and Hazards for COPCs.

The areas surrounding the sites are extensively developed. Therefore surface soil is minimal, and any exposed soil is regularly maintained and altered through mowing and landscaping. The development of the sites results in the absence of ecological habitat on the sites. There is no surface water within the sites, and no connection of site groundwater to surface water; therefore, no connection to offsite aquatic ecological habitat. As such, a quantitative ecological risk assessment will not be used to assess the potential adverse impacts to ecological receptors exposed to contaminants in surface soil since a complete exposure pathway does not exist.

The table below shows the tentative schedule of the major project activities to be performed at ZZ007, TU008, and TU009.

DETAIL SCHEDULE - NERS RI/FS NEW ENGLAND ANG INSTALLATIONS

ID	Task	Task Name	ⓘ	Finish Variance	Duration	Baseline Start	Baseline Finish	Actual Start	Actual Finish	Start	Finish
0		Newly Evaluated Restoration Sites Remedial Investigations/Feasibility Studies at Multiple Air National Guard Installations New England Region Project # ANG2015NEWENGLAND		-25 days	914 days	Thu 9/24/15	Sat 5/11/19	Thu 9/24/15	NA	Thu 9/24/15	Sat 4/6/19
1	0	CONTRACT AWARD	✓	1 day	1 day	Thu 9/24/15	Thu 9/24/15	Thu 9/24/15	Thu 9/24/15	Thu 9/24/15	Thu 9/24/15
2											
3		TASK ORDER PLANNING		0 days	759 days	Thu 9/24/15	Fri 8/31/18	Thu 9/24/15	NA	Thu 9/24/15	Fri 8/31/18
4	1.1	Quality Control Plan (QCP)	✓	15 days	52 days	Thu 9/24/15	Fri 11/13/15	Thu 9/24/15	Mon 12/7/15	Thu 9/24/15	Mon 12/7/15
5		Prepare Draft QCP	✓	6 days	28 days	Thu 9/24/15	Sat 10/24/15	Thu 9/24/15	Mon 11/2/15	Thu 9/24/15	Mon 11/2/15
6		ANG Review and Comment	✓	2 days	6 days	Mon 10/26/15	Fri 11/6/15	Tue 11/3/15	Tue 11/10/15	Tue 11/3/15	Tue 11/10/15
7		Final QCP	✓	15 days	18 days	Mon 11/9/15	Fri 11/13/15	Wed 11/11/15	Mon 12/7/15	Wed 11/11/15	Mon 12/7/15
8	1.2	Project Kick Off (KO) Meeting	✓	34 days	20 days	Thu 10/1/15	Thu 10/8/15	Thu 10/29/15	Wed 11/25/15	Thu 10/29/15	Wed 11/25/15
9		Project Kick Off Meeting at A4OR	✓	20 days	1 day	Thu 10/1/15	Thu 10/1/15	Thu 10/29/15	Thu 10/29/15	Thu 10/29/15	Thu 10/29/15
10		Prepare Kick Off Meeting Minutes	✓	34 days	19 days	Fri 10/2/15	Thu 10/8/15	Fri 10/30/15	Wed 11/25/15	Fri 10/30/15	Wed 11/25/15
11	1.3	Period Progress Reports (PPR)		0 days	752 days	Fri 10/30/15	Fri 8/31/18	Sat 10/3/15	NA	Sat 10/3/15	Fri 8/31/18
47		INSTALLATION FIELD WORK AND REPORTS		-25 days	914 days	Thu 9/24/15	Sat 5/11/19	Thu 9/24/15	NA	Thu 9/24/15	Sat 4/6/19
48	2	East Granby, CT - 2 Sites		-85 days	578 days	Fri 10/9/15	Sat 5/19/18	Fri 10/23/15	NA	Fri 10/23/15	Sat 1/20/18
134	3	Burlington, VT - 1 Site		-75 days	598 days	Fri 10/9/15	Sat 6/2/18	Fri 10/23/15	NA	Fri 10/23/15	Sat 2/17/18
178	4	Gabreski, NY - 2 Sites		-20 days	753 days	Fri 10/9/15	Sat 10/20/18	Fri 10/23/15	NA	Fri 10/23/15	Sat 9/22/18
267	5	Hancock, NY - 1 Site		-20 days	559 days	Wed 10/14/15	Sat 2/3/18	Thu 11/5/15	NA	Thu 11/5/15	Sat 1/6/18
308	6	Harrisburg, PA - 1 Site		-20 days	678 days	Fri 10/9/15	Sat 7/7/18	Fri 10/23/15	NA	Fri 10/23/15	Sat 6/9/18
355	7	Martin State, MD - 3 Sites		-25 days	729 days	Thu 9/24/15	Sat 8/25/18	Thu 9/24/15	NA	Thu 9/24/15	Sat 7/21/18
484	8	McLaughlin (Yeager) Charlestown, WV - 3 sites		-25 days	883 days	Mon 10/19/15	Sat 5/11/19	Fri 11/6/15	NA	Fri 11/6/15	Sat 4/6/19
644	9	Pease, NH - 2 Sites		-15 days	647 days	Fri 10/9/15	Sat 6/16/18	Mon 11/23/15	NA	Mon 11/23/15	Sat 5/26/18
731	10	Quonset, RI - 2 Sites		0 days	652 days	Wed 10/14/15	Sat 5/26/18	Mon 11/16/15	NA	Mon 11/16/15	Sat 5/26/18
817	11	Schenectady, NY - 3 Sites		-20 days	774 days	Mon 10/19/15	Sat 12/1/18	Thu 11/5/15	NA	Thu 11/5/15	Sat 11/3/18
818		ZZ007-Former Building 13 Area		-15 days	634 days	Mon 10/19/15	Sat 5/12/18	Thu 11/5/15	NA	Thu 11/5/15	Sat 4/21/18
819	11.1a	Project Kick Off and Progress Meeting	✓	20 days	13 days	Mon 10/19/15	Mon 10/26/15	Thu 11/5/15	Mon 11/23/15	Thu 11/5/15	Mon 11/23/15
820		Installation Kick Off Meeting and Site Visit	✓	13 days	1 day	Mon 10/19/15	Mon 10/19/15	Thu 11/5/15	Thu 11/5/15	Thu 11/5/15	Thu 11/5/15
821		Prepare Kick Off Meeting Minutes	✓	20 days	12 days	Tue 10/20/15	Mon 10/26/15	Fri 11/6/15	Mon 11/23/15	Fri 11/6/15	Mon 11/23/15
822	11.2a	RI WP with UFP- QAPP and HASP		-17 days	115 days	Wed 12/2/15	Tue 6/28/16	Mon 12/21/15	NA	Mon 12/21/15	Sat 6/4/16
823		Prepare Draft Project Plan	✓	29 days	46 days	Wed 12/2/15	Mon 1/18/16	Mon 12/21/15	Fri 2/26/16	Mon 12/21/15	Fri 2/26/16
824		ANG Review and Comment	✓	27 days	20 days	Tue 1/19/16	Wed 2/17/16	Fri 2/26/16	Fri 3/25/16	Fri 2/26/16	Fri 3/25/16
825		Prepare Draft Final Project Plan	✓	9 days	2 days	Thu 2/18/16	Wed 3/16/16	Fri 3/25/16	Tue 3/29/16	Fri 3/25/16	Tue 3/29/16
826		Regulator Review	✓	18 days	7.38 edays	Wed 3/16/16	Sat 4/30/16	Wed 3/30/16	Fri 5/6/16	Wed 3/30/16	Fri 5/6/16

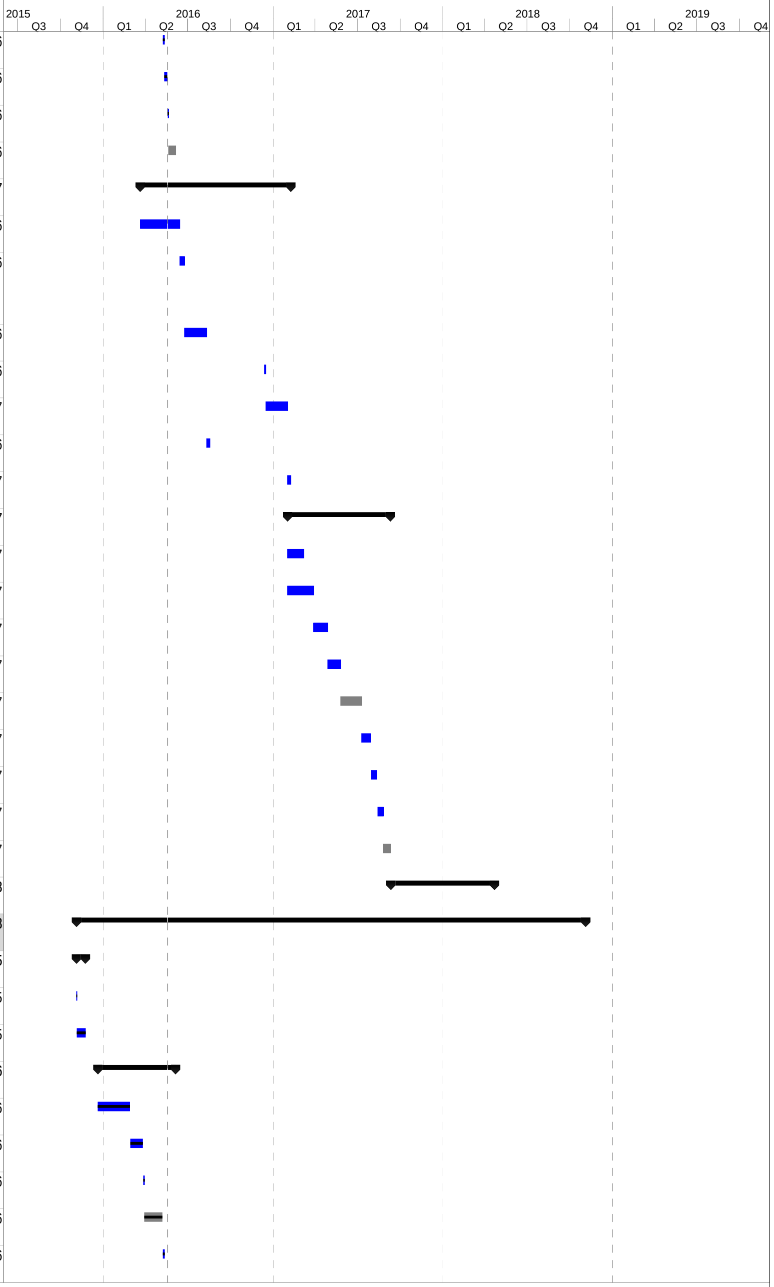


Date: Thu 5/19/16

Task ▬ Milestone ◆ Summary ▬ Project Summary ▬ Progress ▬ Deadline ⇩

DETAIL SCHEDULE - NERS RI/FS NEW ENGLAND ANG INSTALLATIONS

ID	Task	Task Name	ⓘ	Finish Variance	Duration	Baseline Start	Baseline Finish	Actual Start	Actual Finish	Start	Finish
827		Prepare RTC	✓	-7 days	3 days	Mon 5/2/16	Fri 5/20/16	Mon 5/9/16	Wed 5/11/16	Mon 5/9/16	Wed 5/11/16
828		ANG Approval of RTC	✓	-13 days	4 days	Mon 5/23/16	Mon 6/6/16	Thu 5/12/16	Tue 5/17/16	Thu 5/12/16	Tue 5/17/16
829		Prepare Final Project Plan	✓	-15 days	3 days	Tue 6/7/16	Mon 6/13/16	Wed 5/18/16	Fri 5/20/16	Wed 5/18/16	Fri 5/20/16
830		Regulator Concurrence on Final Project Plan		-72 days	15 edays	Mon 6/13/16	Tue 6/28/16	NA	NA	Fri 5/20/16	Sat 6/4/16
831	11.3a	RI Field Work		-15 days	229 days	Fri 7/1/16	Tue 2/28/17	Mon 3/21/16	NA	Mon 3/21/16	Tue 2/7/17
832		Procurement/Coordination/Mobilization		-15 days	60 days	Fri 7/1/16	Tue 7/5/16	Mon 3/21/16	NA	Mon 3/21/16	Mon 6/13/16
833		ZZ007 Soil Borings, Well Install and Sampling (1st Event)		-15 days	8 days	Wed 7/6/16	Fri 7/15/16	NA	NA	Tue 6/14/16	Thu 6/23/16
834		Data Analysis and Validation		-15 days	33 days	Mon 7/18/16	Wed 8/31/16	NA	NA	Fri 6/24/16	Wed 8/10/16
835		ZZ007 Sampling (2nd Event)		-15 days	3 days	Tue 1/3/17	Thu 1/5/17	NA	NA	Tue 12/13/16	Thu 12/15/16
836		Data Analysis and Validation		-15 days	33 days	Fri 1/6/17	Tue 2/21/17	NA	NA	Fri 12/16/16	Tue 1/31/17
837		ERPIMS Submittal (1st event)		-15 days	5 days	Thu 9/1/16	Thu 9/8/16	NA	NA	Thu 8/11/16	Wed 8/17/16
838		ERPIMS Submittal (2nd event)		-15 days	5 days	Wed 2/22/17	Tue 2/28/17	NA	NA	Wed 2/1/17	Tue 2/7/17
839	11.4a	RI Report		-15 days	158 days	Wed 2/22/17	Sat 9/30/17	NA	NA	Wed 2/1/17	Sat 9/9/17
840		Risk Assessment		-15 days	25 days	Wed 2/22/17	Tue 3/28/17	NA	NA	Wed 2/1/17	Tue 3/7/17
841		Prepare Draft RI Report		-15 days	40 days	Wed 2/22/17	Tue 4/18/17	NA	NA	Wed 2/1/17	Tue 3/28/17
842		ANG Review and Comments		-15 days	22 days	Wed 4/19/17	Thu 5/18/17	NA	NA	Wed 3/29/17	Thu 4/27/17
843		Prepare Draft Final RI Report		-15 days	20 days	Fri 5/19/17	Thu 6/15/17	NA	NA	Fri 4/28/17	Thu 5/25/17
844		Regulator Review		-63 days	45 edays	Thu 6/15/17	Sun 7/30/17	NA	NA	Thu 5/25/17	Sun 7/9/17
845		Prepare RTC		-15 days	15 days	Mon 7/31/17	Fri 8/18/17	NA	NA	Mon 7/10/17	Fri 7/28/17
846		ANG approval of RTCs complete		-15 days	10 days	Mon 8/21/17	Fri 9/1/17	NA	NA	Mon 7/31/17	Fri 8/11/17
847		Prepare Final RI Report		-15 days	10 days	Mon 9/4/17	Fri 9/15/17	NA	NA	Mon 8/14/17	Fri 8/25/17
848		Regulator Concurrence on Final RI Report		-63 days	15 edays	Fri 9/15/17	Sat 9/30/17	NA	NA	Fri 8/25/17	Sat 9/9/17
849	11.5a	FS		-15 days	160 days	Mon 10/2/17	Sat 5/12/18	NA	NA	Mon 9/11/17	Sat 4/21/18
858		TU008-Former Heating Oil UST #41 at Former Buil	✓	-20 days	774 days	Mon 10/19/15	Sat 12/1/18	Thu 11/5/15	NA	Thu 11/5/15	Sat 11/3/18
859	11.1b	Project Kick Off and Progress Meeting	✓	20 days	13 days	Mon 10/19/15	Mon 10/26/15	Thu 11/5/15	Mon 11/23/15	Thu 11/5/15	Mon 11/23/15
860		Installation Kick Off Meeting and Site Visit	✓	13 days	1 day	Mon 10/19/15	Mon 10/19/15	Thu 11/5/15	Thu 11/5/15	Thu 11/5/15	Thu 11/5/15
861		Prepare Kick Off Meeting Minutes	✓	20 days	12 days	Tue 10/20/15	Mon 10/26/15	Fri 11/6/15	Mon 11/23/15	Fri 11/6/15	Mon 11/23/15
862	11.2b	RI WP with UFP- QAPP and HASP	✓	-17 days	115 days	Wed 12/2/15	Tue 6/28/16	Mon 12/21/15	NA	Mon 12/21/15	Sat 6/4/16
863		Prepare Draft Project Plan	✓	29 days	46 days	Wed 12/2/15	Mon 1/18/16	Mon 12/21/15	Fri 2/26/16	Mon 12/21/15	Fri 2/26/16
864		ANG Review and Comment	✓	27 days	20 days	Tue 1/19/16	Wed 2/17/16	Fri 2/26/16	Fri 3/25/16	Fri 2/26/16	Fri 3/25/16
865		Prepare Draft Final Project Plan	✓	9 days	2 days	Thu 2/18/16	Wed 3/16/16	Fri 3/25/16	Tue 3/29/16	Fri 3/25/16	Tue 3/29/16
866		Regulator Review	✓	18 days	7.38 edays	Wed 3/16/16	Sat 4/30/16	Wed 3/30/16	Fri 5/6/16	Wed 3/30/16	Fri 5/6/16
867		Prepare RTC	✓	-7 days	3 days	Mon 5/2/16	Fri 5/20/16	Mon 5/9/16	Wed 5/11/16	Mon 5/9/16	Wed 5/11/16



Date: Thu 5/19/16

Task	Milestone	Summary	Project Summary	Progress	Deadline
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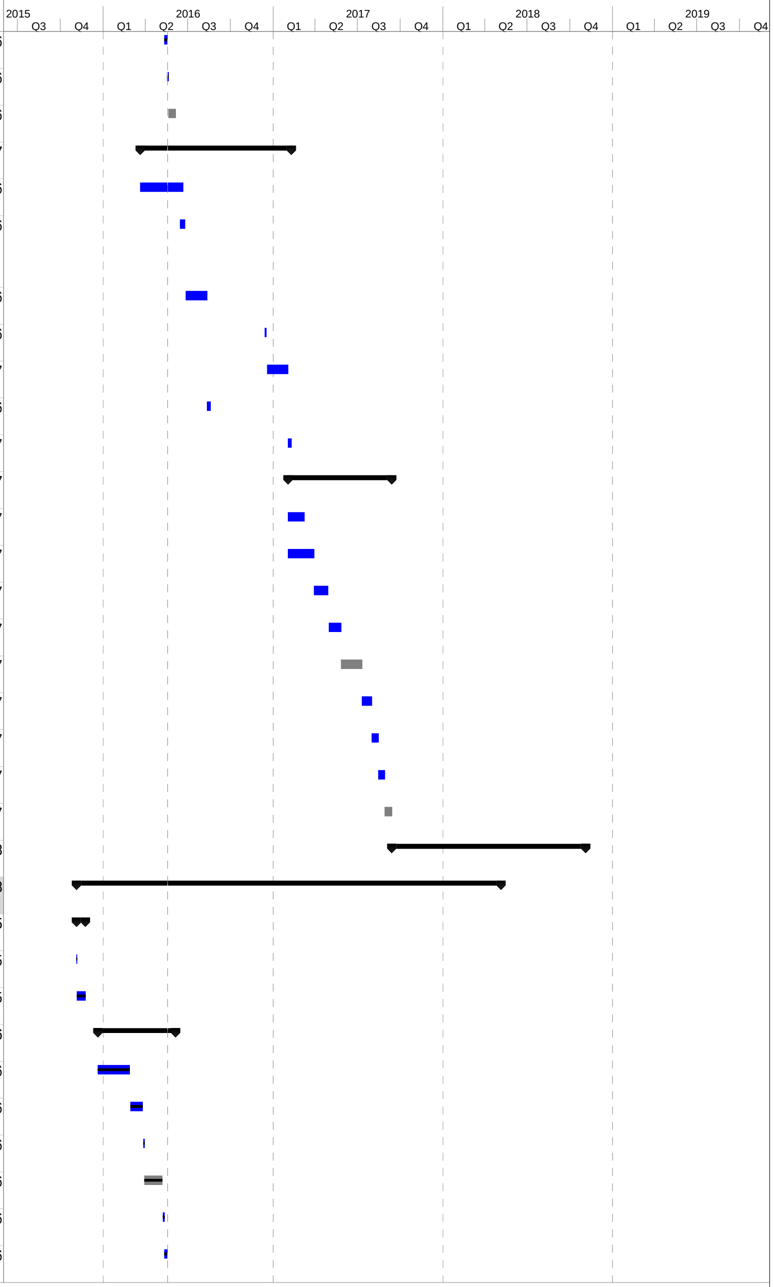
DETAIL SCHEDULE - NERS RI/FS NEW ENGLAND ANG INSTALLATIONS

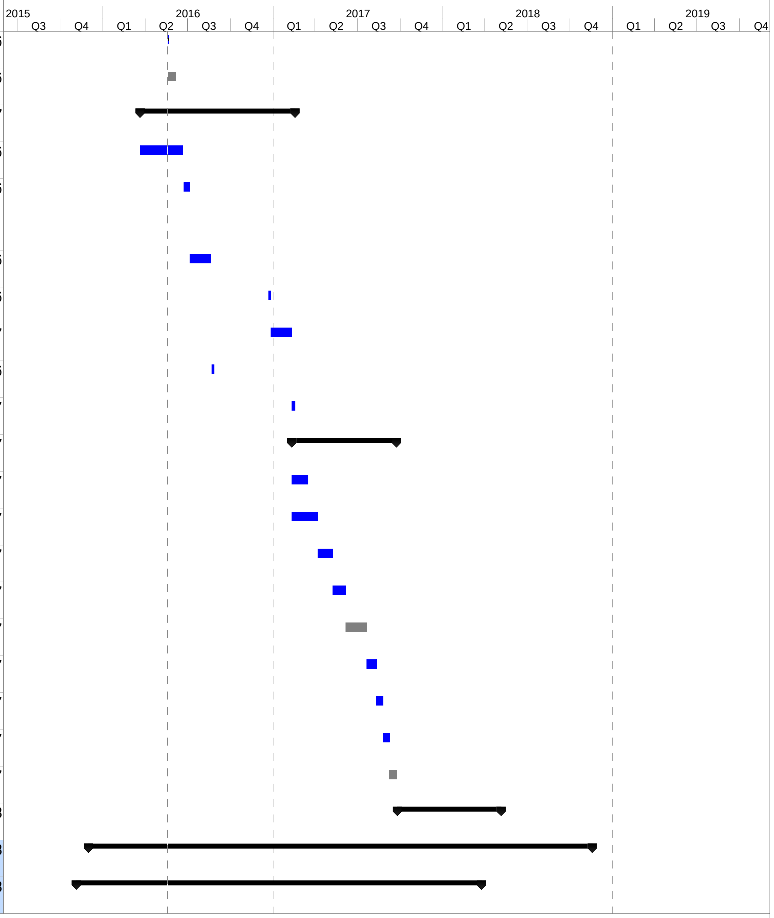
ID	Task	Task Name	ℹ	Finish Variance	Duration	Baseline Start	Baseline Finish	Actual Start	Actual Finish	Start	Finish
868		ANG Approval of RTC	✓	-13 days	4 days	Mon 5/23/16	Mon 6/6/16	Thu 5/12/16	Tue 5/17/16	Thu 5/12/16	Tue 5/17/16
869		Prepare Final Project Plan	✓	-15 days	3 days	Tue 6/7/16	Mon 6/13/16	Wed 5/18/16	Fri 5/20/16	Wed 5/18/16	Fri 5/20/16
870		Regulator Concurrence on Final Project Plan		-72 days	15 edays	Mon 6/13/16	Tue 6/28/16	NA	NA	Fri 5/20/16	Sat 6/4/16
871	11.3b	RI Field Work		-19 days	230 days	Fri 7/1/16	Tue 3/7/17	Mon 3/21/16	NA	Mon 3/21/16	Wed 2/8/17
872		Procurement/Coordination/Mobilization		-10 days	65 days	Fri 7/1/16	Tue 7/5/16	Mon 3/21/16	NA	Mon 3/21/16	Mon 6/20/16
873		TU008 Soil Borings, Well Install and Sampling (1st Event)		-19 days	8 days	Wed 7/13/16	Fri 7/22/16	NA	NA	Wed 6/15/16	Fri 6/24/16
874		Data Analysis and Validation		-19 days	33 days	Mon 7/25/16	Thu 9/8/16	NA	NA	Mon 6/27/16	Thu 8/11/16
875		TU008 Sampling (2nd Event)		-19 days	3 days	Tue 1/10/17	Thu 1/12/17	NA	NA	Wed 12/14/16	Fri 12/16/16
876		Data Analysis and Validation		-19 days	33 days	Fri 1/13/17	Tue 2/28/17	NA	NA	Mon 12/19/16	Wed 2/1/17
877		ERPIMS Submittal (1st event)		-19 days	5 days	Fri 9/9/16	Thu 9/15/16	NA	NA	Fri 8/12/16	Thu 8/18/16
878		ERPIMS Submittal (2nd event)		-19 days	5 days	Wed 3/1/17	Tue 3/7/17	NA	NA	Thu 2/2/17	Wed 2/8/17
879	11.4b	RI Report		-18 days	159 days	Wed 3/1/17	Sat 10/7/17	NA	NA	Thu 2/2/17	Tue 9/12/17
880		Risk Assessment		-19 days	25 days	Wed 3/1/17	Tue 4/4/17	NA	NA	Thu 2/2/17	Wed 3/8/17
881		Prepare Draft RI Report		-19 days	40 days	Wed 3/1/17	Tue 4/25/17	NA	NA	Thu 2/2/17	Wed 3/29/17
882		ANG Review and Comments		-19 days	22 days	Wed 4/26/17	Thu 5/25/17	NA	NA	Thu 3/30/17	Fri 4/28/17
883		Prepare Draft Final RI Report		-19 days	20 days	Fri 5/26/17	Thu 6/22/17	NA	NA	Mon 5/1/17	Fri 5/26/17
884		Regulator Review		-81 days	45 edays	Thu 6/22/17	Sun 8/6/17	NA	NA	Fri 5/26/17	Mon 7/10/17
885		Prepare RTC		-19 days	15 days	Mon 8/7/17	Fri 8/25/17	NA	NA	Tue 7/11/17	Mon 7/31/17
886		ANG approval of RTCs complete		-19 days	10 days	Mon 8/28/17	Fri 9/8/17	NA	NA	Tue 8/1/17	Mon 8/14/17
887		Prepare Final RI Report		-19 days	10 days	Mon 9/11/17	Fri 9/22/17	NA	NA	Tue 8/15/17	Mon 8/28/17
888		Regulator Concurrence on Final RI Report		-75 days	15 edays	Fri 9/22/17	Sat 10/7/17	NA	NA	Mon 8/28/17	Tue 9/12/17
889	11.5b	NFRAP DD		-20 days	298 days	Mon 10/9/17	Sat 12/1/18	NA	NA	Wed 9/13/17	Sat 11/3/18
906		TU009-WWTP Bypass UST near IRP Site 6		-15 days	644 days	Mon 10/19/15	Sat 5/26/18	Thu 11/5/15	NA	Thu 11/5/15	Sat 5/5/18
907	11.1c	Project Kick Off and Progress Meeting	✓	20 days	13 days	Mon 10/19/15	Mon 10/26/15	Thu 11/5/15	Mon 11/23/15	Thu 11/5/15	Mon 11/23/15
908		Installation Kick Off Meeting and Site Visit	✓	13 days	1 day	Mon 10/19/15	Mon 10/19/15	Thu 11/5/15	Thu 11/5/15	Thu 11/5/15	Thu 11/5/15
909		Prepare Kick Off Meeting Minutes	✓	20 days	12 days	Tue 10/20/15	Mon 10/26/15	Fri 11/6/15	Mon 11/23/15	Fri 11/6/15	Mon 11/23/15
910	11.2c	RI WP with UFP- QAPP and HASP		-17 days	115 days	Wed 12/2/15	Tue 6/28/16	Mon 12/21/15	NA	Mon 12/21/15	Sat 6/4/16
911		Prepare Draft Project Plan	✓	29 days	46 days	Wed 12/2/15	Mon 1/18/16	Mon 12/21/15	Fri 2/26/16	Mon 12/21/15	Fri 2/26/16
912		ANG Review and Comment	✓	27 days	20 days	Tue 1/19/16	Wed 2/17/16	Fri 2/26/16	Fri 3/25/16	Fri 2/26/16	Fri 3/25/16
913		Prepare Draft Final Project Plan	✓	9 days	2 days	Thu 2/18/16	Wed 3/16/16	Fri 3/25/16	Tue 3/29/16	Fri 3/25/16	Tue 3/29/16
914		Regulator Review	✓	18 days	7.38 edays	Wed 3/16/16	Sat 4/30/16	Wed 3/30/16	Fri 5/6/16	Wed 3/30/16	Fri 5/6/16
915		Prepare RTC	✓	-7 days	3 days	Mon 5/2/16	Fri 5/20/16	Mon 5/9/16	Wed 5/11/16	Mon 5/9/16	Wed 5/11/16
916		ANG Approval of RTC	✓	-13 days	4 days	Mon 5/23/16	Mon 6/6/16	Thu 5/12/16	Tue 5/17/16	Thu 5/12/16	Tue 5/17/16



Date: Thu 5/19/16	Task	▬	Milestone	◆	Summary	▬	Project Summary	▬	Progress	—	Deadline	⇩

DETAIL SCHEDULE - NERS RI/FS NEW ENGLAND ANG INSTALLATIONS

ID	Task	Task Name	ⓘ	Finish Variance	Duration	Baseline Start	Baseline Finish	Actual Start	Actual Finish	Start	Finish
917		Prepare Final Project Plan	✓	-15 days	3 days	Tue 6/7/16	Mon 6/13/16	Wed 5/18/16	Fri 5/20/16	Wed 5/18/16	Fri 5/20/16
918		Regulator Concurrence on Final Project Plan		-72 days	15 edays	Mon 6/13/16	Tue 6/28/16	NA	NA	Fri 5/20/16	Sat 6/4/16
919	11.3c	RI Field Work		-18 days	236 days	Fri 7/1/16	Tue 3/14/17	Mon 3/21/16	NA	Mon 3/21/16	Thu 2/16/17
920		Procurement/Coordination/Mobilization		-10 days	65 days	Fri 7/1/16	Tue 7/5/16	Mon 3/21/16	NA	Mon 3/21/16	Mon 6/20/16
921		TU009 Soil Borings, Well Install and Sampling (1st Event)		-18 days	8 days	Wed 7/20/16	Fri 7/29/16	NA	NA	Thu 6/23/16	Tue 7/5/16
922		Data Analysis and Validation		-18 days	33 days	Mon 8/1/16	Thu 9/15/16	NA	NA	Wed 7/6/16	Fri 8/19/16
923		TU009 Sampling (2nd Event)		-18 days	3 days	Tue 1/17/17	Thu 1/19/17	NA	NA	Thu 12/22/16	Mon 12/26/16
924		Data Analysis and Validation		-18 days	33 days	Fri 1/20/17	Tue 3/7/17	NA	NA	Tue 12/27/16	Thu 2/9/17
925		ERPIMS Submittal (1st event)		-18 days	5 days	Fri 9/16/16	Thu 9/22/16	NA	NA	Mon 8/22/16	Fri 8/26/16
926		ERPIMS Submittal (2nd event)		-18 days	5 days	Wed 3/8/17	Tue 3/14/17	NA	NA	Fri 2/10/17	Thu 2/16/17
927	11.4c	RI Report		-15 days	161 days	Wed 3/8/17	Sat 10/14/17	NA	NA	Fri 2/10/17	Fri 9/22/17
928		Risk Assessment		-18 days	25 days	Wed 3/8/17	Tue 4/11/17	NA	NA	Fri 2/10/17	Thu 3/16/17
929		Prepare Draft RI Report		-18 days	40 days	Wed 3/8/17	Tue 5/2/17	NA	NA	Fri 2/10/17	Thu 4/6/17
930		ANG Review and Comments		-18 days	22 days	Wed 5/3/17	Thu 6/1/17	NA	NA	Fri 4/7/17	Mon 5/8/17
931		Prepare Draft Final RI Report		-18 days	20 days	Fri 6/2/17	Thu 6/29/17	NA	NA	Tue 5/9/17	Mon 6/5/17
932		Regulator Review		-72 days	45 edays	Thu 6/29/17	Sun 8/13/17	NA	NA	Mon 6/5/17	Thu 7/20/17
933		Prepare RTC		-16 days	15 days	Mon 8/14/17	Fri 9/1/17	NA	NA	Fri 7/21/17	Thu 8/10/17
934		ANG approval of RTCs complete		-16 days	10 days	Mon 9/4/17	Fri 9/15/17	NA	NA	Fri 8/11/17	Thu 8/24/17
935		Prepare Final RI Report		-16 days	10 days	Mon 9/18/17	Fri 9/29/17	NA	NA	Fri 8/25/17	Thu 9/7/17
936		Regulator Concurrence on Final RI Report		-66 days	15 edays	Fri 9/29/17	Sat 10/14/17	NA	NA	Thu 9/7/17	Fri 9/22/17
937	11.5c	FS		-15 days	160 days	Mon 10/16/17	Sat 5/26/18	NA	NA	Mon 9/25/17	Sat 5/5/18
946	12	South Portland, ME - 2 Sites	✓	-10 days	767 days	Fri 10/9/15	Sat 12/1/18	Tue 12/1/15	NA	Tue 12/1/15	Sat 11/17/18
1043	13	Stewart, NY - 1 Site	✓	-55 days	614 days	Wed 10/21/15	Sat 6/9/18	Thu 11/5/15	NA	Thu 11/5/15	Sat 3/24/18



Date: Thu 5/19/16

Task	▬	Milestone	◆	Summary	▬	Project Summary	▬	Progress	―	Deadline	⇩

WORKSHEET #15 PROJECT ACTION LIMITS AND LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS

This worksheet provides the target analytes, their PALs, the laboratory's LOD/LOQ values, and the DoD QSM v5.0 LCS limits, where applicable. The laboratory LOD/LOQ values are compared to the most current USEPA RSLs under a residential exposure scenario, NYSDEC CP-51 Unrestricted Use Standards for soil, and NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives, USEPA MCLs for groundwater, USEPA tap water RSLs, and NYSDEC TOGS Drinking Water Standards in Tables 15-1 through 15-8. PAL concentrations are shown in the table as shaded where lower than the laboratory limits. Where DoD QSM LCS control limits are not available, the laboratory's in-house control limits are provided. Tables 15-1 through 15-8 provide the VOC, SVOC, metals, and mercury analyte lists for this investigation; these will be reported as definitive level data and will be validated.

Table 15-1 Reference Limits and Evaluation Table for VOCs (Water)
Matrix: Groundwater
Analytical Group: VOCs by SW8260C

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	CAS Number	Units	Lab LOQ	Lab LOD	Lab DL	Accuracy (%R)	Precision (% RPD)	2015 EPA Tap Water RSL (THQ=1; TR=1E-06)[a]	EPA MCL[b]	NYSDEC TOGS-Drinking Water[c]
1,1,1-Trichloroethane	71-55-6	µg/L	5	1	0.291	74 - 131	20	8000	200	5
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	5	2	0.425	71 - 121	20	0.076	NP	0.20
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	5	2	0.246	70 - 136	20	55000	NP	5
1,1,2-Trichloroethane	79-00-5	µg/L	5	1	0.573	80 - 119	20	0.41	5	1
1,1-Dichloroethane	75-34-3	µg/L	5	1	0.392	77 - 125	20	2.7	NP	NP
1,1-Dichloroethene	75-35-4	µg/L	5	1	0.365	71 - 131	20	280	7	0.70
1,2,3-Trichlorobenzene	87-61-6	µg/L	5	2	0.65	69 - 129	20	7	NP	5
1,2,4-Trichlorobenzene	120-82-1	µg/L	5	2	0.55	69 - 130	20	4	70	5
1,2,4-Trimethylbenzene	95-63-6	µg/L	5	2	0.401	76 - 124	20	15	NP	5
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	10	2	1.15	62 - 128	20	0.0086	0.2	0.04
1,2-Dibromoethane	106-93-4	µg/L	5	2	0.437	80 - 120	20	0.0075	0.05	0.0006
1,2-Dichlorobenzene	95-50-1	µg/L	5	2	0.28	80 - 119	20	300	600	NP
1,2-Dichloroethane	107-06-2	µg/L	5	1	0.372	73 - 128	20	0.17	5	0.6
1,2-Dichloroethene, Total	540-59-0	µg/L	10	2	0.237	79 - 121	20	NP	NP	NP
1,2-Dichloropropane	78-87-5	µg/L	5	1	0.317	78 - 122	20	0.44	5	1
1,3,5-Trimethylbenzene	108-67-8	µg/L	5	2	0.284	75 - 124	20	120	NP	NP
1,3-Dichlorobenzene	541-73-1	µg/L	5	2	0.234	80 - 119	20	NP	NP	NP
1,4-Dichlorobenzene	106-46-7	µg/L	5	2	0.35	79 - 118	20	0.48	75	NP
2-Butanone (MEK)	78-93-3	µg/L	20	5	0.389	56 - 143	20	5600	NP	50
2-Hexanone	591-78-6	µg/L	20	2	0.593	57 - 139	20	38	NP	50
4-Methyl-2-pentanone (MIBK)	108-10-1	µg/L	20	2	0.326	67 - 130	20	1200	NP	NP
Acetone	67-64-1	µg/L	20	10	6.67	39 - 160	20	14000	NP	50
Benzene	71-43-2	µg/L	5	1	0.253	79 - 120	20	0.45	5	1
Bromobenzene	108-86-1	µg/L	5	2	0.334	80 - 120	20	62	NP	5
Bromodichloromethane	75-27-4	µg/L	5	2	0.254	79 - 125	20	0.13	80	50
Bromoform	75-25-2	µg/L	5	1	0.366	66 - 130	20	3.3	80	50
Bromomethane	74-83-9	µg/L	10	2	0.396	53 - 141	20	7.5	NP	5
Carbon disulfide	75-15-0	µg/L	5	1	0.369	64 - 133	20	810	NP	NP
Carbon tetrachloride	56-23-5	µg/L	5	1	0.36	72 - 136	20	0.45	5	5
Chlorobenzene	108-90-7	µg/L	5	1	0.382	82 - 118	20	78	100	5
Chloroethane	75-00-3	µg/L	10	1	0.382	60 - 138	20	21000	NP	5
Chloroform	67-66-3	µg/L	5	1	0.147	79 - 124	20	0.22	80	7
Chloromethane	74-87-3	µg/L	10	2	0.553	50 - 139	20	190	NP	5
cis-1,2-Dichloroethene	156-59-2	µg/L	5	1	0.159	78 - 123	20	36	70	5
cis-1,3-Dichloropropene[1]	10061-01-5	µg/L	5	1	0.339	75 - 124	20	0.47	NP	NP
Cyclohexane	110-82-7	µg/L	10	2	0.363	71 - 130	20	13000	NP	NP
Dibromochloromethane	124-48-1	µg/L	5	1	0.329	74 - 126	20	0.17	80	50
Dichlorodifluoromethane	75-71-8	µg/L	10	2	0.449	32 - 152	20	200	NP	5
Ethylbenzene	100-41-4	µg/L	5	1	0.299	79 - 121	20	1.5	700	5
Isopropylbenzene	98-82-8	µg/L	5	2	0.258	72 - 131	20	450	NP	5
Methyl acetate	79-20-9	µg/L	25	5	2.29	56 - 136	20	20000	NP	NP
Methyl tert-butyl ether	1634-04-4	µg/L	5	2	0.401	71 - 124	20	14	NP	NP
Methylcyclohexane	108-87-2	µg/L	10	2	0.259	72 - 132	20	NP	NP	NP
Methylene chloride	75-09-2	µg/L	7.5	5	1.67	74 - 124	20	110	5	5
m,p-Xylene	179601-23-1	µg/L	5	1	0.569	80 - 121	20	NP	10000	5

Table 15-1 Reference Limits and Evaluation Table for VOCs (Water)

Matrix: Groundwater

Analytical Group: VOCs by SW8260C

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Tap Water RSL (THQ=1; TR=1E-06)[a]**	**EPA MCL[b]**	**NYSDEC TOGS-Drinking Water[c]**
Naphthalene	91-20-3	µg/L	5	2	0.85	61 - 128	20	0.17	NP	NP
n-Butylbenzene	104-51-8	µg/L	5	2	0.232	75 - 128	20	1000	NP	5
n-Propylbenzene	103-65-1	µg/L	5	2	0.298	76 - 126	20	660	NP	5
o-Xylene	95-47-6	µg/L	5	1	0.318	78 - 122	20	190	10000	5
sec-Butylbenzene	135-98-8	µg/L	5	2	0.31	77 - 126	20	2000	NP	5
Styrene	100-42-5	µg/L	5	1	0.347	78 - 123	20	1200	100	5
tert-Butylbenzene	98-06-6	µg/L	5	2	0.311	78 - 124	20	690	NP	5
Tetrachloroethene	127-18-4	µg/L	5	1	0.28	74 - 129	20	41	5	0.7
Toluene	108-88-3	µg/L	5	1	1	80 - 121	20	1100	1000	5
trans-1,2-Dichloroethene	156-60-5	µg/L	5	1	0.178	75 - 124	20	360	100	5
trans-1,3-Dichloropropene[1]	10061-02-6	µg/L	5	1	0.349	73 - 127	20	0.47	NP	NP
Trichloroethene	79-01-6	µg/L	5	1	0.29	79 - 123	20	2.8	5	5
Trichlorofluoromethane	75-69-4	µg/L	5	2	0.221	65 - 141	20	1100	NP	5
Vinyl chloride	75-01-4	µg/L	5	1	0.428	58 - 137	20	0.019	2	2
Xylenes, Total	1330-20-7	µg/L	10	5	0.854	79 - 121	20	190	10000	5

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits.

Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨 Less than the DL
🟩 Less than the LOD but greater than the DL
🟦 Less than the LOQ but greater than the LOD

[1] - PALs for 1,3-dichloropropene used

6 NYCRR - 6 of the Official Compilation of New York Codes
%R - Percent Recovery
µg/L - Microgram per Liter
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification

MCL - Maximum Contaminant Level
NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
THQ - Target Hazard Quotient
TOGS - Technical and Operational Guidance Series
TR - Target Risk Level
VOC - Volatile Organic Compound

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - EPA National Primary Drinking Water Regulations (http://water.epa.gov/drink/contaminants/)
c - NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (http://www.dec.ny.gov/docs/water_pdf/togs111.pdf)

Table 15-2 Reference Limits and Evaluation Table for VOCs (Soil)
Matrix: Soil
Analytical Group: VOCs by SW8260C

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	CAS Number	Units	Lab LOQ	Lab LOD	Lab DL	Accuracy (%R)	Precision (% RPD)	2015 EPA Res RSL (THQ=1; TR=1E-06)[a]	NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives[b]	NYSDEC CP-51 Unrestricted Use[c]
1,1,1-Trichloroethane	71-55-6	mg/kg	0.005	0.001	0.000431	73 - 130	20	8100	0.68	NP
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	0.005	0.001	0.000401	70 - 124	20	0.6	NP	35
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	mg/kg	0.005	0.005	0.00168	66 - 136	20	40000	NP	100
1,1,2-Trichloroethane	79-00-5	mg/kg	0.005	0.001	0.000573	78 - 121	20	1.5	NP	NP
1,1-Dichloroethane	75-34-3	mg/kg	0.005	0.001	0.000392	76 - 125	20	3.6	0.27	NP
1,1-Dichloroethene	75-35-4	mg/kg	0.005	0.005	0.00161	70 - 131	20	230	0.33	NP
1,2,3-Trichlorobenzene	87-61-6	mg/kg	0.005	0.001	0.000444	66 - 130	20	63	NP	80
1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.005	0.001	0.000425	67 - 129	20	58	NP	NP
1,2,4-Trimethylbenzene	95-63-6	mg/kg	0.005	0.001	0.0006	75 - 123	20	58	3.6	NP
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	0.01	0.005	0.00145	61 - 132	20	0.0053	NP	NP
1,2-Dibromoethane	106-93-4	mg/kg	0.005	0.001	0.000699	78 - 121	20	0.036	NP	NP
1,2-Dichlorobenzene	95-50-1	mg/kg	0.005	0.001	0.000282	78 - 121	20	1800	1.1	NP
1,2-Dichloroethane	107-06-2	mg/kg	0.005	0.001	0.000867	73 - 128	20	0.46	0.02	NP
1,2-Dichloroethene, Total	540-59-0	mg/kg	0.01	0.002	0.000958	78 - 122	20	NP	NP	NP
1,2-Dichloropropane	78-87-5	mg/kg	0.005	0.001	0.000383	76 - 123	20	1	NP	NP
1,3,5-Trimethylbenzene	108-67-8	mg/kg	0.005	0.001	0.000313	73 - 124	20	780	8.4	NP
1,3-Dichlorobenzene	541-73-1	mg/kg	0.005	0.001	0.00028	77 - 121	20	NP	2.4	NP
1,4-Dichlorobenzene	106-46-7	mg/kg	0.005	0.001	0.0006	75 - 120	20	2.6	1.8	NP
2-Butanone (MEK)	78-93-3	mg/kg	0.02	0.005	0.00192	51 - 148	20	27000	0.12	100
2-Hexanone	591-78-6	mg/kg	0.02	0.005	0.00177	53 - 145	20	200	NP	NP
4-Methyl-2-pentanone (MIBK)	108-10-1	mg/kg	0.02	0.005	0.000732	65 - 135	20	5300	NP	NP
Acetone	67-64-1	mg/kg	0.02	0.01	0.00647	36 - 164	20	61000	0.05	NP
Benzene	71-43-2	mg/kg	0.005	0.001	0.000253	77 - 121	20	1.2	0.06	NP
Bromobenzene	108-86-1	mg/kg	0.005	0.001	0.000368	78 - 121	20	290	NP	NP
Bromodichloromethane	75-27-4	mg/kg	0.005	0.001	0.000254	75 - 127	20	0.29	NP	NP
Bromoform	75-25-2	mg/kg	0.005	0.001	0.000366	67 - 132	20	19	NP	NP
Bromomethane	74-83-9	mg/kg	0.01	0.005	0.0011	53 - 143	20	6.8	NP	NP
Carbon disulfide	75-15-0	mg/kg	0.005	0.001	0.000685	63 - 132	20	770	NP	100
Carbon tetrachloride	56-23-5	mg/kg	0.005	0.001	0.000513	70 - 135	20	0.65	0.76	NP
Chlorobenzene	108-90-7	mg/kg	0.005	0.001	0.000382	79 - 120	20	280	1.1	NP
Chloroethane	75-00-3	mg/kg	0.01	0.001	0.000516	59 - 139	20	14000	NP	NP
Chloroform	67-66-3	mg/kg	0.005	0.001	0.000376	78 - 123	20	0.32	0.37	NP
Chloromethane	74-87-3	mg/kg	0.01	0.005	0.00065	50 - 136	20	110	NP	NP
cis-1,2-Dichloroethene	156-59-2	mg/kg	0.005	0.001	0.000597	77 - 123	20	160	0.25	NP
cis-1,3-Dichloropropene[1]	542-75-6	mg/kg	0.005	0.001	0.000595	74 - 126	20	1.8	NP	NP
Cyclohexane	110-82-7	mg/kg	0.01	0.001	0.000363	67 - 131	20	6500	NP	NP
Dibromochloromethane	124-48-1	mg/kg	0.005	0.001	0.000406	74 - 126	20	0.75	NP	NP
Dichlorodifluoromethane	75-71-8	mg/kg	0.01	0.005	0.00131	29 - 149	20	87	NP	NP
Ethylbenzene	100-41-4	mg/kg	0.005	0.001	0.000299	76 - 122	20	5.8	1	NP
Isopropylbenzene	98-82-8	mg/kg	0.005	0.001	0.000258	68 - 134	20	1900	NP	100
Methyl acetate	79-20-9	mg/kg	0.025	0.005	0.00138	53 - 144	20	78000	NP	NP
Methyl tert-butyl ether	1634-04-4	mg/kg	0.005	0.001	0.000476	73 - 125	20	47	0.93	NP
Methylcyclohexane	108-87-2	mg/kg	0.01	0.001	0.00026	66 - 133	20	NP	NP	NP
Methylene chloride	75-09-2	mg/kg	0.01	0.005	0.00158	70 - 128	20	350	0.05	NP

Table 15-2 Reference Limits and Evaluation Table for VOCs (Soil)
Matrix: Soil

Analytical Group: VOCs by SW8260C

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Res RSL (THQ=1; TR=1E-06)[a]**	**NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives[b]**	**NYSDEC CP-51 Unrestricted Use[c]**
m,p-Xylene	179601-23-1	mg/kg	0.005	0.002	0.000569	77 - 124	20	NP	0.26	NP
Naphthalene	91-20-3	mg/kg	0.005	0.001	0.000492	62 - 129	20	3.8	NP	NP
n-Butylbenzene	104-51-8	mg/kg	0.005	0.001	0.0006	70 - 128	20	3900	12	NP
n-Propylbenzene	103-65-1	mg/kg	0.005	0.001	0.00032	73 - 125	20	3800	3.9	NP
o-Xylene	95-47-6	mg/kg	0.005	0.001	0.000336	77 - 123	20	650	0.26	NP
sec-Butylbenzene	135-98-8	mg/kg	0.005	0.001	0.00031	73 - 126	20	7800	11	NP
Styrene	100-42-5	mg/kg	0.005	0.001	0.000347	76 - 124	20	6000	NP	NP
tert-Butylbenzene	98-06-6	mg/kg	0.005	0.001	0.000311	73 - 125	20	7800	5.9	NP
Tetrachloroethene	127-18-4	mg/kg	0.005	0.001	0.000322	73 - 128	20	81	1.3	NP
Toluene	108-88-3	mg/kg	0.005	0.001	0.0007	77 - 121	20	4900	0.7	NP
trans-1,2-Dichloroethene	156-60-5	mg/kg	0.005	0.001	0.000943	74 - 125	20	1600	0.19	NP
trans-1,3-Dichloropropene[1]	10061-02-6	mg/kg	0.005	0.001	0.000349	71 - 130	20	1.8	NP	NP
Trichloroethene	79-01-6	mg/kg	0.005	0.001	0.000385	77 - 123	20	4.1	0.47	NP
Trichlorofluoromethane	75-69-4	mg/kg	0.005	0.001	0.0005	62 - 140	20	730	NP	NP
Vinyl chloride	75-01-4	mg/kg	0.01	0.001	0.000428	56 - 135	20	0.059	0.02	NP
Xylenes, Total	1330-20-7	mg/kg	0.01	0.005	0.000854	78 - 124	20	650	0.26	NP

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits.

Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨 Less than the DL
🟩 Less than the LOD but greater than the DL
🟦 Less than the LOQ but greater than the LOD

[1] - PALs for 1,3-dichloropropene used

6 NYCRR - 6 of the Official Compilation of New York Codes
%R - Percent Recovery
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification
mg/kg - Milligram per Kilogram
NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
RSL - Regional Screening Level
THQ - Target Hazard Quotient
TR - Target Risk Level
VOC - Volatile Organic Compound

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - NYSDEC 6 NYCRR Part 375, December 2006 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/part375.pdf)
c - NYSDEC CP-51 Soil Cleanup Guidance, October 201 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/cpsoil.pdf)

Table 15-3 Reference Limits and Evaluation Table for SVOCs (Water)

Matrix: Groundwater

Analytical Group: SVOCs by SW8270D

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Tap Water RSL (THQ=1; TR=1E-06)[a]**	**EPA MCL[b]**	**NYSDEC TOGS-Drinking Water[c]**
1,2,4,5-Tetrachlorobenzene	95-94-3	µg/L	10	4.4	1.73	35 - 121	20	1.7	NP	NP
1,2,4-Trichlorobenzene	120-82-1	µg/L	10	1	0.28	29 - 116	20	4	NP	NP
1,2-Dichlorobenzene	95-50-1	µg/L	10	0.5	0.23	32 - 111	20	300	NP	3
1,2-Diphenylhydrazine	122-66-7	µg/L	10	0.505	0.23	49 - 122	20	0.077	NP	NP
1,3-Dichlorobenzene	541-73-1	µg/L	10	1	0.3	28 - 110	20	NP	NP	3
1,4-Dichlorobenzene	106-46-7	µg/L	10	1	0.32	29 - 112	20	0.48	NP	3
2,2'-Oxybis(1-chloropropane)	108-60-1	µg/L	10	1	0.28	37 - 130	20	0.36	NP	NP
2,4,5-Trichlorophenol	95-95-4	µg/L	20	1	0.45	53 - 123	20	1200	NP	NP
2,4,6-Trichlorophenol	88-06-2	µg/L	20	1	0.29	50 - 125	20	12	NP	NP
2,4-Dichlorophenol	120-83-2	µg/L	10	2	0.64	47 - 121	20	46	NP	0.3
2,4-Dimethylphenol	105-67-9	µg/L	10	2	0.58	31 - 124	20	360	NP	50
2,4-Dinitrophenol	51-28-5	µg/L	80	30	10	23 - 143	20	39	NP	10
2,4-Dinitrotoluene	121-14-2	µg/L	20	4.4	1.66	57 - 128	20	0.24	NP	5
2,6-Dichlorophenol	87-65-0	µg/L	10	4	1.35	50 - 118	20	NP	NP	NP
2,6-Dinitrotoluene	606-20-2	µg/L	20	4.4	1.89	57 - 124	20	0.048	NP	0.07
2-Chloronaphthalene	91-58-7	µg/L	10	1	0.26	40 - 116	20	750	NP	10
2-Chlorophenol	95-57-8	µg/L	10	4.4	2	38 - 117	20	91	NP	NP
2-Methylnaphthalene	91-57-6	µg/L	10	1	0.29	40 - 121	20	36	NP	4.7
2-Methylphenol	95-48-7	µg/L	10	2	0.98	30 - 117	20	930	NP	NP
3 & 4 Methylphenol	15831-10-4	µg/L	20	0.5	0.25	29 - 110	20	NP	NP	NP
3,3'-Dichlorobenzidine	91-94-1	µg/L	50	4.4	2	27 - 129	20	0.12	NP	5
3-Nitroaniline	99-09-2	µg/L	50	4.4	2	41 - 128	20	NP	NP	5
4,6-Dinitro-2-methylphenol	534-52-1	µg/L	80	8.8	4	44 - 137	20	1.5	NP	NP
4-Chloroaniline	106-47-8	µg/L	25	4.4	2.14	33 - 117	20	0.36	NP	NP
4-Chlorophenyl-phenylether	7005-72-3	µg/L	10	4.4	1.66	53 - 121	20	NP	NP	NP
4-Nitroaniline	100-01-6	µg/L	50	4.4	2	70 - 120	20	3.8	NP	5
4-Nitrophenol	100-02-7	µg/L	50	4	1.23	59 - 129	20	NP	NP	NP
Acenaphthene	83-32-9	µg/L	10	1	0.28	47 - 122	20	530	NP	20
Acenaphthylene	208-96-8	µg/L	10	1	0.49	41 - 130	20	NP	NP	NP
Anthracene	120-12-7	µg/L	10	1	0.42	57 - 123	20	1800	NP	50
Benzidine	92-87-5	µg/L	200	100	50	27 - 150	20	0.00011	NP	NP
Benzo(a)anthracene	56-55-3	µg/L	10	1	0.35	58 - 125	20	0.033	NP	0.002
Benzo(a)pyrene	50-32-8	µg/L	10	1	0.31	54 - 128	20	0.0034	0.2	0.002
Benzo(b)fluoranthene	205-99-2	µg/L	10	2	0.531	53 - 131	20	0.034	NP	0.002
Benzo(g,h,i)perylene	191-24-2	µg/L	10	1	0.5	50 - 134	20	NP	NP	NP
Benzo(k)fluoranthene	207-08-9	µg/L	10	1	0.46	57 - 129	20	0.34	NP	0.002
Benzoic acid	65-85-0	µg/L	80	30	10	41 - 120	20	75000	NP	NP
Benzyl alcohol	100-51-6	µg/L	25	0.5	0.23	31 - 112	20	2000	NP	NP
Bis(2-chloroethoxy)methane	111-91-1	µg/L	10	2	0.97	48 - 120	20	59	NP	5
Bis(2-chloroethyl)ether	111-44-4	µg/L	20	1	0.41	43 - 118	20	0.014	NP	0.03
Bis(2-ethylhexyl)phthalate	117-81-7	µg/L	10	2	0.56	55 - 135	20	5.6	6	5
Butylbenzylphthalate	85-68-7	µg/L	20	2	1	53 - 134	20	16	NP	50
Carbazole	86-74-8	µg/L	10	1	0.43	60 - 122	20	NP	NP	NP
Chrysene	218-01-9	µg/L	10	2	0.54	59 - 123	20	3.4	NP	0.002
Dibenzo(a,h)anthracene	53-70-3	µg/L	10	2	0.51	51 - 134	20	0.0034	NP	NP
Dibenzofuran	132-64-9	µg/L	10	1	0.29	53 - 118	20	7.9	NP	NP
Diethylphthalate	84-66-2	µg/L	20	1	0.38	56 - 125	20	15000	NP	50

Table 15-3 Reference Limits and Evaluation Table for SVOCs (Water)
Matrix: Groundwater
Analytical Group: SVOCs by SW8270D

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	CAS Number	Units	Lab LOQ	Lab LOD	Lab DL	Accuracy (%R)	Precision (% RPD)	2015 EPA Tap Water RSL (THQ=1; TR=1E-06)[a]	EPA MCL[b]	NYSDEC TOGS-Drinking Water[c]
Dimethylphthalate	131-11-3	µg/L	20	0.5	0.21	45 - 127	20	NP	NP	50
Di-n-butylphthalate	84-74-2	µg/L	20	4.4	1.16	59 - 127	20	900	NP	50
Di-n-octylphthalate	117-84-0	µg/L	20	1	0.35	51 - 140	20	200	NP	50
Fluoranthene	206-44-0	µg/L	20	0.5	0.2	57 - 128	20	800	NP	50
Fluorene	86-73-7	µg/L	10	1	0.31	52 - 124	20	290	NP	50
Hexachlorobenzene	118-74-1	µg/L	10	2	0.66	53 - 125	20	0.0098	1	0.04
Hexachlorobutadiene	87-68-3	µg/L	30	10	3.3	22 - 124	20	0.14	NP	0.5
Hexachlorocyclopentadiene	77-47-4	µg/L	50	30	10	10 - 120	20	0.41	50	5
Hexachloroethane	67-72-1	µg/L	10	4.4	2.1	21 - 115	20	0.33	NP	5
Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	10	2	0.65	52 - 134	20	0.034	NP	0.002
Isophorone	78-59-1	µg/L	10	0.5	0.21	42 - 124	20	78	NP	50
Naphthalene	91-20-3	µg/L	10	1	0.29	40 - 121	20	0.17	NP	10
Nitrobenzene	98-95-3	µg/L	20	2	0.81	45 - 121	20	0.14	NP	0.4
N-Nitrosodimethylamine	62-75-9	µg/L	10	1	0.29	56 - 120	20	0.00045	NP	NP
N-Nitroso-di-n-propylamine	621-64-7	µg/L	20	1	0.35	49 - 119	20	0.011	NP	NP
N-Nitrosodiphenylamine	86-30-6	µg/L	10	1	0.44	51 - 123	20	12	NP	50
N-Nitrosopyrrolidine	930-55-2	µg/L	10	2	0.804	48 - 113	20	0.037	NP	NP
Pentachlorophenol	87-86-5	µg/L	80	60	20	35 - 138	20	0.04	1	NP
Phenanthrene	85-01-8	µg/L	10	1	0.26	59 - 120	20	NP	NP	50
Phenol	108-95-2	µg/L	10	4.4	2	61 - 120	20	5800	NP	NP
Pyrene	129-00-0	µg/L	10	1	0.37	57 - 126	20	120	NP	50

Notes:

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🟩 Less than the LOD but greater than the DL
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%R - Percent Recovery
µg/L - Microgram per Liter
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification
MCL - Maximum Contaminant Level
NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
RSL - Regional Screening Level
SVOC - Semi-Volatile Organic Compound
THQ - Target Hazard Quotient
TOGS - Technical and Operational Guidance Series
TR - Target Risk Level

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - EPA National Primary Drinking Water Regulations (http://water.epa.gov/drink/contaminants/)
c - NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (http://www.dec.ny.gov/docs/water_pdf/togs111.pdf)

Table 15-4 Reference Limits and Evaluation Table for SVOCs (Soil)

Matrix: Soil

Analytical Group: SVOCs by SW8270D

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	CAS Number	Units	Lab LOQ	Lab LOD	Lab DL	Accuracy (%R)	Precision (% RPD)	2015 EPA Res RSL (THQ=1; TR=1E-06)[a]	NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives[b]	NYSDEC CP-51 Unrestricted Use[c]
1,2,4,5-Tetrachlorobenzene	95-94-3	mg/kg	0.33	0.133	0.049	37 - 119	20	23.0	NP	NP
1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.33	0.067	0.028	34 - 118	20	58.0	NP	NP
1,2-Dichlorobenzene	95-50-1	mg/kg	0.33	0.067	0.022	33 - 117	20	1,800	NP	NP
1,2-Diphenylhydrazine	122-66-7	mg/kg	0.33	0.067	0.022	41 - 125	20	0.68	NP	NP
1,3-Dichlorobenzene	541-73-1	mg/kg	0.33	0.033	0.012	30 - 115	20	NP	NP	NP
1,4-Dichlorobenzene	106-46-7	mg/kg	0.33	0.033	0.0136	31 - 115	20	2.6	NP	NP
2,2'-Oxybis(1-chloropropane)	108-60-1	mg/kg	0.33	0.067	0.023	33 - 131	20	4.9	NP	NP
2,4,5-Trichlorophenol	95-95-4	mg/kg	0.33	0.033	0.01	41 - 124	20	6,300	NP	100
2,4,6-Trichlorophenol	88-06-2	mg/kg	0.33	0.033	0.01	39 - 126	20	63.0	NP	NP
2,4-Dichlorophenol	120-83-2	mg/kg	0.33	0.033	0.01	40 - 122	20	190	NP	100
2,4-Dimethylphenol	105-67-9	mg/kg	0.33	0.133	0.066	30 - 127	20	1,300	NP	NP
2,4-Dinitrophenol	51-28-5	mg/kg	1.6	1	0.333	46 - 120	20	130	NP	100
2,4-Dinitrotoluene	121-14-2	mg/kg	0.33	0.133	0.066	48 - 126	20	1.7	NP	NP
2,6-Dichlorophenol	87-65-0	mg/kg	0.33	0.167	0.069	41 - 117	20	NP	NP	NP
2,6-Dinitrotoluene	606-20-2	mg/kg	0.33	0.067	0.028	46 - 124	20	0.4	NP	1.03
2-Chloronaphthalene	91-58-7	mg/kg	0.33	0.033	0.01	41 - 114	20	4,800	NP	NP
2-Chlorophenol	95-57-8	mg/kg	0.33	0.067	0.021	34 - 121	20	390	100	NP
2-Methylnaphthalene	91-57-6	mg/kg	0.33	0.067	0.019	38 - 122	20	240	NP	0.41
2-Methylphenol	95-48-7	mg/kg	0.33	0.033	0.013	32 - 122	20	3,200	0.33	NP
3 & 4 Methylphenol	15831-10-4	mg/kg	0.33	0.067	0.033	34 - 119	20	NP	0.33	NP
3,3'-Dichlorobenzidine	91-94-1	mg/kg	1.6	0.267	0.09	22 - 121	20	1.2	NP	NP
3-Nitroaniline	99-09-2	mg/kg	1.6	0.267	0.073	33 - 119	20	NP	NP	NP
4,6-Dinitro-2-methylphenol	534-52-1	mg/kg	1.6	1	0.33	29 - 132	20	5.1	NP	NP
4-Chloroaniline	106-47-8	mg/kg	0.33	0.267	0.0819	17 - 106	20	2.7	NP	100
4-Chlorophenyl-phenylether	7005-72-3	mg/kg	0.33	0.067	0.021	45 - 121	20	NP	NP	NP
4-Nitroaniline	100-01-6	mg/kg	1.6	0.267	0.0725	64 - 120	20	25.0	NP	NP
4-Nitrophenol	100-02-7	mg/kg	1.6	0.267	0.097	30 - 132	20	NP	NP	NP
Acenaphthen	83-32-9	mg/kg	0.33	0.033	0.0103	40 - 123	20	3,600	20	NP
Acenaphthylene	208-96-8	mg/kg	0.33	0.067	0.017	32 - 132	20	NP	100	NP
Anthracene	120-12-7	mg/kg	0.33	0.067	0.017	47 - 123	20	18,000	100	NP
Benzidine	92-87-5	mg/kg	4	2	0.99	5 - 150	20	0.00053	NP	NP
Benzo(a)anthracene	56-55-3	mg/kg	0.33	0.067	0.02	49 - 126	20	0.16	1	NP
Benzo(a)pyrene	50-32-8	mg/kg	0.33	0.067	0.02	45 - 129	20	0.016	1	NP
Benzo(b)fluoranthene	205-99-2	mg/kg	0.33	0.067	0.0262	45 - 132	20	0.16	1	NP
Benzo(g,h,i)perylene	191-24-2	mg/kg	0.33	0.033	0.016	43 - 134	20	NP	100	NP
Benzo(k)fluoranthene	207-08-9	mg/kg	0.33	0.133	0.04	47 - 132	20	1.6	0.8	NP
Benzoic acid	65-85-0	mg/kg	1.6	1	0.33	32 - 120	20	250,000	NP	100
Benzyl alcohol	100-51-6	mg/kg	0.33	0.033	0.01	29 - 122	20	6,300	NP	NP
Bis(2-chloroethoxy)methane	111-91-1	mg/kg	0.33	0.067	0.023	36 - 121	20	190	NP	NP
Bis(2-chloroethyl)ether	111-44-4	mg/kg	0.33	0.033	0.0166	31 - 120	20	0.23	NP	NP
Bis(2-ethylhexyl)phthalate	117-81-7	mg/kg	0.33	0.133	0.046	51 - 133	20	39.0	NP	50
Butylbenzylphthalate	85-68-7	mg/kg	0.33	0.133	0.043	48 - 132	20	290	NP	100
Carbazole	86-74-8	mg/kg	0.33	0.133	0.036	50 - 123	20	NP	NP	NP
Chrysene	218-01-9	mg/kg	0.33	0.067	0.027	50 - 124	20	16.0	1	NP

Table 15-4 Reference Limits and Evaluation Table for SVOCs (Soil)
Matrix: Soil

Analytical Group: SVOCs by SW8270D

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Res RSL (THQ=1; TR=1E-06)[a]**	**NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives[b]**	**NYSDEC CP-51 Unrestricted Use[c]**
Dibenzo(a,h)anthracene	53-70-3	mg/kg	0.33	0.067	0.019	45 - 134	20	0.016	0.33	NP
Dibenzofuran	132-64-9	mg/kg	0.33	0.067	0.02	44 - 120	20	73.0	NP	NP
Diethylphthalate	84-66-2	mg/kg	0.66	0.067	0.026	50 - 124	20	51,000	NP	100
Dimethylphthalate	131-11-3	mg/kg	0.33	0.067	0.023	48 - 124	20	NP	NP	100
Di-n-butylphthalate	84-74-2	mg/kg	0.33	0.067	0.029	51 - 128	20	6,300	NP	100
Di-n-octylphthalate	117-84-0	mg/kg	0.33	0.066	0.0144	45 - 140	20	630	NP	100
Fluoranthene	206-44-0	mg/kg	0.33	0.133	0.036	50 - 127	20	2,400	100	NP
Fluorene	86-73-7	mg/kg	0.33	0.067	0.018	43 - 125	20	2,400	30	NP
Hexachlorobenzene	118-74-1	mg/kg	0.33	0.067	0.029	45 - 122	20	0.21	0.33	0.41
Hexachlorobutadiene	87-68-3	mg/kg	0.33	0.033	0.01	32 - 123	20	1.20	NP	NP
Hexachlorocyclopentadiene	77-47-4	mg/kg	1.7	0.133	0.05	47 - 120	20	1.80	NP	NP
Hexachloroethane	67-72-1	mg/kg	0.33	0.067	0.0213	28 - 117	20	1.80	NP	NP
Indeno(1,2,3-cd)pyrene	193-39-5	mg/kg	0.33	0.067	0.022	45 - 133	20	0.16	0.5	NP
Isophorone	78-59-1	mg/kg	0.33	0.067	0.017	30 - 122	20	570	NP	100
Naphthalene	91-20-3	mg/kg	0.33	0.067	0.031	35 - 123	20	3.80	12	NP
Nitrobenzene	98-95-3	mg/kg	0.33	0.067	0.022	34 - 122	20	5.10	NP	3.7
N-Nitrosodimethylamine	62-75-9	mg/kg	0.52	0.133	0.037	23 - 120	20	0.002	NP	NP
N-Nitroso-di-n-propylamine	621-64-7	mg/kg	0.33	0.067	0.031	36 - 120	20	0.078	NP	NP
N-Nitrosodiphenylamine	86-30-6	mg/kg	0.33	0.067	0.021	38 - 127	20	110	NP	NP
N-Nitrosopyrrolidine	930-55-2	mg/kg	0.33	0.167	0.064	45 - 126	20	0.26	NP	NP
Pentachlorophenol	87-86-5	mg/kg	1.6	1	0.33	25 - 133	20	1.00	0.8	NP
Phenanthrene	85-01-8	mg/kg	0.33	0.067	0.017	50 - 121	20	NP	100	NP
Phenol	108-95-2	mg/kg	0.33	0.067	0.018	34 - 121	20	19,000	0.33	NP
Pyrene	129-00-0	mg/kg	0.4	0.033	0.0121	47 - 127	20	1,800	100	NP

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits. Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨 Less than the DL
🟩 Less than the LOD but greater than the DL
🟦 Less than the LOQ but greater than the LOD

6 NYCRR - 6 of the Official Compilation of New York Codes
%R - Percent Recovery
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification
mg/kg - Milligram per Kilogram

NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
RSL - Regional Screening Level
SVOC - Semi-Volatile Organic Compound
THQ - Target Hazard Quotient
TR - Target Risk Level

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - NYSDEC 6 NYCRR Part 375, December 2006 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/part375.pdf)
c - NYSDEC CP-51 Soil Cleanup Guidance, October 201 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/cpsoil.pdf)

Table 15-5 Reference Limits and Evaluation Table for Metals (Water)

Matrix: Groundwater

Analytical Group: Metals by SW6010C

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Tap Water RSL (THQ=1; TR=1E-06)[a]**	**EPA MCL[b]**	**NYSDEC TOGS-Drinking Water[c]**
Aluminum	7429-90-5	µg/L	300	70	18	86 - 115	20	20,000	NP	100
Antimony	7440-36-0	µg/L	20	12	3.14	88 - 113	20	7.8	6	3
Arsenic	7440-38-2	µg/L	25	15	4.41	87 - 113	20	0.052	10	25
Barium	7440-39-3	µg/L	10	2	0.576	88 - 113	20	3,800	2000	1000
Beryllium	7440-41-7	µg/L	1.5	1.2	0.474	89 - 112	20	25	4	3
Cadmium	7440-43-9	µg/L	5	1.8	0.452	88 - 113	20	9.2	5	5
Calcium	7440-70-2	µg/L	1000	135	34.5	87 - 113	20	NP	NP	NP
Chromium	7440-47-3	µg/L	15	2.6	0.663	90 - 113	20	NP	100	50
Cobalt	7440-48-4	µg/L	15	4.5	1.23	89 - 114	20	6	NP	5
Copper	7440-50-8	µg/L	15	5	1.36	86 - 114	20	800	1300	200
Iron	7439-89-6	µg/L	100	85	22	87 - 115	20	14,000	NP	300
Lead	7439-92-1	µg/L	15	10	2.61	86 - 113	20	15	15	25
Magnesium	7439-95-4	µg/L	500	40	10.7	85 - 113	20	NP	NP	35000
Manganese	7439-96-5	µg/L	10	1	0.253	90 - 114	20	430	NP	300
Nickel	7440-02-0	µg/L	40	5	1.29	88 - 113	20	390	NP	100
Potassium	7440-09-7	µg/L	3000	940	237	86 - 114	20	NP	NP	NP
Selenium	7782-49-2	µg/L	22	19	4.86	83 - 114	20	100	50	10
Silver	7440-22-4	µg/L	15	3.5	0.933	84 - 115	20	94	NP	50
Sodium	7440-23-5	µg/L	5000	350	91.6	87 - 115	20	NP	NP	20,000
Thallium	7440-28-0	µg/L	40	19	4.91	85 - 114	20	0.20	2	0.5
Vanadium	7440-62-2	µg/L	15	4	1.11	90 - 111	20	86	NP	14
Zinc	7440-66-6	µg/L	150	15	4.53	87 - 115	20	6,000	NP	2000

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits. Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨	Less than the DL
🟩	Less than the LOD but greater than the DL
🟦	Less than the LOQ but greater than the LOD

%R - Percent Recovery
µg/L - Microgram per Liter
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification
MCL - Maximum Contaminant Level

NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
RSL - Regional Screening Level
THQ - Target Hazard Quotient
TOGS - Technical and Operational Guidance Series
TR - Target Risk Level

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - EPA National Primary Drinking Water Regulations (http://water.epa.gov/drink/contaminants/)
c - NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (http://www.dec.ny.gov/docs/water_pdf/togs111.pdf)

Table 15-6 Reference Limits and Evaluation Table for Metals (Soil)

Matrix: Soil

Analytical Group: Metals by SW6010C

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Res RSL (THQ=1; TR=1E-06)[a]**	**NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives[b]**	**NYSDEC CP-51 Unrestricted Use[c]**
Aluminum	7429-90-5	mg/kg	50	6	1.55	74 - 119	20	77,000	NP	NP
Antimony	7440-36-0	mg/kg	2	1.5	0.38	79 - 114	20	31	NP	NP
Arsenic	7440-38-2	mg/kg	5	2.5	0.66	82 - 111	20	0.68	13	NP
Barium	7440-39-3	mg/kg	2	0.3	0.076	83 - 113	20	15,000	350	NP
Beryllium	7440-41-7	mg/kg	0.5	0.12	0.033	83 - 113	20	160	7.2	NP
Cadmium	7440-43-9	mg/kg	0.5	0.15	0.041	82 - 113	20	71	2.5	NP
Calcium	7440-70-2	mg/kg	100	50	14.1	81 - 116	20	NP	NP	NP
Chromium	7440-47-3	mg/kg	3.5	0.2	0.058	85 - 113	20	120,000	30	NP
Cobalt	7440-48-4	mg/kg	1	0.4	0.1	85 - 112	20	23	NP	30
Copper	7440-50-8	mg/kg	5	0.8	0.217	81 - 117	20	3,100	50	NP
Iron	7439-89-6	mg/kg	80	15	3.8	81 - 118	20	55,000	NP	2000
Lead	7439-92-1	mg/kg	0.9	0.8	0.27	81 - 112	20	400	63	NP
Magnesium	7439-95-4	mg/kg	30	14	3.7	78 - 115	20	NP	NP	NP
Manganese	7439-96-5	mg/kg	4.5	0.4	0.1	84 - 114	20	1,800	1600	NP
Nickel	7440-02-0	mg/kg	4	0.45	0.123	83 - 113	20	1,500	30	NP
Potassium	7440-09-7	mg/kg	300	160	41	81 - 116	20	NP	NP	NP
Selenium	7782-49-2	mg/kg	5	3	0.86	78 - 111	20	390	3.9	NP
Silver	7440-22-4	mg/kg	1.5	0.6	0.16	82 - 112	20	390	2	NP
Sodium	7440-23-5	mg/kg	500	200	59	83 - 118	20	NP	NP	NP
Thallium	7440-28-0	mg/kg	3	2.5	0.65	83 - 111	20	0.78	NP	NP
Vanadium	7440-62-2	mg/kg	2	0.35	0.094	82 - 114	20	390	NP	100
Zinc	7440-66-6	mg/kg	8	1.5	0.398	82 - 113	20	23,000	109	NP

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits.

Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨 Less than the DL
🟩 Less than the LOD but greater than the DL
🟦 Less than the LOQ but greater than the LOD

6 NYCRR - 6 of the Official Compilation of New York Codes	mg/kg - milligram per kilogram
%R - Percent Recovery	NP - Not Published
CAS - Chemical Abstract Service	NYSDEC - New York State Department of Environmental Conservation
DL - Detection Limit	QSM - Quality System Manual
DoD - Department of Defense	Res - Residential
ECL - Environmental Conservation Law	RPD - Relative Percent Difference
EPA - United States Environmental Protection Agency	RSL - Regional Screening Level
LOD - Limit of Detection	THQ - Target Hazard Quotient
LOQ - Limit of Quantification	TR - Target Risk Level

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - NYSDEC 6 NYCRR Part 375, December 2006 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/part375.pdf)
c - NYSDEC CP-51 Soil Cleanup Guidance, October 201 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/cpsoil.pdf)

Table 15-7 Reference Limits and Evaluation Table for Mercury (Water)
Matrix: Groundwater
Analytical Group: Mercury by SW7470A

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	CAS Number	Units	Lab LOQ	Lab LOD	Lab DL	Accuracy (%R)	Precision (% RPD)	2015 EPA Tap Water RSL (THQ=1; TR=1E-06)[a]	EPA MCL[b]	NYSDEC TOGS-Drinking Water[c]
Mercury	7439-97-6	µg/L	0.2	0.08	0.027	82 - 119	20	0.63	2	0.7

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits. Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨	Less than the DL
🟩	Less than the LOD but greater than the DL
🟦	Less than the LOQ but greater than the LOD

%R - Percent Recovery
µg/L - Microgram per Liter
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification
MCL - Maximum Contaminant Level
NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
RSL - Regional Screening Level
THQ - Target Hazard Quotient
TOGS - Technical and Operational Guidance Series
TR - Target Risk Level

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - EPA National Primary Drinking Water Regulations (http://water.epa.gov/drink/contaminants/)
c - NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (http://www.dec.ny.gov/docs/water_pdf/togs111.pdf)

Table 15-8 Reference Limits and Evaluation Table for Mercury (Soil)
Matrix: Soil
Analytical Group: Mercury by SW7471A

			Laboratory Specific Limits			Control Limits		Project Action Levels		
Analyte	**CAS Number**	**Units**	**Lab LOQ**	**Lab LOD**	**Lab DL**	**Accuracy (%R)**	**Precision (% RPD)**	**2015 EPA Res RSL (THQ=1; TR=1E-06)[a]**	**NYSDEC ECL 375-6 Unrestricted Use Soil Cleanup Objectives[b]**	**NYSDEC CP-51 Unrestricted Use[c]**
Mercury	7439-97-6	mg/kg	0.017	0.0133	0.00553	80 - 124	20	9.4	0.18	NP

Notes:

Control limits are laboratory provided acceptance criteria. Lab limits are set at DOD QSM criteria when published. If no QSM criteria are published, then the lab limits are in-house limits.

Non-detections are reported at the LOD. TestAmerica LODs are evaluated, reviewed, and verified quarterly according to DoD QSM 5.0 requirements and therefore are subject to change. The laboratory will adhere to the most currently verified LODs.

🟨 Less than the DL
🟩 Less than the LOD but greater than the DL
🟦 Less than the LOQ but greater than the LOD

6 NYCRR - 6 of the Official Compilation of New York Codes
%R - Percent Recovery
CAS - Chemical Abstract Service
DL - Detection Limit
DoD - Department of Defense
ECL - Environmental Conservation Law
EPA - United States Environmental Protection Agency
LOD - Limit of Detection
LOQ - Limit of Quantification
mg/kg - Milligram per Kilogram
NP - Not Published
NYSDEC - New York State Department of Environmental Conservation
QSM - Quality System Manual
Res - Residential
RPD - Relative Percent Difference
RSL - Regional Screening Level
THQ - Target Hazard Quotient
TR - Target Risk Level

a - EPA June 2015 Regional Screening Level (http://www2.epa.gov/risk/risk-based-screening-table-generic-tables)
b - NYSDEC 6 NYCRR Part 375, December 2006 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/part375.pdf)
c - NYSDEC CP-51 Soil Cleanup Guidance, October 201 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/cpsoil.pdf)

WORKSHEET #17 SAMPLING DESIGN AND RATIONALE

Sites ZZ007, TU008, and TU009 will be evaluated in accordance with the CERCLA RI process with the following objectives:

1. Develop a CSM from data collected at the sites.
2. Determine the nature and extent of contamination that present a risk to human health and the environment with definitive data.
3. Identify and quantify current or potential fate and transport pathways.
4. Conduct human health risk assessments at each site for current and anticipated future receptors that may become exposed to contaminants.
5. Collect sufficient data to prove that NFRAP is warranted, or to define the nature and extent of contamination to support development of remedial alternatives in an FS for each site.

Analytical data collected as part of this RI will augment data provided in the SI phase of the CERCLA process. The SI sampling approach focused on potential source areas, with a limited number of soil borings and temporary monitoring wells (no longer available to sample) to determine presence or absence of COPCs.

The sections below describe the sampling system in terms of which matrices will be sampled, where the samples will be collected, the number of samples to be collected, the sampling frequency, and discuss the rationale for choosing the sampling process design methodology. Sample locations, descriptions and associated analyses fore Sites ZZ007, TU008, and TU009 are summarized at the end of this section in **Table 17-1**. Worksheet #18 provides a detailed list of the samples to be collected. Target analytes and analytical methods are shown in Worksheet #15.

17.1 PROPOSED INVESTIGATION APPROACH FOR ZZ007, TU008, AND TU009

The investigation approach of the RI is focused on delineating the horizontal and vertical extent of constituents identified in soil and groundwater at ZZ007, TU008, and TU009 identified during the SI activities. The investigation will be implemented in a phased approach.

17.1.1 Site ZZ007 - Former Building 13 Area

Figure 5 presents the site location, boundaries, and proposed soil boring and MW locations for ZZ007. It should be noted that preliminary plans to construct a building within former Building 13 footprint are in progress.

As described in Worksheet #10, several metals were detected in the groundwater collected from temporary wells during the SI. The groundwater was reported to have high turbidity. Sampling of permanent, developed wells is expected to result in less turbid water samples, and resultantly lower concentrations of metals.

The proposed investigation approach for ZZ008 is as follows.

- Initial Phase:
    - Install three permanent groundwater monitoring wells (MW) using HSA at ZZ007. A new building is planned for the footprint of former Building 13; as such, monitoring wells will not be installed within the footprint of the former building. One MW will be installed as close to PA/SI groundwater sampling locations ZZ07SB05/ZZ07GW05 and ZZ07SB02/ZZ07GW05 as possible but outside of the new building footprint to avoid damage during construction. One MW will be installed on the north (upgradient) side of former Building 13, as feasible with

pending building plans. One MW will be installed downgradient to the southeast and of former Building 13 approximately 25-ft downgradient of the existing MW (MWUNK). The three MWs will be installed as shallow wells screened across the shallow water table expected from 2 to 5 ft bgs. Proposed MW locations are presented on **Figure 5**.

  - Groundwater samples will be collected from the three wells described above and from the existing MW on the site for metals analysis. The existing MW was sampled during the SI and was labeled MWUNK. Groundwater samples will be analyzed for total and dissolved metals. Groundwater samples analyzed for dissolved metals will be field filtered with a 0.45-micron filter.
  - Collect up to two soil samples from each MW boring. One soil sample will be collected from the 2-ft interval just above the groundwater table, and one soil sample will be collected at an intermediate depth at the most affected interval based on field observations and/or PID readings. If an interval is not deemed impacted based on visual observations or PID readings, a soil sample will be collected from the 0-2 ft soil zone under any surface material (i.e., asphalt). Soil samples will be analyzed for metals.
  - Survey the new and existing MWs to determine groundwater flow direction.
- Potential Second Phase:
  - If the groundwater analytical results at a MW indicate impact as determined by concentrations exceeding PALs and that indicate risk, an additional MW may be installed in the downgradient direction from the original monitoring well if a delineation MW is absent.
  - Additional rounds of groundwater data may be necessary to evaluate concentration trends and seasonal variations.

17.1.2 Site TU008 - Former Heating Oil UST #41 at former Building 4

Figure 6 shows the site location, boundaries, and proposed soil boring and MW locations for TU008. As described in Worksheet #10, a former UST associated with the building may be the source of affected media. Previous soil sample results indicate that VOCs and SVOCs were not reported above site PALs during the PA/SI. Groundwater samples collected from temporary wells installed at the site reported VOCs and SVOCs at concentrations above the site PALs.

The proposed investigation approach for TU008 is as follows.

- Initial Phase:
  - Install four permanent MWs using HSA drilling techniques to confirm the SI results and to delineate potential contamination downgradient of the suspected source area. One of the permanent MWs will be installed upgradient of the potential source area to determine if an upgradient source of contamination is present and to confirm localized groundwater flow direction. One MW will be installed in the vicinity of the PA/SI groundwater samples and two MWs will be installed downgradient of the PA/SI sampling locations.
  - Collect two soil samples from each MW boring to determine if there is possible soil contamination as a result of a potential subsurface release from the former heating oil UST. One soil sample will be collected from just above the groundwater table and one soil sample will be collected at an intermediate depth at the most affected interval based on field observations and/or PID readings. If an interval is not deemed impacted based on visual observations or PID readings, the soil sample will be collected from 4 to 6 ft bgs, the depth of a most likely potential release from a UST. Soil samples will be analyzed for VOCs and SVOCs.
  - Following development, groundwater samples will be collected from the four MWs and analyzed for VOCs and SVOCs.
  - Survey the MWs to determine groundwater flow direction.

- Potential Second Phase:
  - Step-out samples may be collected during a second phase to determine the nature and extent of VOCs or SVOCs in soil and groundwater, based on a comparison of laboratory analytical results obtained during the first phase to the PALs identified in Worksheet #15.
  - If the groundwater analytical results at a MW indicate impact as determined by concentrations exceeding PALs, an additional MW will be installed in the downgradient direction from the original monitoring well if a delineation MW is absent. No step-out MWs will be installed for off-site upgradient locations.
  - Additional rounds of groundwater data may be necessary to evaluate concentration trends and seasonal variations.

17.1.3 Site TU009 - WWTP Bypass UST near IRP Site 6

Figure 7 presents the site location, boundaries, and proposed soil boring and MW locations for TU009. As described in Worksheet #10, previous sample results indicate arsenic, copper, iron, nickel, and zinc present in soil at concentrations above PALs. Metals and SVOCs were detected in groundwater at concentration above the site PALs. Sampling of permanent, developed wells is expected to result in less turbid water samples, and resultantly lower concentrations of metals.

The proposed investigation approach for TU009 is as follows.

- Initial Phase:
  - Install three permanent MWs using HSA drilling techniques to confirm the SI results and to delineate potential contamination downgradient of the suspected source area. One of the permanent MWs will be installed upgradient of the potential source area to determine if an upgradient source of contamination is present, confirm PA/SI groundwater sampling results, andconfirm localized groundwater flow direction. One MW will be installed in the vicinity of the PA/SI groundwater samples and one MW will be installed downgradient of the PA/SI sampling locations.
  - Collect up to two soil samples from each MW boring. One soil sample will be collected from the 2-ft interval just above the groundwater table, and one soil sample will be collected at an intermediate depth at the most affected interval based on field observations and/or PID readings. If an interval is not deemed impacted based on visual observations or PID readings, the soil sample will be collected from 4 to 6 ft bgs, the depth of a most likely potential release from a UST. Soil samples will be analyzed for SVOCs and metals.
  - Following development, groundwater samples will be collected from the three new MWs and existing Site 6 monitoring well 6MW24 and analyzed for SVOCs and total and dissolved metals. Groundwater samples analyzed for dissolved metals will be field filtered with a 0.45-micron filter.
  - Survey the MWs to determine groundwater flow direction. Water levels will be collected from available Site 6 wells to supplement water level data collected from the newly installed MWs.

- Potential Second Phase:
  - If the groundwater analytical results at a MW indicate impact as determined by concentrations exceeding PALs, an additional MW may be installed in the downgradient direction from the original monitoring well if a delineation MW is absent.
  - Additional rounds of groundwater data may be necessary to evaluate concentration trends and seasonal variations.

17.2 SAMPLING METHODOLOGY

MWs will be installed using HSA techniques in accordance with SOP W-1 (**Appendix C**). Groundwater samples will be collected using a bladder, variable- or low-speed submersible, or peristaltic pump with disposable dedicated tubing, and data will be recorded on the appropriate Field Form (**Appendix D**) in accordance with the SOP (**Appendix C**).

Data collected during each groundwater sampling event will include at a minimum:

- Well condition
- Headspace measurements
- Static Water Level (SWL)
- Depth to bottom of casing
- Screened zone
- Location of pump intake
- Purge method
- Purge rate
- Purge parameters
- Purge volume
- Final sampling water level
- Groundwater sample definition data

Subsurface soil samples will be collected continuously to the total depth of each boring using a hollow stem auger. Soil cores will be logged for lithology and headspace using a field PID, and data will be recorded on the appropriate Field Forms (**Appendix D**). Soil samples for laboratory analysis will be collected in accordance with SOP SS-1 and SOP SS-3 (HSA drilling) (**Appendix C**).

Soil and groundwater samples for each site will be containerized, labeled, preserved, and shipped in a sampling cooler for laboratory analysis for designated parameters presented in Subsection 17.1. Additional "step-out" sampling may be required to adequately characterize the extent of any COPCs. The step-out distance will be determined based on the sampling results and layout of existing samples so that the extent can be adequately defined.

Table 17-1 Sample Locations

Sample Location (LocID)[1]	Description	Soil Samples			Groundwater Samples		
		VOCs by 8260C	**SVOCs by 8270D**	**Metals by 6010C/ 7470A**	**VOCs by 8260C**	**SVOCs by 8270D**	**Metals by 6010C/ 7471A**
ZZ007							
SC-ZZ007-MW001	Upgradient well	0	0	2	0	0	2
SC-ZZ007-MW002	South and downgradient of former Building 13 and MWUNK	0	0	2	0	0	2
SC-ZZ007-MW003	Source area as close as possible to former groundwater sampling locations	0	0	2	0	0	2
SC-ZZ007-MWUNK	Existing monitoring well	0	0	0	0	0	2
Number of Investigative Samples		0	0	6	0	0	8
Field QA/QC Samples	Field Duplicates	0	0	1	0	0	2
	MS/MSD[3]	0	0	1	0	1	1
Total Number of Samples (ZZ007)		0	0	7	0	0	10
TU008							
SC-TU008-MW001	Upgradient well	2	2	0	1	1	0
SC-TU008-MW002	Source area near PA/SI sampling locations	2	2	0	1	1	0
SC-TU008-MW003	Downgradient of potential source area	2	2	0	1	1	0
SC-TU008-MW004	Downgradient of potential source area	2	2	0	1	1	0
Number of Investigative Samples		8	8	0	4	4	0
Field QA/QC Samples	Trip Blanks[2]	(see note 2)	0	0	1	0	0
	Field Duplicates	1	1	0	1	1	0
	MS/MSD[3]	1	1	0	1	1	0
Total Number of Samples (TU008)		9	9	0	6	5	0
TU009							
SC-TU009-MW001	Upgradient well	0	2	2	0	1	2
SC-TU009-MW002	Source area near PA/SI sampling locations	0	2	2	0	1	2

Table 17-1 Sample Locations (Continued)

Sample Location (LocID)[1]	Description	Soil Samples			Groundwater Samples		
		VOCs by 8260C	SVOCs by 8270D	Metals by 6010C/ 7470A	VOCs by 8260C	SVOCs by 8270D	Metals by 6010C/ 7471A
SC-TU009-MW003	Downgradient of potential source area	0	2	2	0	1	2
SC-TU009-6MW24	Existing Site 6monitoring well	0	0	0	0	1	2
Number of Investigative Samples		0	6	6	0	4	8
Field QA/QC Samples	Field Duplicates	0	1	1	0	1	2
	MS/MSD[3]	0	1	1	0	1	1
Total Number of Samples (TU009)		0	7	7	0	5	10

Notes:

[1] Sample locations are provided in **Figures 5** through **7**

[2] One trip blank required based on assumption that there will be one cooler containing VOCs per sampling event per site. One additional trip blank per cooler as needed.

[3] MS/MSD samples are not counted into the total number of samples as they generally are not considered as field QC samples

LocID – Location Identifier; refers to ERPIMS database field which identifies a location where one or more samples may be collected over time.
MS/MSD - Matrix Spike/Matrix Spike Duplicate
MW – Monitoring Well
PA/SI – Preliminary Assessment/Site Inspection
QA/QC – Quality Assurance/Quality Control
SVOC – Semivolatile Organic Compound
UNK - Unknown
VOC – Volatile Organic Compound

WORKSHEET #18 SAMPLING LOCATIONS AND METHODS

This worksheet summarizes the investigative samples to be collected. Field QC samples are identified in Worksheet #20.

Table 18-1 Sampling Locations and Methods/SOP Requirements

Sample Location (LocID)	Sample ID[1]	Matrix	Depth (ft bgs)	Analytical Group	Sampling SOP[2]	Laboratory SOP[3]
SC-ZZ007-MW001	SC-ZZ007-MW001-G-1	GW	Screen midpoint	Metals	W-4	DV-MT-0021 DV-MT-0017
SC-ZZ007-MW001	SC-ZZ007-MW001-Sxxxx	Soil	Most impacted		SS-1/SS-3	
SC-ZZ007-MW001	SC-ZZ007-MW001-Sxxxx	Soil	Above GW interface			
SC-ZZ007-MW002	SC-ZZ007-MW002-G-1	GW	Screen midpoint		W-4	
SC-ZZ007-MW002	SC-ZZ007-MW002-Sxxxx	Soil	Most impacted		SS-1/SS-3	
SC-ZZ007-MW002	SC-ZZ007-MW002-Sxxxx	Soil	Above GW interface			
SC-ZZ007-MW003	SC-ZZ007-MW003-G-1	GW	Screen midpoint		W-4	
SC-ZZ007-MW003	SC-ZZ007-MW003-Sxxxx	Soil	Most impacted		SS-1/SS-3	
SC-ZZ007-MW003	SC-ZZ007-MW003-Sxxxx	Soil	Above GW interface			
SC-ZZ007-MWUNK	SC-ZZ007-MWUNK-G-1	GW	Screen midpoint		W-4	
SC-TU008-MW001	SC-TU008-MW001- G-1	GW	Screen midpoint	VOCs, SVOCs	W-4	ST-MS-0002 DV-MS-0012
SC-TU008-MW001	SC-TU008-MW001-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU008-MW001	SC-TU008-MW001-Sxxxx	Soil	Most impacted			
SC-TU008-MW002	SC-TU008-MW002-G-1	GW	Screen midpoint		W-4	
SC-TU008-MW002	SC-TU008-MW002-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU008-MW002	SC-TU008-MW002-Sxxxx	Soil	Most impacted			
SC-TU008-MW003	SC-TU008-MW003-G-1	GW	Screen midpoint		W-4	
SC-TU008-MW003	SC-TU008-MW003-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU008-MW003	SC-TU008-MW003-Sxxxx	Soil	Most impacted			
SC-TU008-MW004	SC-TU008-MW004-G-1	GW	Screen midpoint		W-4	
SC-TU008-MW004	SC-TU008-MW004-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU008-MW004	SC-TU008-MW004-Sxxxx	Soil	Most impacted			

Table 18-1 Sampling Locations and Methods/SOP Requirements (Continued)

Sample Location (LocID)	Sample ID[1]	Matrix	Depth (ft bgs)	Analytical Group	Sampling SOP[2]	Laboratory SOP[3]
SC-TU009-MW001	SC-TU009-MW001-G-1	GW	Screen midpoint	SVOCs, Metals	W-4	DV-MS-0012 DV-MT-0021 DV-MT-0017
SC-TU009-MW001	SC-TU009-MW001-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU009-MW001	SC-TU009-MW001-Sxxxx	Soil	Most impacted			
SC-TU009-MW002	SC-TU009-MW002-G-1	GW	Screen midpoint		W-4	
SC-TU009-MW002	SC-TU009-MW002-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU009-MW002	SC-TU009-MW002-Sxxxx	Soil	Most impacted			
SC-TU009-MW003	SC-TU009-MW003-G-1	GW	Screen midpoint		W-4	
SC-TU009-MW003	SC-TU009-MW003-Sxxxx	Soil	Above GW interface		SS-1/SS-3	
SC-TU009-MW003	SC-TU009-MW003-Sxxxx	Soil	Most impacted			
SC-TU009-6MW24	SC-TU009-6MW24-G-1	GW	Screen midpoint		W-4	

Notes:

[1] Sample ID nomenclature is identified in Worksheet #27.

[2] Sampling SOPs can be found in **Appendix C.**

[3] Laboratory SOPs can be found in **Appendix E.**

ft bgs – Feet Below Ground Surface
GW – Groundwater
LocID – Location Identifier; refers to ERPIMS database field which identifies a location where one or more samples may be collected over time.
MW – Monitoring well
Sample ID – Field sample identifier that is the unique sample name included on sample labels and chain of custody records
SOP – Standard Operating Procedure
SVOC – Semivolatile Organic Compound
VOC – Volatile Organic Compound

WORKSHEETS #19 AND #30 SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

This worksheet summarizes the sample containers, preservation requirements, and holding times for each analytical group.

Table 19-1 and 30-1 Analytical SOP Requirements Table (Soil Samples)

Analyte/ Analytical Group	Matrix	Method/ SOP[1]	Accreditation Expiration Date	Container(s) (number, size, & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
VOCs	Soil	SW8260C (SW5035A)/ ST-MS-0002	TASL ELAP: 04/10/2016 NYS: 4/1/2016	Extrude 1 soil core into each of 3 VOA vials: ▪ 2 x 40-mL VOA vials with sodium bisulfate ▪ 1 x 40-mL VOA vial with methanol (include a 2 oz. jar of soil for percent solids)	5 mL sodium bisulfate. 10 mL methanol; Cool to ≤ 6°C	N/A	14 days to analysis from sampling	2 weeks
SVOCs	Soil	SW8270D (SW3550C or 3546)/y DV-MS-0012	TAD ELAP: 10/31/2017 NYS: 4/1/2016	1 x 4 oz. jar	Cool to ≤ 6°C	14 days to extraction	40 days to analysis from extraction	2 weeks
ICP-AES Metals	Soil	SW6010C (SW3050B)/ DV-MT-0021	TAD ELAP: 10/31/2017 NYS: 4/1/2016	1 x 4 oz. glass jar	Cool to ≤ 6°C	N/A	180 days	2 weeks
Mercury	Soil	SW7471A/ DV-MT-0016	TAD ELAP: 10/31/2017 NYS: 4/1/2016		Cool to ≤ 6°C	N/A	28 days	2 weeks
TCLP VOC	Soil	SW8260C (SW1311)/ ST-MS-0002 and ST-OP-0009	TASL ELAP: 04/10/2016 NYS: 4/1/2016	1 x 4 oz. glass jar with Teflon-lined lid	No headspace, Cool to ≤ 6°C	14 days to TCLP zero headspace extraction (ZHE)	14 days from ZHE extraction to analysis	2 weeks

Table 19-1 and 30-1 Analytical SOP Requirements Table (Soil Samples) (Continued)

Analyte/ Analytical Group	Matrix	Method/ SOP[1]	Accreditation Expiration Date	Container(s) (number, size, & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
TCLP SVOC, metals, and mercury	Soil	SW8270D, SW6010C, SW7470A (SW1311)/ DV-MS-0012, DV-MT-0021; DV-MT-0017 (DV-IP-0012)	TAD ELAP: 10/31/2017 NYS: 4/1/2016	2 x 8 oz. glass jar	Cool to ≤ 6°C	TCLP SVOC: 14 days to TCLP extraction plus 7 days to SVOC extraction TCLP mercury: 28 days to TCLP extraction TCLP metals: 180 days to TCLP extraction	TCLP SVOC: 40 days from SVOC extraction TCLP mercury: 28 days from TCLP extraction to analysis TCLP metals: 180 days from TCLP extraction to analysis	2 weeks
Ignitability	Soil	SW1020A/ TA-WC-0154	TAS ELAP: 1/19/2019	1 x 4 oz. jar, minimal headspace	Cool to < 6°C	None	None	2 weeks
pH (Corrosivity)	Soil	SW9045D/ DV-WC-0001	TAD ELAP: 10/31/2017 NYS: 4/1/2016	1 x 4 oz. jar	Cool to ≤ 6°C	28 days to water leach	same day as leached	2 weeks

Notes:

[1] Laboratory SOPs are listed on Worksheet #23. Preparation methods and SOPs are in parentheses in this table.
TestAmerica Denver will be the primary laboratory for this project. TestAmerica St. Louis will analyze VOCs.

°C – Degrees Celsius
< – Less Than
≤ – Less than or Equal to
ELAP – DoD Environmental Laboratory Accreditation Program
ICP-AES – Inductively Coupled Plasma-Atomic Emission Spectroscopy
mL – Milliliter
N/A – Not Applicable
oz. – Ounce
SOP – Standard Operating Procedure
SVOC – Semivolatile Organic Compound
SW – EPA SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TAD – TestAmerica Denver
TAS – TestAmerica Seattle
TASL – TestAmerica St. Louis
TCLP – Toxicity Characteristic Leaching Procedure
VOA – Volatile Organic Analysis
VOC – Volatile Organic Compound
ZHE – Zero Headspace Extraction

Table 19-2 and 30-2 Analytical SOP Requirements Table (Water Samples)

Analyte/ Analytical Group	Matrix	Method/SOP[1]	Accreditation Expiration Date	Container(s) (number, size, & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
VOCs	Water	SW8260C (SW5030)/ ST-MS-0002	TASL ELAP: 04/10/2016 NYS: 4/1/2016	3 x 40 mL VOA vials	HCl to pH <2, Cool to ≤ 6ºC	N/A	14 days to analysis	2 weeks
SVOCs	Water	SW8270D (SW3510C or 3520C)/ DV-MS-0012	TAD ELAP: 10/31/2017 NYS: 4/1/2016	2 x 1 L amber glass	Cool to ≤ 6°C	7 days to extraction	40 days from extraction	2 weeks
ICP-AES Metals	Water	SW6010C (SW3010B)/ DV-MT-0021	TAD ELAP: 10/31/2017 NYS: 4/1/2016	1 x 250-mL HDPE	HNO_3 to pH<2 Cool to ≤ 6°C	N/A	180 days	2 weeks
Mercury	Water	SW7470A/ DV-MT-0017	TAD ELAP: 10/31/2017 NYS: 4/1/2016			N/A	28 days	2 weeks

Notes:

[1] Laboratory SOPs are listed on Worksheet #23. Preparation methods and SOPs are in parentheses in this table. TestAmerica Denver will be the primary laboratory for this project; TestAmerica St. Louis will be analyzing VOCs.

°C – Degrees Celsius
< – Less Than
≤ – Less Than or Equal to
ELAP – DoD Environmental Laboratory Accreditation Program
HCl – Hydrochloric Acid
HDPE – High Density Polyethylene
HNO_3 – Nitric Acid
ICP-AES – Inductively coupled plasma-atomic emission spectroscopy
L – Liter
mL – Milliliter
N/A – Not Applicable
pH – Measure of acidity or basicity of an aqueous solution
SOP – Standard Operating Procedure
SVOC – Semivolatile Organic Compound
SW – USEPA SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TAD – TestAmerica–Denver
TASL – TestAmerica St. Louis
VOA – Volatile Organic Analysis
VOC – Volatile Organic Compound

WORKSHEET #20 FIELD QUALITY CONTROL SUMMARY

This worksheet summarizes the field QC samples to be collected and their collection frequency.

Table 20-1 Field Quality Control Sample Summary

Matrix	Analytical Group	No. of Samples	No. of Field Events	No. of Field Duplicates	No. of Equipment Rinsate Blanks[1]	No. of MS/MSDs[2]	No. of Trip Blanks[3]	No. of Temperature Blanks	Total No. of Samples to Lab[4]
Sampling Frequency:				Minimum 10%	As needed; 1 per event	Minimum 5%	1 per cooler with VOCs	1 per cooler	
ZZ007									
Water	Metals	8	1	2	N/A	1	N/A	N/A	10
Soil	Metals	6	1	1	N/A	1	N/A	N/A	7
TU008									
Soil	VOCs	8	1	1	N/A	1	See Note 3	N/A	9
Soil	SVOCs	8	1	1	N/A	1	N/A	N/A	9
Water	VOCs	4	1	1	N/A	1	1	N/A	6
Water	SVOCs	4	1	1	N/A	1	N/A	N/A	5
TU009									
Soil	SVOCs	6	1	1	N/A	1	N/A	N/A	7
Soil	Metals	6	1	1	N/A	1	N/A	N/A	7
Water	SVOCs	4	1	1	N/A	1	N/A	N/A	5
Water	Metals	8	1	2	N/A	1	N/A	N/A	10

Notes:

[1] If non-dedicated sampling equipment is used an equipment blank will be collected and analyzed for the same analytes as the samples.

[2] The MS/MSD is not considered a field QC sample, increased sample volume is required.

[3] One trip blank required based on assumption that there will be one cooler containing VOCs. One additional trip blank per cooler as needed.

[4] MS/MSD samples are not counted into the total number of samples.

% – Percent
MS/MSD – Matrix Spike/Matrix Spike Duplicate
N/A – Not Applicable
No. – Number
SVOC – Semivolatile Organic Compound
VOC – Volatile Organic Compound

WORKSHEET #21 FIELD SOPS

This worksheet summarizes the SOPs used for sampling and other field activities that may occur on the project.

Table 21-1 Project Sampling SOP References

Reference Number[1]	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	SOP Location
SOP G-1	Field Documentation	TEC-Weston JV	See SOP	N	**Appendix C**
SOP G-2	Calibration and Use of Field Instruments	TEC-Weston JV	See SOP	N	
SOP G-3	Sample Chain-of-Custody	TEC-Weston JV	See SOP	N	
SOP G-4	Sample Packing and Shipping	TEC-Weston JV	See SOP	N	
SOP G-5	Surveying	TEC-Weston JV	See SOP	N	
SOP G-6	Decontamination	TEC-Weston JV	See SOP	N	
SOP G-7	Management of Investigation Derived Waste	TEC-Weston JV	See SOP	N	
SOP G-8	Utility Location	TEC-Weston JV	See SOP	N	
SOP G-9	Field Filtration	TEC-Weston JV	See SOP	N	
SOP SS-1	Soil Sampling	TEC-Weston JV	See SOP	N	
SOP SS-3	Soil Sampling Using Hollow Stem Auger Technology	TEC-Weston JV	See SOP	N	
SOP W-1	Groundwater Monitoring Well Installation	TEC-Weston JV	See SOP	N	
SOP W-2	Well Development	TEC-Weston JV	See SOP	N	
SOP W-3	Water Level and Well Depth Measurements	TEC-Weston JV	See SOP	N	
SOP W-4	Low Stress (Low Flow) Groundwater Purging and Sampling	TEC-Weston JV	See SOP	N	
SOP W-5	Borehole/Well Abandonment	TEC-Weston JV	See SOP	N	
SOP W-6	Slug Test Aquifer Testing	TEC-Weston JV	See SOP	N	

Notes:

[1] Reference Number for SOP included in **Appendix C**, Field Standard Operating Procedures.

G – General
N – No
SOP – Standard Operating Procedure
SS – Soil
TEC-Weston JV – TEC-Weston Joint Venture
W – Water
Y – Yes

WORKSHEET #22 FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

This worksheet summarizes commonly used field equipment and details calibration, maintenance, testing, and inspections.

Table 22-1 Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference
Hand-held GPS unit[1]	N/A	Charge battery and place in case at the end of each day.	Field test in accordance with the equipment manual.	Inspect for external damage (e.g., screen dents, etc.).	Daily	Refer to manufacturer's instructions.	Refer to manufacturer's instructions.	Field Team Leader	G-2
Water Level Indicator	Rental agency to calibrate quarterly to determine the accuracy of the measurement.	Perform maintenance per manufacturer's instructions.	Measures depth-to-liquid and total well depth.	Per manufacturer's instructions.	Prior to use	Notable Beep; ±0.01 foot	Check battery condition	Field Team Leader	W-3
Turbidity Meter	Calibrate daily prior to collecting water quality data according to the manufacturer calibration specifications developed for the instrument being calibrated.	Perform maintenance per manufacturer's instructions.	Measures turbidity	Per manufacturer's instructions.	Daily before use	Check operations manual for acceptable range of calibrated probes.	If sensor fails to calibrate, the sensor will be cleaned and a span calibration will be performed, or the unit will be returned to a qualified service representative for repairs.	Field Team Leader	G-2
PID, FID	Calibrate for organic vapors using compressed gas cylinders, per manufacturer's instructions.	Charge batteries. Allow the batteries to totally discharge before recharging to prevent battery memory from occurring. Perform maintenance per manufacturer's instructions.	Screens for potential volatile compound concentrations.	Ensure probe tip not fouled.	Daily before use.	Check operations manual for acceptable range of calibrated probe for the specific lamp model.	If meter fails to calibrate, do not use this meter.	Field Team Leader	G-2

Table 22-1 Field Equipment Calibration, Maintenance, Testing, and Inspection (Continued)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference
Multi-Parameter Water Quality Meter	Calibrate daily prior to collecting water quality data according to the manufacturer's calibration specifications developed for the instrument being calibrated.	Perform maintenance per manufacturer's instructions.	Measures dissolved oxygen, ORP, turbidity, conductance, pH, and temperature	Per manufacturer's instructions.	Daily pH calibration	Within the specified range for pH in the SOP	If sensor fails to calibrate, the sensor will be cleaned and a span calibration will be performed, or the unit will be returned to a qualified service representative for repairs.	Field Team Leader	G-2
					Daily conductivity calibration	Within the specified range for conductivity in the SOP			
					Daily temperature calibration	Within the specified range for temperature in the SOP			
					Daily dissolved oxygen calibration	Within the specified range for dissolved oxygen in the SOP			
					Daily ORP calibration	Within the specified range for ORP in the SOP			

Notes:

[1] GPS units will be checked against a known survey point to ensure their accuracy to within ±5 meter prior to their use in the field. Field conditions such as confining topography may reduce the level of accuracy of the GPS. Additional reference points generally consisting of building corners, road intersections, permanent fencing/walls/infrastructure, or other similar structures will be acquired as local control points for spatial orientation of the GPS.

± – Plus or Minus
FID – Flame Ionization Detector
GPS – Global Positioning System
N/A – Not Applicable
ORP – Oxidation-Reduction Potential
pH – Measure of acidity or basicity of an aqueous solution
PID – Photoionization Detector
SOP – Standard Operating Procedure

WORKSHEET #23 ANALYTICAL SOPS

This worksheet summarizes the laboratory's analytical SOPs for the project. Laboratory SOPs can be found in **Appendix E**.

Table 23-1 Analytical SOP References

Lab SOP Number	Title, Date, and URL (if available)[1]	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option of Equipment Type	Organization Performing Analysis[2]	Modified for Project Work (Y/N)
VOCs in Water and Soil by SW8260C						
ST-MS-0002	Determination of Volatile Organics by GC/MS, Rev. 23, 12/01/2014.	Definitive	Water and Soil, VOCs	GC/MS	TestAmerica –St. Louis	N
SVOCs in Water by SW8270D						
DV-MS-0012	GC/MS Analysis Based on Method 8270D. Rev. 8, 10/31/2015.	Definitive	Water/ SVOCs	GC/MS	TestAmerica Denver	N
DV-OP-0006	Extraction of Aqueous Samples by Separatory Funnel, SW-846 3510C and EPA 600 Series. Rev. 13, 08/31/2015.	Preparation	Water/ SVOC (Prep)	N/A	TestAmerica Denver	N
DV-OP-0008	Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C and Method 625. Rev. 9, 12/31/2014.	Preparation	Water/ SVOC (Prep)	N/A	TestAmerica Denver	N
DV-OP-0007	Concentration and Clean-up of Organic Extracts (SW-846 3510C, 3520C, 3540C, 3546, 3550B, 3550C, 3620C, 3660B, 3665A, and EPA 600 series). Rev. 9, 12/31/2014.	Preparation	Water/ SVOC (Prep)	N/A	TestAmerica Denver	N
SVOCs in Soil by SW8270D						
DV-MS-0012	GC/MS Analysis Based on Method 8270D. Rev. 8, 10/31/2015.	Definitive	Soil/ SVOCs	GC/MS	TestAmerica Denver	N
DV-OP-0016	Ultrasonic Extraction of Solid Samples by Method SW-846 3550C. Rev. 6, 1/31/2015.	Preparation	Soil/ SVOC (Prep)	N/A	TestAmerica Denver	N
DV-OP-0015	Microwave Extraction of Solid Samples by Method [SW 3546]. Rev. 5, 1/31/2015.	Preparation	Soil/ SVOC (Prep)	N/A	TestAmerica Denver	N
DV-OP-0007	Concentration and Clean-up of Organic Extracts (SW-846 3510C, 3520C, 3540C, 3546, 3550B, 3550C, 3620C, 3660B, 3665A, and EPA 600 series). Rev. 9, 12/31/2014.	Preparation	Soil/ SVOC (Prep)	N/A	TestAmerica Denver	N

Table 23-1 Analytical SOP References (Continued)

Lab SOP Number	Title, Date, and URL (if available)[1]	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option of Equipment Type	Organization Performing Analysis[2]	Modified for Project Work (Y/N)
ICP-AES METALS in Water by SW6010C						
DV-MT-0021	ICP Analysis for Trace Elements by SW-846 Method 6010C. Rev. 3, 07/31/2015.	Definitive	Water/ Metals	ICP-AES	TestAmerica Denver	N
DV-IP-0010	Acid Digestion of Aqueous Samples for Metals Analysis by ICP. Rev. 8, 06/30/2015.	Preparation	Water/ Metals (Prep)	N/A	TestAmerica Denver	N
ICP-AES METALS in Soil by SW6010C						
DV-MT-0021	ICP Analysis for Trace Elements by SW-846 Method 6010C. Rev. 3, 07/31/2015.	Definitive	Soil/ Metals	ICP-AES	TestAmerica Denver	N
DV-IP-0015	Acid Digestion of Solids (EPA 3050B). Rev. 8, 10/31/2015.	Preparation	Soil/ Metals (Prep)	N/A	TestAmerica Denver	N
Mercury in Water by SW7470A						
DV-MT-0017	Mercury in Water by Cold Vapor Atomic Absorption (CVAA) (SW-846 7470A). Rev. 4, 08/11/2015.	Definitive	Water/ Mercury	CVAA	TestAmerica Denver	N
Mercury in Soil by SW7471A						
DV-MT-0016	Mercury in Solids by Cold Vapor Atomic Absorption (SW-846 7471A). Rev. 7, 02/28/2015.	Definitive	Soil/ Mercury	CVAA	TestAmerica Denver	N
Waste Characterization Analyses						
ST-MS-0002	Determination of Volatile Organics by GC/MS, Rev. 23, 12/01/2014.	Definitive	TCLP Extract/ TCLP VOCs	GC/MS	TestAmerica –St. Louis	N
ST-OP-0009	Toxicity Characteristic Leaching Procedure (TCLP), Synthetic Precipitation Leaching Procedure (SPLP) and the California Wet Leach Procedure (CWET). Rev. 5, 06/04/2015.	Preparation	Soil/ TCLP (1311) and SPLP (1312) extraction (Prep)	N/A	TestAmerica –St. Louis	N
DV-MS-0012	GC/MS Analysis Based on Method 8270D. Rev. 8, 10/31/2015.	Definitive	TCLP Extract/ TCLP SVOCs	GC/MS	TestAmerica Denver	N

Table 23-1 Analytical SOP References (Continued)

Lab SOP Number	Title, Date, and URL (if available)[1]	Definitive or Screening Data	Matrix/ Analytical Group	SOP Option of Equipment Type	Organization Performing Analysis[2]	Modified for Project Work (Y/N)
DV-OP-0006	Extraction of Aqueous Samples by Separatory Funnel, SW-846 3510C and EPA 600 Series. Rev. 13, 08/31/2015.	Preparation	TCLP Extract/ TCLP SVOC (Prep)	N/A	TestAmerica Denver	N
DV-MT-0021	ICP Analysis for Trace Elements by SW-846 Method 6010C. Rev. 3, 07/31/2015.	Definitive	TCLP Extract/ Metals	ICP-AES	TestAmerica Denver	N
DV-IP-0010	Acid Digestion of Aqueous Samples for Metals Analysis by ICP. Rev. 8, 06/30/2015.	Preparation	TCLP Extract/ TCLP Metals (Prep)	N/A	TestAmerica Denver	N
DV-MT-0017	Mercury in Water by Cold Vapor Atomic Absorption (CVAA) (SW-846 7470A). Rev. 4, 08/11/2015.	Definitive	TCLP Extract/ Mercury	CVAA	TestAmerica Denver	N
DV-IP-0012	Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) [SW846 1311 and 1312]. Rev. 9, 10/31/2015.	Preparation	Soil or Water/ TCLP (1311) and SPLP (1312) extraction (Prep)	N/A	TestAmerica Denver	N
TA-WC-0154	Seta Flash Ignitability [SW1020S, ASTM D3278-78]	Definitive	Water & Soil Ignitability	SetaFlash Tester	TestAmerica Seattle	N
DV-WC-0001	Soil and Waste pH [SW9045C & SW 9045D]. Rev. 11, 10/31/2015.	Definitive	Soil or Waste/ pH	Probe & Meter	TestAmerica Denver	N

Notes:

[1] SOPs are reviewed and revised on an annual schedule. The current version will be followed at the time of sample receipt.

[2] Laboratories are DoD-ELAP and State certified where applicable.

CLLE – Continuous Liquid/Liquid Extraction
CVAA – Cold Vapor Atomic Absorption
CWET – California Wet Leach Procedure
GC/MS – Gas Chromatograph/Mass Spectrometer
ICP – Inductively Coupled Plasma
ICP-AES – Inductively Coupled Plasma-Atomic Emission Spectroscopy
N/A – Not Applicable
pH – Measure of acidity or basicity of an aqueous solution
SOP – Standard Operating Procedure
SPLP – Synthetic Precipitation Leaching Procedure
SVOC – Semi-Volatile Organic Compound
SW – SW-846 method from USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TCLP – Toxicity Characteristic Leaching Procedure
USEPA – Environmental Protection Agency
VOC – Volatile Organic Compound

WORKSHEET #24 ANALYTICAL INSTRUMENT CALIBRATION

This worksheet describes the calibration procedures and schedule for the analytical instruments used on this project. Values provided in this table were derived from the DoD QSM v5.0.

Table 24-1 Analytical Instrument Calibration

Instrument	Calibration Procedure (ICAL Range)	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS (VOCs by SW8260C)	Tune Check	Prior to ICAL and prior to each 12-hour period of sample analysis	Specific ion abundance criteria of BFB from method	Retune instrument and verify	TASL Analyst/ Section Supervisor	ST-MS-0002
GC/MS (VOCs by SW8260C)	Minimum five-point initial calibration (ICAL) for target analytes for linear or six-point for quadratic; lowest concentration standard at or below the reporting limit. (Water: 5-200 µg/L Soil: 5-200 µg/kg)	Initial calibration prior to sample analysis	%RSD<20% all compounds, Relative Response Factor meet method criteria.	Repeat calibration	TASL Analyst/ Section Supervisor	ST-MS-0002
GC/MS (VOCs by SW8260C)	Second Source Calibration Verification	Once after each initial calibration	Value of second source for all analytes within ±20% of true value.	Rerun ICV one time, second failure requires recalibration	TASL Analyst/ Section Supervisor	ST-MS-0002
GC/MS (VOCs by SW8260C)	Calibration Verification (CCV)	Daily, before sample analysis, and every 12 hours of analysis time and at the end of the analytical batch run	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Re-inject CCV; if passes rerun previous 10 samples and continue run; if second CCV fails, recalibrate	TASL Analyst/ Section Supervisor	ST-MS-0002

Table 24-1 Analytical Instrument Calibration (Continued)

Instrument	Calibration Procedure (ICAL Range)	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS (VOCs by SW8260C)	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	TASL Analyst/ Section Supervisor	ST-MS-0002
GC/MS (VOCs by SW8260C)	Retention Time window position establishment	Once per ICAL and at the beginning of the analytical 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	N/A	TASL Analyst/ Section Supervisor	ST-MS-0002
GC/MS (VOCs by SW8260C)	Evaluation of Relative Retention Times (RRT)	With each sample	RRT of each reported analyte within +/- 0.06 RRT units	Correct problem, then rerun ICAL	TASL Analyst/ Section Supervisor	ST-MS-0002
GC/MS (SVOCs by SW8270D)	Tune Check - Check of mass spectral ion intensities (tuning procedure) using DFTPP (SW8270C)	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	TAD Analyst/ Section Supervisor	DV-MS-0012
GC/MS (SVOCs by SW8270D)	Performance Check	At the beginning of each 12-hour period, prior to sample analysis	Degradation ≤20% for DDT. Benzidine and Pentachlorophenol present at their normal responses, and tailing factor for each < 2.	Correct problem (inspect/change liner, clip front end of column, or other maintenance as indicated), then repeat the performance check.	TAD Analyst/ Section Supervisor	DV-MS-0012
GC/MS (SVOCs by SW8270D)	Initial Calibration (ICAL) Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit.	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: $r^2 \geq 0.99$; ▪ Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Verify standard solutions still valid, perform instrument maintenance as needed, then repeat the ICAL.	TAD Analyst/ Section Supervisor	DV-MS-0012

Table 24-1 Analytical Instrument Calibration (Continued)

Instrument	Calibration Procedure (ICAL Range)	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS (SVOCs by SW8270D)	Initial Calibration Verification (ICV)	Second source standard once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 20% of true value.	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat initial calibration.	TAD Analyst/ Section Supervisor	DV-MS-0012
GC/MS (SVOCs by SW8270D)	Retention Time Window Position Establishment	Once per ICAL, and at the beginning of the analytical sequence 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.	N/A	TAD Analyst/ Section Supervisor	DV-MS-0012
GC/MS (SVOCs by SW8270D)	Continuing calibration verification (CCV)	Daily, prior to sample analysis and after every 12 hours of analysis time; and at the end of the analytical batch.	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV. 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.	TAD Analyst/ Section Supervisor	DV-MS-0012
GC/MS (SVOCs by SW8270D)	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	TAD Analyst/ Section Supervisor	DV-MS-0012

Table 24-1 Analytical Instrument Calibration (Continued)

Instrument	Calibration Procedure (ICAL Range)	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES (Metals by 6010C)	Initial Calibration (ICAL) - Minimum of one high standard and a calibration blank	Prior to sample analysis.	N/A	N/A	TAD Analyst/ Section Supervisor	DV-MT-0021
ICP-AES (Metals by 6010C)	Initial calibration verification (ICV)	Second source standard immediately following ICAL	All reported analytes ± 10% of expected value.	Correct any problems and rerun ICV. If that fails, correct problem and repeat ICAL. No samples shall be analyzed until the second-source calibration verification is successful.	TAD Analyst/ Section Supervisor	DV-MT-0021
ICP-AES (Metals by 6010C)	Low-Level Calibration Check Standard $\leq$ LOQ (Low-level ICV)	Daily after one-point ICAL	All reported analytes must be within ± 20% of expected value.	Correct any problems, then reanalyze or repeat ICAL. Results cannot be reported without a valid low-level calibration check standard.	TAD Analyst/ Section Supervisor	DV-MT-0021
ICP-AES (Metals by 6010C)	Interference Check Solutions (ICS)	After ICAL and prior to sample analysis	ICS-A: Absolute value of concentration for all non-spiked project analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within + 20% of true value. (Not needed if instrument can read negative responses.)	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	TAD Analyst/ Section Supervisor	DV-MT-0021

Table 24-1 Analytical Instrument Calibration (Continued)

Instrument	Calibration Procedure (ICAL Range)	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES (Metals by 6010C)	Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the sequence.	All reported analytes ± 10% of expected value.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; 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.	TAD Analyst/ Section Supervisor	DV-MT-0021
ICP-AES (Metals by 6010C)	Initial and Continuing Calibration Blank (ICB, CCB)	Before analyzing samples, after every 10 field samples, and at the end of the analysis sequence.	No analytes detected > LOD	Correct any problems and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed. CCB failures due to carryover may not require an ICAL.	TAD Analyst/ Section Supervisor	DV-MT-0021
CVAA – (Mercury by SW7470A/ SW7471A/ or SW7471B)	Initial calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis.	$r^2 \geq 0.99$	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.	TAD Analyst/ Section Supervisor	DV-MT-0016, DV-MT-0017
CVAA – (Mercury by SW7470A, SW7471A, or SW7471B)	Initial calibration verification (ICV)	Run second-source standard once after each ICAL and prior to sample analysis.	Analytes within $\underline{+}$10% of expected value	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.	TAD Analyst/ Section Supervisor	DV-MT-0016, DV-MT-0017

Table 24-1 Analytical Instrument Calibration (Continued)

Instrument	Calibration Procedure (ICAL Range)	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
CVAA – (Mercury by SW7470A, SW7471A, or SW7471B)	Continuing calibration verification (CCV)	After every 10 field samples, and at the end of the analysis sequence	All analytes within 10% of expected value	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; 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.	TAD Analyst/ Section Supervisor	DV-MT-0016, DV-MT-0017
CVAA – (Mercury by SW7470A, SW7471A, or SW7471B)	Calibration blank (ICB/CCB)	Before beginning a sample run, after every continuing calibration verification	No analytes detected > LOD	Evaluate failure and impact on samples. If samples non-detect for analytes which have a high bias, report non-detect results with case narrative comment with 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.	TAD Analyst/ Section Supervisor	DV-MT-0016, DV-MT-0017

Table 24-1 Analytical Instrument Calibration (Continued)

***Notes**:*

[1] This is a summary of the acceptance criteria; refer to the method SOP for specific or more information.

[2] SOPs are reviewed and revised on an annual schedule. The current version will be followed at the time of sample receipt.

% – Percent
≥ – Greater Than or Equal to
< – Less Than
≤ – Less Than or Equal to
± – Plus or Minus
µg/kg – Microgram per Kilogram
µg/L – Microgram per Liter
BFB – 4-bromofluorobenzene
CA – Corrective Action
CCB – Continuing Calibration Blank
CCV – Continuing Calibration Verification
CVAA – Cold Vapor Atomic Absorption
DCV - Daily Calibration Verification
DDT – Dichlorodiphenyl Trichloroethane
DFTPP – Decafluorotriphenylphosphine
EICP - Extracted Ion Current Profile
GC/MS – Gas Chromatograph/Mass Spectrometer
ICAL – Initial Calibration
ICP-AES – Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICAL – Initial Calibration
ICB – Initial Calibration Blank
ICS – Interference Check Solutions
ICV – Initial Calibration Verification
LOD – Limit of Detection
LOQ – Limit of Quantitation
N/A – Not Applicable
r – Linear Regression Value
RRT – Relative Retention Time
RSD – Relative Standard Deviation
SOP – Standard Operating Procedure
SVOC – Semivolatile Organic Compound
TAD – TestAmerica – Denver
TASL – TestAmerica – St. Louis
VOC – Volatile Organic Compound

WORKSHEET #25 ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

This worksheet describes the maintenance, testing, and inspection procedures for commonly used analytical instruments. The laboratory's SOP associated with each instrument/analysis is listed in Worksheet #23.

Table 25-1 Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Person Responsible for CA	Reference
GC-MS (VOCs, SVOCs)	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	Analyst	Quality Assurance Manual – Section 20
GC-MS (VOCs, SVOCs)	Change septum, clean injection port, change or clip column, install new liner, change trap	Response factors and chromatogram review	Instrument performance and sensitivity	As needed	Tune and CCV pass criteria	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst	Quality Assurance Manual – Section 20
ICP-AES (Metals)	Replace pump windings and gas tanks, check standard and sample flow	Monitor IS counts for variation	Instrument performance and sensitivity	As needed	Monitor IS counts for variation	Replace windings, recalibrate and reanalyze	Analyst	Quality Assurance Manual – Section 20
CVAA (Mercury)	Replace disposables, flush lines, check lamp current and gas flow	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	Quality Assurance Manual – Section 20

Notes:

CA – Corrective Action
CCV – Continuing Calibration Verification
CVAA – Cold Vapor Atomic Absorption
GC/MS – Gas Chromatograph/Mass Spectrometer
ICP-AES - Inductively Coupled Plasma-Atomic Emission Spectroscopy
IS – Internal Standard
SVOC – Semivolatile Organic Compound
VOC – Volatile Organic Compound

WORKSHEETS #26, & #27 SAMPLE HANDLING, CUSTODY, AND DISPOSAL

This worksheet lists all personnel who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to laboratory delivery, to sample disposal.

Table 26-1 Sample Handling System

	Responsible Person	Organization	SOP Reference
SAMPLE COLLECTION, PACKAGING, AND SHIPMENT			
Sample Collection	Sampling Personnel	TEC-Weston JV	SS-1, SS-3, W-4
Sample Packaging	Sampling Personnel	TEC-Weston JV	G-4
Coordination of Shipment	Sampling Personnel	TEC-Weston JV	G-4
Completion of COC	Sampling Personnel	TEC-Weston JV	G-3
Type of Shipment/Carrier:	FedEx, UPS, or Courier Service – Priority Overnight as needed		G-4
SAMPLE RECEIPT AND ANALYSIS			
Sample Receipt	Receiving Supervisor at TestAmerica Denver or St. Louis		The laboratory will notify TEC-Weston JV of sample receipt electronically. TestAmerica's sample custody procedures are described in Section 23 of their Quality Assurance Manual. Sample receipt is described in Section 23.2; sample storage and archiving in Section 23.4; and sample disposal in Section 23.7.
Sample Custody and Storage	Sample Custodian at TestAmerica Denver or St. Louis		
Sample Preparation	Organic and/or Inorganic Prep Supervisor at TestAmerica Denver or St. Louis		
Sample Determinative Analysis	Organic and/or Inorganic Laboratory Analyst at TestAmerica Denver or St. Louis		
Sample Disposal	TestAmerica Denver or St. Louis		

Notes:

COC – Chain-of-Custody
SOP – Standard Operating Procedure
TEC-Weston JV – TEC-Weston Joint Venture
TestAmerica – TestAmerica Laboratories, Inc.

This worksheet presents the procedures used for sample identification. Sample documentation (labels, COC, field logbook) protocols are presented in **Appendix C**. **Appendix C** also includes the procedures that will be used to maintain sample custody and integrity (e.g., labels, COCs, field logbook) and the protocols for sample shipment.

27.1 SAMPLE IDENTIFICATION

Each sample collected will be given a unique sample identifier (ID). A record of all sample IDs will be kept with the field records and recorded on a COC form. In addition, the sample IDs will be used to identify and retrieve analytical results from the laboratory, validation, and upload into ERPIMS. Sample IDs will format:

- "SC-" Installation Acronym (e.g., SC = Schenectady ANGB)
- "TU0008-" Site Number; either TU0008, TU0009, or ZZ007
- "MW001-" Location type; MW = MW, SB = soil boring

SC-TU008-MW001 and SC-TU0008-SB002 are examples of ERPIMS LOCIDs

- "S-" Sample media; S = soil, G = groundwater
- "##" Designates the sampling event (for groundwater) or the beginning and ending depth of the soil sample

For example, SC-TU008-MW001-G-1 represents a groundwater sample collected during the first sampling event from MW001 at site TU008 at Schenectady ANGB. Sample ID SC-TU008-MW001-S0103 is a subsurface soil sample collected at 1 to 3 ft bgs from MW001 at site TU008 at Schenectady ANGB.

Field duplicates will be designated by adding "D" to the end of the sample ID (e.g., SC-TU008-MW001-G-1-D). Trip blanks will be associated with a specific cooler on a specific date; therefore, trip blanks will be assigned a sequential number identical to the cooler number (e.g., SC-TU008-TB-040116-01 for cooler #1 on April 1, 2016, SC-TU008-TB-040116-02 for cooler #2 on April 1, 2016, etc.). To ensure correct association and electronic documentation, the sample manager will write the cooler number in the notes section of the COC.

If non-dedicated sampling equipment is used, equipment blanks will be collected at a frequency of per event and analyzed for the same analytes as the samples. Equipment blanks will be designated by "EB" followed by a date identifier (e.g., SC-TU008-EB-040216 for the equipment blank collected on April 2, 2016).

Additional sample volume will be collected and submitted to the laboratory for analysis of MS/MSDs. The sample ID will be the same as the parent with the addition of MS or MSD. For example, SC-TU008-MW001-G-1MS and SC-TU008-MW001-G-1MSD. The COCs will designate which sample locations are associated with the extra volume for MS/MSD analysis. Although the matrix spikes and spike duplicates should not be listed separately on the COC, the laboratory will make this distinction when they submit the ERPIMS EDD.

WORKSHEET #28 ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

This worksheet identifies the QC samples and their respective acceptance limits for commonly-used analytical groups. Values provided in this table were derived from the DoD QSM v5.0.

Table 28-1 Laboratory QC Samples Table for VOCs

Matrix	Soil and Water
Analytical Group	VOCs
Analytical Method/ SOP Reference[1]	SW8260C/ST-MS-0002

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank	One per preparatory batch (up to 20 samples)	No analytes > ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater). No common lab contaminants >LOQ.	If sufficient sample is available, re-prep and reanalyze samples. Qualify data as needed and discuss in case narrative.	Analyst/ Supervisor	No analytes >1/2 LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater). No common lab contaminants > LOQ.
LCS	1 per preparatory batch (up to 20 samples)	QSM limits (if available) or current in-housel limits if no QSM limits published.	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/ Supervisor	QSM 5.0 Recovery Control Limits per Appendix C Table 23 (soil) and Table 24 (water). For analytes not listed in Tables 23 and 24, use laboratory Recovery Control Limits.
MS/MSD	One MS/MSD per preparatory batch (20 samples)	<u>Recovery</u>: QSM limits (if available) or current in-house limits if no QSM limits published. <u>RPD</u>: RPD between MS and MSD ≤ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/ Supervisor	QSM 5.0 Recovery Control Limits per Appendix C Table 23 (soil) and Table 24 (water). For analytes not listed in Tables 23 and 24, use laboratory Recovery Control Limits. RPD between MS and MSD ≤ 20%

Table 28-1 Laboratory QC Samples Table for VOCs (Continued)

Matrix	Soil and Water
Analytical Group	VOCs
Analytical Method/ SOP Reference[1]	SW8260C/ST-MS-0002

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Surrogates	Every field and QC sample	QSM limits (if available) or current in-house limits if no QSM limits published.	Evaluate data, if samples non-detect and surrogate recovery is above upper limits, report with case narrative comment. If obvious chromatographic interference is present, report with narrative comment. Otherwise, reanalyze.	Analyst/ Supervisor	QSM 5.0 Recovery Control Limits per Appendix C Table 23 (soil) and Table 24 (water), if available. Otherwise Laboratory control limits.
Internal Standards	Each sample, QC sample, and 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 in accordance with DoD QSM requirements. If field samples still outside criteria, qualify data and explain in case narrative.	Analyst/ Supervisor	QSM 5.0 criteria: 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.

Table 28-2 Laboratory QC Samples Table for SVOCs

Matrix	Soil and Water
Analytical Group	SVOCs
Analytical Method/ SOP Reference[1]	SW8270D/ DV-MS-0012

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank	One per preparatory batch (20 samples)	No analytes> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater). No common lab contaminants >LOQ.	If sufficient sample is available, re-prep and reanalyze samples. Qualify data as needed.	Analyst/ Supervisor	No analytes >1/2 LOQ; no common lab contaminants > LOQ.
LCS	1 per analytical batch 20 or less	QSM 5.0 limits (if available) or current in-housel limits if no QSM limits published.	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/ Supervisor	QSM 5.0 Recovery Control Limits per Appendix C Table 25 (soil) and Table 26 (water). For analytes not listed in Tables 25 and 26, use laboratory Recovery Control Limits.
MS/MSD	One MS/MSD per preparatory batch (20 samples)	<u>Recovery</u>: QSM 5.0 limits (if available) or current in-housel limits if no QSM limits published. <u>RPD</u>: RPD between MS and MSD ≤ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/ Supervisor	QSM 5.0 Recovery Control Limits per Appendix C Table 25 (soil) and Table 26 (water). For analytes not listed in table 25 and 64, use laboratory recovery Control Limits. RPD between MS and MSD ≤ 20%

Table 28-2 Laboratory QC Samples Table for SVOCs (Continued)

Matrix	Soil and Water
Analytical Group	SVOCs
Analytical Method/ SOP Reference[1]	SW8270D/ DV-MS-0012

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Surrogates	Every field and QC sample	QSM 5.0 limits (if available) or current in-house limits if no QSM limits published.	Evaluate data, if samples non-detect and surrogate recovery is above upper limits, report with case narrative comment. If obvious chromatographic interference is present, report with narrative comment. Otherwise, reanalyze.	Analyst/ Supervisor	QSM 5.0 Recovery Control Limits per Appendix C Table 25 (soil) and Table 26 (water), if available. Otherwise Laboratory control limits.
Internal Standards	Each sample, QC sample, and calibration standard	Retention time within ± 30 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 in accordance with DoD QSM requirements. If field samples still outside criteria, qualify data and explain in case narrative.	Analyst/ Supervisor	QSM 5.0 criteria: 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.

Table 28-3 Laboratory QC Samples Table for Metals by ICP-AES

Matrix	Soil and Water
Analytical Group	Metals
Analytical Method/ SOP Reference[1]	SW6010C/ DV-MT-0021

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	CA	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No target analytes> ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Common lab contaminants: no analytes detected > LOQ.	If sufficient sample is available, reprep and reanalyze samples. Qualify data as needed. Report results if sample results >10 times the method blank result or the sample result is non-detected.	Analyst/ Supervisor	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).
LCS	One per preparation batch of twenty or fewer samples of similar matrix.	Water: QSM 5.0 Appendix C Table 4 Soil: QSM 5.0 Appendix C Table 3	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/ Supervisor	Water: QSM 5.0 Appendix C Table 4 Soil: QSM 5.0 Appendix C Table 3
MS/MSD	One per preparation batch of 20 or fewer samples of similar matrix	Water: QSM 5.0 Appendix C Table 4 Soil: QSM 5.0 Appendix C Table 3 RPD ≤ 20%	If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/ Supervisor	Water: QSM 5.0 Appendix C Table 4 Soil: QSM 5.0 Appendix C Table 3 RPD ≤ 20%
Dilution test (serial dilution)	One per preparatory batch if MS or MSD fails. Only applies to analytes with concentrations > 50 times the LOQ.	Five-fold dilution must agree within + 10% of the original determination	If dilution test fails analyze post digestion spike.	Analyst/ Supervisor	Five-fold dilution must agree within + 10% of the original determination

Table 28-3 Laboratory QC Samples Table for Metals by ICP-AES (Continued)

Matrix	Soil and Water
Analytical Group	Metals
Analytical Method/ SOP Reference[1]	SW6010C/ DV-MT-0021

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	CA	Person(s) Responsible for CA	Measurement Performance Criteria
Post digestion spike (PDS) addition	Perform if MS/MSD fails. One per preparatory batch (using the same sample used for the MS/MSD if possible.)	Recovery within 80-120% of expected results	No specific CA. Apply J-flag if acceptance criteria are not met. Note in case narrative.	Analyst/ Supervisor	Recovery within 80-120% of expected results

Table 28-4 Laboratory QC Samples Table for Mercury by CVAA

Matrix	Soil and Water
Analytical Group	Metals
Analytical Method/ SOP Reference[1]	SW7470A/ DV-MT-0016 SW7471A/ DV-MT-0017

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[2]	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	No target analytes > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	If sufficient sample is available, reprep and reanalyze samples. Qualify data as needed. Report results if sample results >10 times the method blank result or the sample result is non-detected.	Analyst/ Supervisor	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).
LCS	One per preparation batch of twenty or fewer samples of similar matrix.	Water: QSM 5.0 Appendix C Table 12 Soil: QSM 5.0 Appendix C Table 11	Reanalyze LCS once. If acceptable, report. Otherwise, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/ Supervisor	Water: QSM 5.0 Appendix C Table 4 Soil: QSM 5.0 Appendix C Table 3
MS/MSD	One per preparation batch of 20 or fewer samples of similar matrix	Water: QSM 5.0 Appendix C Table 12 Soil: QSM 5.0 Appendix C Table 11 RPD ≤ 20%	If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/ Supervisor	Water: QSM 5.0 Appendix C Table 12 Soil: QSM 5.0 Appendix C Table 11 RPD ≤ 20%

Notes for all Worksheet #28 tables:

[1] Laboratory SOPs are listed on Worksheet #23.

[2] Where applicable, the Acceptance Limits are consistent with the DoD QSM v5.0.

% – Percent
> – Greater Than
≤ – Less Than or Equal to
± – Plus or Minus
CA – Corrective Action
CVAA – Cold Vapor Atomic Absorption
DoD – Department of Defense
EICP – Extracted Ion Current Profile
GC – Gas Chromatograph
ICAL – Initial Calibration
ICP-AES - Inductively Coupled Plasma-Atomic Emission Spectroscopy
LCS – Laboratory Control Sample
LOQ – Limit of Quantitation
MS – Matrix Spike
MSD – Matrix Spike Duplicate
PDS – Post Digestion Spike
QC – Quality Control
QSM – Quality System Manual
RPD – Relative Percent Difference
SOP – Standard Operating Procedure
SVOC – Semivolatile Organic Compound
VOC – Volatile Organic Compound

WORKSHEET #29 PROJECT DOCUMENTS AND RECORDS

This worksheet identifies project documents and records that will be generated for every aspect of the project.

Table 29-1 Project Documents and Records

Record	Generation	Verification	Storage Location/Archival
Sample Collection, On-Site Analysis, and Data Assessment Documents and Records			
Project UFP-QAPP	Project Staff	Project Manager	Electronic PDF copies in the project file. Hard copy (bound notebook) in the project file. Archived at project closeout.
Field Logbook	Field Team Leader	Installation Lead	Electronic PDF copies in the project file. Hard copy (bound notebook) in the project file. Archived at project closeout.
Chain-of-Custody Records	Field Team Leader	Installation Lead	Electronic PDF copies in the project file. Hard copy in the project file. Archived at project closeout.
Air Bills	Field Team Leader	Installation Lead	Hard copy in the project file. Archived at project closeout.
Electronic Field Data Deliverables	Field Team Leader	Installation Lead	Loaded in the Field Database, then electronic data deliverables are saved in secure project-specific databases in ERPIMS.
Various field measurements	Field Team	Field Team Leader	Recorded in field logbook, then electronic data deliverables are saved in secure project-specific databases in ERPIMS.
Field equipment calibration information	Field Team	Field Team Leader	Recorded in field logbook.
Field equipment maintenance records	Field Team	Field Team Leader	Inspected by Field Team Leader. Not maintained.
Safety Meeting Attendance Log	Field Team Leader	Site Health and Safety Officer	Hard copy in the project file. Archived at project closeout.
Sampling/Drilling Forms	Field Team Leader	Installation Lead	Electronic PDF copies in the project file.
Laboratory Forms and Documents			
Sample Receipt, Custody, and Tracking Records	Project Chemist	Project Manager	Electronic PDF copies in the project file. Hard copy in the full data package and stored in ERPIMS.
Equipment Calibration Logs	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package. Archived at project closeout.
Sample Prep Logs	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package. Archived at project closeout.
Run Logs	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package. Archived at project closeout.
Equipment Maintenance, Testing, and Inspection Logs	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package. Archived at project closeout.
Reported Results for Standards, QC Checks, and QC Samples	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package. Archived at project closeout.

Table 29-1 Project Documents and Records (Continued)

Record	Generation	Verification	Storage Location/Archival
Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package. Archived at project closeout.
Data Package Completeness Checklists	Laboratory	Validator Project Chemist	Electronic PDF copies in the data validation report. Archived at project closeout.
Sample Disposal Records	Laboratory	Validator Project Chemist	Maintained by the laboratory.
Extraction/Cleanup Records	Laboratory	Validator Project Chemist	Electronic PDF copies in the full data package Archived at project closeout.
Fixed Laboratory Audit Checklists	Laboratory	Validator Project Chemist	If completed, electronic PDF copy in the project file. Archived at project closeout.
Data Validation Reports	Validator	Project Chemist	Electronic PDF copies in the project file. Archived at project closeout.
Electronic Data Deliverables and Electronic Login Deliverables	Laboratory	Project Chemist	Electronic data deliverables are saved in secure project specific databases in ERPIMS.
Laboratory Accreditation Certificates	Laboratory	Project Chemist	Electronic PDF copy in the project file. Archived at project closeout.
Quality Assurance Manual/Laboratory SOPs	Laboratory	Project Chemist	Electronic PDF copy in the project file. Archived at project closeout.

Notes:

ERPIMS - Environmental Resources Program Information Management System
QC –Quality Control
SOP – Standard Operating Procedure
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan

WORKSHEETS #31, #32, AND #33 ASSESSMENTS AND CORRECTIVE ACTIONS

This worksheet identifies the assessments/audits planned for the project.

Table 31-1 Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action (CA)	Person(s) Responsible for Monitoring Effectiveness of CA
Daily Quality Control Assessment	Daily	Internal	TEC-Weston JV	Field Team Leader	Installation Lead	Installation Lead/Field Team Leader	Field Team Leader
Review of Field Notes/Logbook	Daily	Internal	TEC-Weston JV	Field Team Leader	Installation Lead	Installation Lead/Field Team Leader	Field Team Leader
Review of Field Instrument Calibration	Daily	Internal	TEC-Weston JV	Field Team Leader	Installation Lead	Installation Lead/Field Team Leader	Field Team Leader
Laboratory Verification	Completed prior to identifying a laboratory for the project	Internal	TEC-Weston JV	Project Chemist	Laboratory Project Manager or Designee	Laboratory Quality Assurance Manager or Designee	Project Chemist
Facility Notification	1 month and 48 hours prior to start of field work	Internal	TEC-Weston JV	Project Manager	N/A	N/A	N/A
Subcontractor Notifications	1 month and 48 hours prior to start of sampling	Internal	TEC-Weston JV	Project Manager	N/A	N/A	N/A
Health and Safety Audit	As needed	Internal	TEC-Weston JV	Health and Safety Officer	Installation Lead and Project Manager	Installation Lead	Installation Lead and Project Manager
Laboratory Data Review Audit	Once per SDG	Both	TestAmerica/ TEC-Weston JV	Data Validator/ Project Chemist	Laboratory Quality Assurance Manager	Project Manager/ Project Chemist	Project Manager

Notes:

Project personnel are identified in Worksheet #7.
CA – Corrective Action
N/A – Not Applicable
QA – Quality Assurance
SDG –Sample Delivery Group
TEC-Weston JV – TEC-Weston Joint Venture

31.1 LABORATORY VERIFICATION

All samples will be analyzed by TestAmerica Denver or TestAmerica St. Louis Laboratories as indicated in Table 19-1 and 30-1. Contracted laboratories that perform analysis on definitive data (e.g., VOCs, SVOCs, metals) will be State of New York-certified and be DoD ELAP-accredited for each method specified. Laboratory verification consists of ensuring that State and DoD ELAP accreditation of primary and secondary laboratories have not expired. Laboratory accreditation certifications are included in **Appendix E.**

31.2 FACILITY NOTIFICATION

At least 48 hours prior to start of sampling, the Schenectady ANGB EM or their representative will be notified of field activities and that all required access to enter the facility has been obtained.

31.3 SUBCONTRACTOR NOTIFICATION

Subcontractors will be notified of the start of field work no later than one month before field work commences. They will be required to provide Health and Safety and specialty certifications no later than two weeks before field work commences. Subcontractors will be provided with the Final UFP-QAPP and a SSHP for review and sign-off no later than two weeks before field work commences. Subcontractors will provide a signature for all employees who will be working on the project verifying that they have read and understand the requirements of the project.

This worksheet describes the sequence of events that include documentation of deficiencies, notification of findings, request for corrective action, implementation of corrective action, and follow-up assessment of the corrective action's effectiveness for each assessment/audit performed on the project.

Table 32-1 Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Audit	Logbook or nonconformance report	Project Manager (or designee)	24 hours after audit	Written Letter	Installation Lead	24 hours after notification
Field Documentation Review	Nonconformance report	Quality Manager	24 hours after document review	Written Memorandum	Project Chemist Installation Lead	24 hours after notification
Laboratory Assessment (if significant QA/QC issues are encountered)	Written audit report	Project Manager Quality Manager Installation Points of Contact or their representative Laboratory Project Manager	5 days after audit	Corrective Action Plan	Laboratory Project Manager	Two weeks after receiving notification

Notes:

Project personnel are identified in Worksheet #7.
QA – Quality Assurance
QC – Quality Control

32.1 FIELD SAMPLING ASSESSMENT

Prior to start of the project, a visit to the project site will be performed to verify site conditions. Throughout the duration of the project, field documentation and sample receipt forms will be reviewed as needed.

The Quality Manager may schedule surveillance of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. The Quality Manager (or designee) may conduct surveillance of field activities during the project during a scheduled visit. Sampling operations may be reviewed and compared to the requirements listed in this UFP-QAPP. Use of proper sample containers, proper handling of samples, and adequate documentation of the sampling operation will be verified. The surveillance may include observations of COC procedure, field documentations, instrument calibrations, and field measurements.

32.2 FIELD DOCUMENTATION REVIEW

Field documents and COC records will be reviewed to ensure that all entries are printed or written in indelible black or blue ink, dated, and signed. The COC will be reviewed daily for completeness by the Project Chemist. A copy of the COC form will be retained by the Project Chemist and kept in the project file until the completion of the project.

32.3 LABORATORY ASSESSMENT

The primary and secondary laboratories selected for this project are current on the New York and DoD ELAP certification. The TEC-Weston JV may conduct a laboratory assessment if warranted during the project. The scope of the laboratory assessment by the TEC-Weston JV will be determined based on quality issues encountered.

32.4 CORRECTIVE ACTION PROCEDURES

The Quality Manager or senior technical staff will document problems and the corrective actions to provide a complete record of QA activities and to help identify necessary preventive actions. Non-conformances that affect the findings or recommendations of the project or that have impacts to work outside of the project will be reported to Installation Points of Contact or their representative and the Project Team.

If the laboratories encounter issues during the project that may impact data quality, the Laboratory Project Manager will notify the Project Chemist within one business day of discovery to discuss corrective actions. A written corrective action plan will be provided in a timely manner and implemented immediately by the laboratory.

This worksheet lists the periodic QA management reports ensuring that managers and stakeholders are updated on project status and the results of the QA assessments.

Table 33-1 Planned Project Assessments

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Daily Field Report	Daily/after start of sampling	Daily/after start of sampling	Field Team Leader	Installation Lead/Project Manager
Monthly Progress Report	Monthly	Monthly	Project Manager	NGB/A4OR Program Manager or their representative
Data Usability Assessment Report	After all data are generated and validated	Submitted with RI Report	Project Chemist	Quality Manager, Project Manager

Notes:

NGB/A4OR – National Guard Bureau, Logistics and Installations Directorate, Operations Division, Restoration Branch

WORKSHEET #34 DATA VERIFICATION AND VALIDATION INPUTS

This worksheet presents the Data Review Process for Verification (Step I). Verification is a completeness check performed before the data review process to determine whether the required measurements are collected and all data deliverables (the complete data package) are present. It involves a review of all data inputs to ensure that they are present. The column titled **Internal/External** is in relation to the data generator.

Table 34-1 Verification (Step I) Process

Verification Input	Description	Internal/ External	Responsible for Verification
COC forms	COC forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Internal	Field Team Leader
Audit reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the project manager will be notified to ensure action is taken.	Internal	Installation Lead
Field notes/logbook	Field notes will be reviewed internally and placed in the project file. A copy of the field notes will be attached to the RI Report.	Internal	Installation Lead/Field Team Leader
Sample Receipt	For samples shipped via courier or by air, the Project Chemist will verify receipt of samples by the laboratory.	Internal	Project Chemist
Sample login	Sample login information will be reviewed for completeness in accordance with the COC forms.	Internal	Installation Lead
		External	Laboratory Project Manager
Laboratory data prior to release	Laboratory data will be reviewed and verified for completeness against analyses requested on the COC forms.	External	Laboratory Project Manager
Laboratory data due at turnaround time listed on COC	Laboratory data will be verified that the analyses reported are consistent with the analyses requested on the COC forms.	Internal	Project Chemist

Table 34-1 Verification (Step I) Process (Continued)

Verification Input	Description	Internal/ External	Responsible for Verification
Laboratory data packages	Laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	External	Laboratory Project Manager or designee.
Laboratory data packages	All received data packages will be verified externally by the data validator or project chemist for completeness. All screening level data and site evaluation/natural attenuation/geochemical conditions parameters will only undergo Verification (Step I), unless otherwise dictated by project requirements. All definitive data will be validated externally according to the data validation procedures specified in UFP-QAPP Worksheet #35.	External	Data Validator or Project Chemist
IDW Disposal Manifests	IDW Disposal Manifests will be reviewed for accuracy and included as an appendix in the RI Report.	Internal	Installation Lead
Field and electronic data	One hundred percent of manual entries will be reviewed against the hardcopy information and 10 percent of electronic uploads will be checked against the hardcopy.	Internal	ERPIMS Data Manager

Notes:

COC – Chain-of-Custody
ERPIMS – Environmental Resources Program Information Management System
IDW – Investigation-Derived Waste
RI – Remedial Investigation
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan

WORKSHEET #35 DATA VERIFICATION PROCEDURES

This worksheet presents the Data Review Process for Validation (Step IIa and IIb). Validation procedures and criteria ensure that data are evaluated properly, completely, and consistently for use in meeting project goals.

Step IIa Validation activities ensure compliance with methods, procedures, and contracts for both sampling and analytical data. Examples of Step IIa validation activities are listed as follows:

Data Deliverables and UFP-QAPP
Analytes
COC
Holding Times
QC acceptance criteria (blanks, surrogates, LCS, MS/MSD, serial dilutions, post digestion spikes)
Sampling Methods and Procedures
Field Transcription
Analytical Methods and Procedures
Validation Flags
Sample Handling
Laboratory Transcription
Standards
Communication
Audits

Step IIb Validation activities ensure compliance with Measurement Performance Criteria in the UFP-QAPP for both sampling and analytical data. Some of the elements have both Step IIa and Step IIb validation activities. Examples of Step IIb validation activities are listed as follows:

Data Deliverables and UFP-QAPP
Deviations
Sampling Plan
Sampling Procedures
Co-located Field Duplicates
Project LOQs
Confirmatory Analyses
Validation Flags
Performance Criteria (ICV, CCV, Method specific instrument performance checks (tunes, breakdown checks, instrument checks, interference checks)

Table 35-1 Validation (Step IIa and IIb) Process

Step IIa/ IIb[1]	Validation Input	Description	Responsible for Validation
IIa	Field logbook	Field logbooks will be reviewed weekly for accuracy and completeness associated with each sampling event. The inspection will be documented in daily quality control report.	Installation Lead Quality Manager
IIa	COC forms	COC forms will be reviewed daily to ensure that project information, sample analyses requested, number of field QC samples collected, and selection of Stage 2B or 3 validation are accurate and in accordance with the requirements in this UFP-QAPP.	Installation Lead Quality Manager
		COC forms will be reviewed by the validator for completeness and that sample preservations are in accordance with this UFP-QAPP.	Data Validator
IIa	Sampling Methods and Procedures	Use of the required sampling methods will be established and any deviations will be noted. The sampling procedures and field measurements will be confirmed to have met performance criteria and any deviations will be documented.	Installation Lead Quality Manager
IIa	Sample receipt	The sample cooler will be checked for compliance with temperature and packaging requirements listed in Worksheet #27 of this UFP-QAPP.	Laboratory Project Manager Project Chemist or Data Validator
IIa	Sample log-ins	Sample log-in will be reviewed for accuracy against the COC form. Sample log-ins will be reviewed by the project chemist or validator that preservation, temperature, and sample receipt conditions are in accordance with this UFP-QAPP.	Laboratory Project Manager Project Chemist or Data Validator
IIa	Laboratory data prior to release	Data reported are compliant with method- and project-specific QC requirements; the reported information is complete; the information in the report narrative is complete and accurate; and results are reasonable.	Laboratory Project Manager or designee
		100 percent of the data comply with the method- and project-specific requirements and that any deviations or failure to meet criteria are documented in the data package case narrative.	
		100 percent of manual entries are free of transcription errors and manual calculations are accurate; computer calculations are spot-checked to verify program validity; data reported are compliant with method- and project- specific QC requirements; raw data and supporting materials are complete; spectral assignments are confirmed; descriptions of deviations from method or project requirements are documented; significant figures and rounding have been appropriately used; reported values include dilution factors; and results are reasonable.	Laboratory Project Manager or designee

Table 35-1 Validation (Step IIa and IIb) Process (Continued)

Step IIa/ IIb[1]	Validation Input	Description	Responsible for Validation
IIb	Data validation reports	All data packages will consist of sample results and summary forms for all QC samples. At least 10 percent of the data packages submitted for definitive data will be USEPA Level IV (includes raw data). For definitive data results, data packages will be evaluated by undergoing data validation in accordance with USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Reviews and in accordance with the DoD QSM v5.0 or current version. Data validation reports will also be reviewed in conjunction with the project DQOs and data quality indicators. Data validation reports will include validation of holding time, sample handling, analytes, analytical methods, and laboratory performance criteria. Field duplicate and field blanks results will be identified and any outlier will be discussed.	Data Validator
		100 percent of the definitive data will undergo a Stage 2B data validation in accordance with the most current version of the USEPA National Functional Guidelines. This includes a verification and validation based on completeness and compliance checks, including sample receipt conditions, and review of both sample-related and instrument-related results. At least 10 percent of the instrument calibration results will be reverified in accordance with Stage 3 verification and validation checks. If anomalies, outliers, or other potential problems are identified during Stage 3 data validation, the data will undergo Stage 4 data validation which includes recalculation of sample and QC results, review of chromatograms, discussions with the analytical laboratory personnel, etc. as warranted.	Data Validator
		The following data qualifiers will be used for all validation: J – Result is estimated U – Analyte is not detected at or above the stated LOD R – Result is rejected and the data are unusable UJ – Analyte is not detected, but there is an uncertainty concerning the reported value	Data Validator

Notes:

Project personnel are identified in Worksheet #7.

[1] IIa=compliance with methods, procedures, and contracts; IIb=comparison with measurement performance criteria in this UFP-QAPP

[2] Stages of data validation are defined in Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (USEPA, 2009)

ANG – Air National Guard
COC – Chain of Custody
DoD QSM v5.0 – Department of Defense Quality Systems Manual, Version 5.0 (DoD, 2013)
DQO – Data Quality Objectives
LOD – Limit of Detection
QC – Quality Control
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan
USEPA – United States Environmental Protection Agency

WORKSHEET #36 DATA VALIDATION PROCEDURES

This worksheet identifies the criteria that will be used to validate data under Steps IIa and IIb.

Table 36-1 Analytical Data Validation (Steps IIa and IIb) Summary

Step IIa/ IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Soil	VOCs	Method SW-846 8260C, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	Data Validator
IIa	Soil	SVOCs	Method SW-846 8270D, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	Data Validator
IIa	Soil	Metals	Method SW-846 6010C, DoD QSM v5.0 (Table B-8), and USEPA CLP guidelines	Data Validator
IIa	Soil	Mercury	Method SW-846 7470A, DoD QSM v5.0 (Table B-8), and USEPA CLP guidelines	Data Validator
IIa	Water	VOCs	Method SW-846 8260C, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	Data Validator
IIa	Water	SVOCs	Method SW-846 8270D, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	Data Validator
IIa	Water	Metals	Method SW-846 6010C, DoD QSM v5.0 (Table B-8), and USEPA CLP guidelines	Data Validator
IIa	Water	Mercury	Method SW-846 7471A, DoD QSM v5.0 (Table B-8), and USEPA CLP guidelines	Data Validator
IIb	Soil	VOCs	Tables 12-1, 15-2, and 28-1 of this UFP-QAPP	Data Validator
IIb	Soil	SVOCs	Tables 12-2, 15-4, and 28-2 of this UFP-QAPP	Data Validator
IIb	Soil	Metals	Tables 12-3, 15-6, and 28-3 of this UFP-QAPP	Data Validator
IIb	Soil	Mercury	Tables 12-4, 15-8, and 28-4 of this UFP-QAPP	Data Validator
IIb	Water	VOCs	Tables 12-1, 15-1, and 28-1 of this UFP-QAPP	Data Validator
IIb	Water	SVOCs	Tables 12-2, 15-3, and 28-2 of this UFP-QAPP	Data Validator
IIb	Water	Metals	Tables 12-3, 15-5, and 28-3 of this UFP-QAPP	Data Validator
IIb	Water	Mercury	Tables 12-4, 15-7, and 28-4 of this UFP-QAPP	Data Validator

Notes:

CLP – Contract Laboratory Program; refers to the National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2014a) or National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2014b)
DoD QSM v5.0 – Department of Defense Quality Systems Manual, Version 5.0
SVOC – Semivolatile Organic Compound
VOC – Volatile Organic Compound
UFP-QAPP – Uniform Federal Policy-Quality Assurance Project Plan
USEPA – Environmental Protection Agency

WORKSHEET #37 DATA USABILITY ASSESSMENT

The usability assessment is an evaluation of data based upon the results of data validation and verification for the decisions being made. In the usability step, reviewers will assess whether the process execution and resulting data meet quality objectives based on criteria established in this UFP-QAPP. The usability assessment will consider data from sampling activity, on-site analytical, off-site laboratory, and validation reports. The usability assessment will be performed by the data assessment team and documented in the RI Report by the Project Chemist. The data assessment team will consist of the Project Manager, Quality Manager, Project Chemist, and ERPIMS Database Manager. In addition, other project personnel (e.g., Installation Points of Contact or their representative, state regulator, Installation Lead) may be involved with the determination of whether data meet project quality objectives.

The data assessment team will:

- Identify project requirements and verify field activities were performed in accordance to the SOPs (**Appendix E**) detailed in Worksheets #14 and #21;
- Review the project DQOs and data validation process detailed in Worksheets #34, #35, and #36;
- Verify that all samples and analytical data collected meet the PQOs;
- Evaluate validated data to assess if they satisfy PQOs (e.g., tolerable limits on decision errors) and are adequate to make the decision regarding additional investigation for the site; and
- Provide input on the suitability of the results for the purposes intended.

In the Usability Assessment, the team will determine the impacts of any deviations from the planned procedures documented in this UFP-QAPP, guidance documents, or SOPs, for the following items:

Sampling Locations
COCs
Holding Times
Damaged Samples
SOPs and Methods

In addition, the team will evaluate the possible effects of outliers or anomalous data from the following:

QC Samples
Matrix
Meteorological Data and Site Conditions
Comparability
Completeness
Background
Critical Samples

These considerations for the Usability Assessment are discussed in detail in Section 5.2.3.2 of the UFP-QAPP Manual (USEPA, 2005a). The Data Usability Assessment will also be prepared in accordance with Data Usability Summary Report requirements indicated in NYSDEC DER-10. The usability assessment will include an evaluation of the data quality indicators (precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity). The impact of any data gaps or deviations from planned procedures will be evaluated. This includes rejected data based on the results of the data validation process. The usability assessment will evaluate the overall dataset for the entire site, and any trends, relationships, or correlations will be described.

After the data usability assessment has been performed, data deemed appropriate for use will be presented in the RI Report. The RI Report will include conclusions and optimization recommendations, as applicable.

REFERENCES

AECOM. 2014. *Final Work Plan for the Regional Compliance Restoration Program Preliminary Assessment/Site Inspection, Schenectady Air National Guard Base, Scotia, New York*. June 2014.

AECOM. 2015. *Final Regional Compliance Restoration Program Preliminary Assessment/Site Inspection, Schenectady Air National Guard Base, Scotia, New York.* August 2015.

ANG (Air National Guard). 2005. CEV 05-1 Policy on Air National Guard Investigation or Remediation Derived Waste Management. March 2005.

Air National Guard, 2006. *Phase 1 Environmental Baseline Survey at the 109th Airlift Wing, New York Air National Guard, Stratton Air National Guard Base, Schenectady County, Scotia, New York*. October 2006.

ANG. 2009. *Environmental Restoration Program Air National Guard Investigation Guidance*. September 2009.

ANG. 2014. About the 109th Airlift Wing fact sheet 1/7/2014 http://www.109aw.ang.af.mil/resources/factsheets/factsheet.asp?id=12587 Accessed December 2015

Balanced Environmental Management Systems (BEM Systems). 2013*. Final Remedial Action Work Plan, Sites 3 and 6, 109th Airlift Wing, Schenectady Air National Guard Base, Scotia, NY*, Site No. 447022. April 2013.

BEM Systems. 2014. *Second Injection Plan Final Remedial Action Work Plan, Sites 3 and 6, 109th Airlift Wing, Schenectady Air National Guard Base, Scotia, NY*, Site No. 447022. April 2014.

BEM Systems. 2016. *Final Remedial Action Completion/Final Engineering Report for Groundwater at Site 6, Schenectady Air National Guard Base.* February 2016.

DoD (Department of Defense). 2013. *DoD Quality Systems Manual for Environmental Laboratories, Version 5.0*. July 2013.

New York State Department of Environmental Conservation (NYSDEC). 1994 & 2000. *Technical and Administrative Guidance Memorandum (TAGM) 4046: Determination of Soil Cleanup Objectives and Cleanup Levels and Addendum*. January 24, 1994 and December 20, 2000.

U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), 2015. Web Soil Service. http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed December 2015

USEPA (United States Environmental Protection Agency). 1989. *USEPA Risk Assessment Guidance for Superfund (RAGS): Vol. 1, Human Health Evaluation Manual, Part A*. Office of Emergency and Remedial Response, Washington, DC. EPA/5401-89/002. December 1989.

USEPA. 2002. Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS. December 2002.

USEPA. 2005a. *Uniform Federal Policy for Quality Assurance Project Plans Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual.* EPA-505-B-04-900A. March 2005.

USEPA. 2005b. *Workbook for Uniform Federal Policy for Quality Assurance Project Plans Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 2A: UFP-QAPP Workbook.* EPA-505-B-04-900C. March 2005.

USEPA. 2005c. *Uniform Federal Policy for Quality Assurance Project Plans. Part 2B: Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities.* EPA-505-B-04-900B. March 2005.

USEPA. 2009. Guidance for Labelling Externally Validated Laboratory Analytical Data for Superfund Use. EPA 540-R-08-005, January 2009.

USEPA. 2012. *Uniform Federal Policy for Quality Assurance Project Plans Optimized UFP-QAPP Worksheets.* March 2012.

USEPA. 2014a. *National Functional Guidelines for Superfund Organic Methods Data Review*. EPA 540-R-014-002. August 2014.

USEPA. 2014b. *National Functional Guidelines for Inorganic Superfund Data Review*. EPA 540-R-013-001. August 2014.

Weston 2015. *Site Investigation Field Notes Schenectady Air National Guard Base, Scotia NY 12302. Former Building 13 Maintenance Area (ZZ007), Former Bldg. 4 Former 6,000 gal UST (TU008), WWTP Bypass UST Near IRP Site 6 (TU 009).* November 2015

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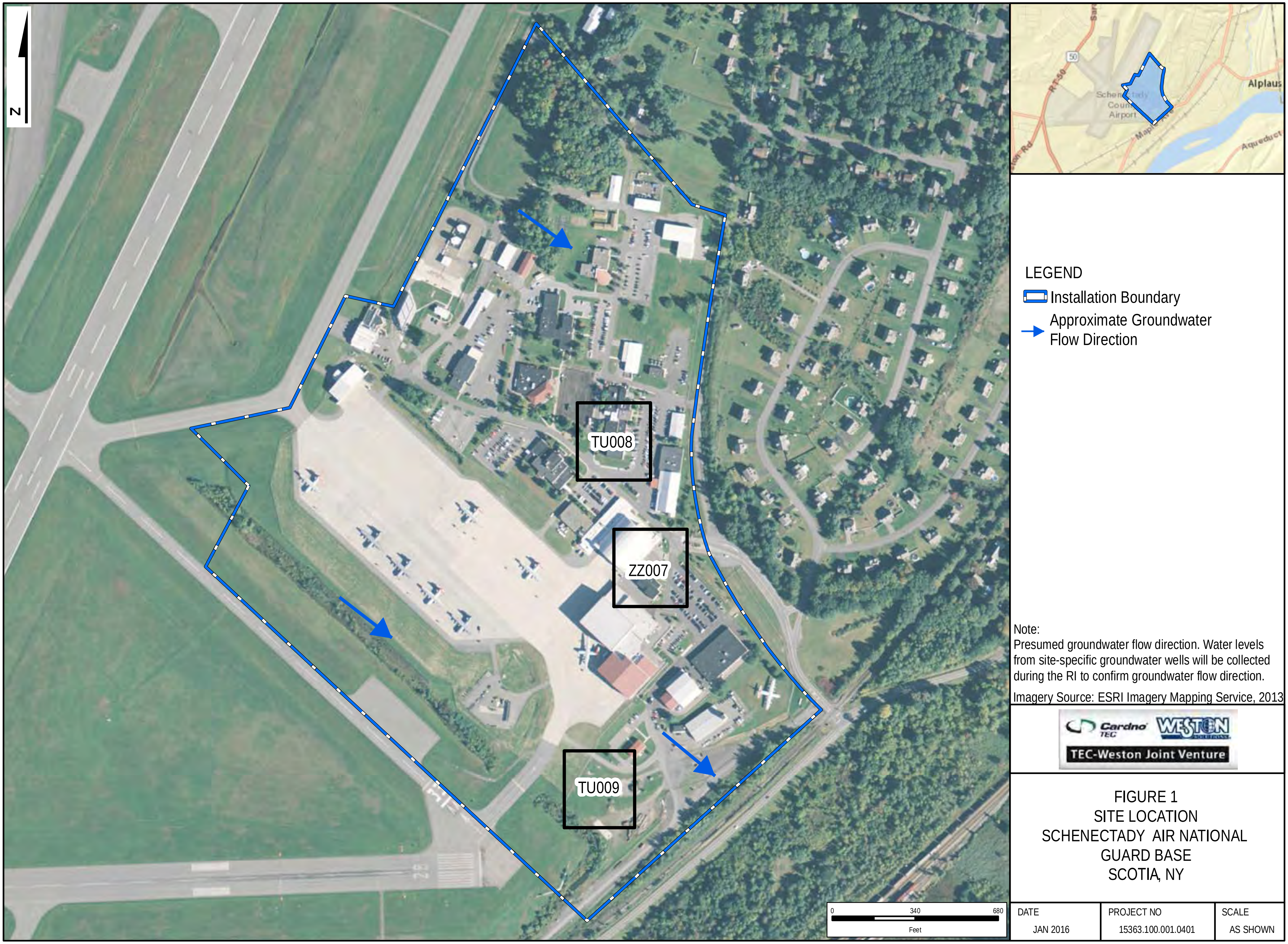
FIGURES



LEGEND

▭ Installation Boundary

→ Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

TEC-Weston Joint Venture

FIGURE 1
SITE LOCATION
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
JAN 2016	15363.100.001.0401	AS SHOWN

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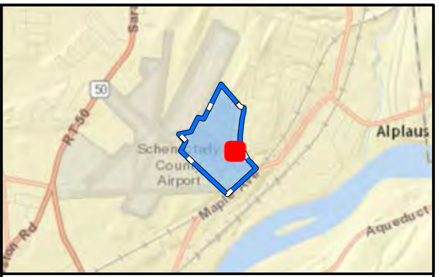

LEGEND

- ⊗ PA/SI Sampling Locations
- ◐ Existing Monitoring Well
- ⬚ Demolished Building
- ▭ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE 2
SITE LAYOUT MAP
SITE ZZ007
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.001.0401	AS SHOWN

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LEGEND

- ⊗ PA/SI Sampling Locations
- ▨ Former Heating Oil UST #41 Area
- ☐ Demolished Building
- ☐ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE 3
SITE LAYOUT MAP
SITE TU008
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.001.0401	AS SHOWN

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LEGEND

- ⊗ PA/SI Sampling Locations
- ● Site 6 Monitoring Wells
- ▨ WWTP Bypass UST Area
- ▭ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE 4
SITE LAYOUT MAP
SITE TU009
SCHENECTADY AIR NATIONAL GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.001.0401	AS SHOWN

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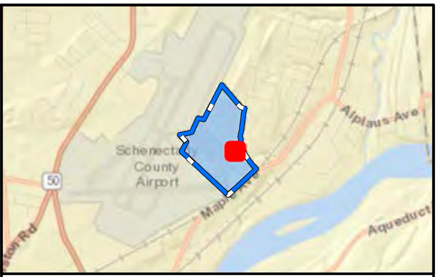

LEGEND

- ⊗ PA/SI Sampling Locations
- ◐ Existing Monitoring Well
- ◐ Proposed Soil Boring and Permanent Monitoring Well Locations
- ▨ Demolished Building
- ▭ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE 5
PROPOSED SAMPLE LOCATION MAP
SITE ZZ007
SCHENECTADY AIR NATIONAL GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
MAY 2016	15363.100.001.0401	AS SHOWN

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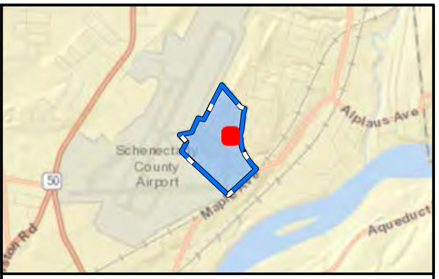

LEGEND

- ⊗ PA/SI Sampling Locations
- ◐ Proposed Soil Boring and Permanent Monitoring Well Locations
- ▨ Former Heating Oil UST #41 Area
- ⬚ Demolished Building
- ▭ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON

TEC-Weston Joint Venture

FIGURE 6
PROPOSED SAMPLE LOCATION MAP
SITE TU008
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
MAY 2016	15363.100.001.0401	AS SHOWN

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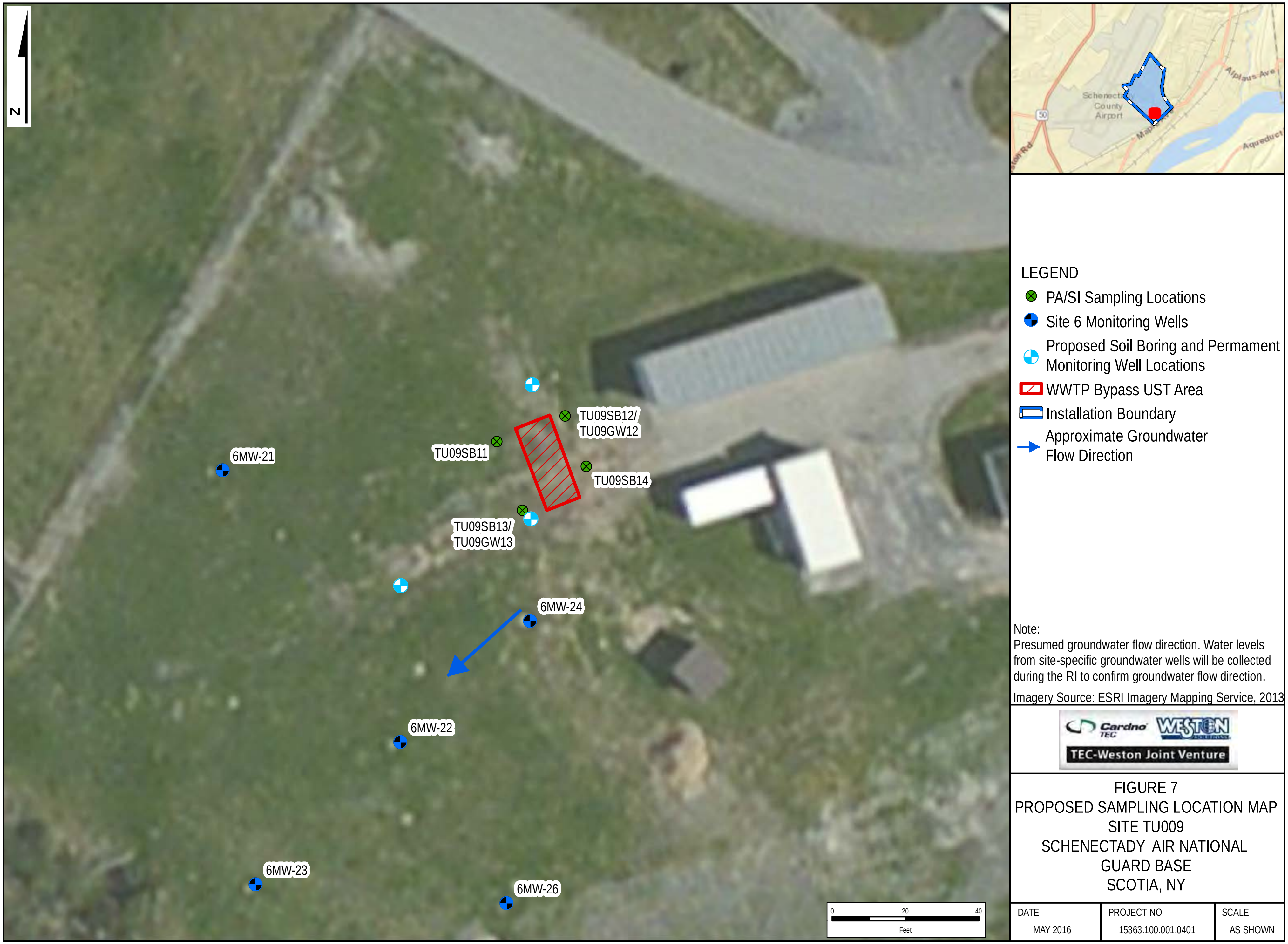

LEGEND

- ⊗ PA/SI Sampling Locations
- ● Site 6 Monitoring Wells
- ○ Proposed Soil Boring and Permament Monitoring Well Locations
- ▨ WWTP Bypass UST Area
- ▭ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE 7
PROPOSED SAMPLING LOCATION MAP
SITE TU009
SCHENECTADY AIR NATIONAL GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
MAY 2016	15363.100.001.0401	AS SHOWN

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APPENDIX A
KICKOFF MEETING MINUTES

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11/05/2015 Kickoff Meeting Minutes
NY Installations – Gabreski, Hancock, Schenectady, Stewart
Newly Eligible Restoration Sites – RI/FS at Multiple ANG Installations – New England Region FY15

Start Time:	**0900-hrs**
Subject:	**Contract No. W9133L-14-D-0008; Delivery Order No. 0005**

Introductions and Contract/Project Information:

- Discussed the attendee/contact list and key stakeholders.
- Add Stanley Moore, ANG COR, and John Swartwout, NYSDEC Section Chief, to attendee/contact list.
- Discussed contract details, project roles/responsibilities and schedule, as shown in the attached Meeting Agenda below.

Installation Summaries:

- The state asked whether Proposed Plans and Decision Documents are included in this Contract. Jody Murata, ANG's Program Manager for the New York (NY) Installations, indicated that these documents will be completed as part of a separate task order. Krista R. clarified that for sites being recommended for No Further Action (NFA) following the RI, Weston will prepare the No Further Remedial Action Planned Decision Document (NFRAP DD) (through final approval) as part of this Contract.
- Hancock Underground Storage Tank (UST) #11 – This is on Class 2 site on State Registry due to the high VC content. This is the highest priority site and of most concern to New York State Department of Environmental Conservation (NYSDEC). Follow DER-10 technical guidance, particularly when comparing groundwater and soil standards.
- John S. indicated that the state requires comparison to their Part 375 SCOs (State Cleanup Objectives) and NYSDEC Technical and Operational Guidance (TOG) water quality standards. He indicated that for the non-Class 2 sites, we can use industrial or commercial criteria as appropriate. Jody M. mentioned that Air National Guard (ANG) prefers unrestricted or residential criteria so that there are not land use controls (LUCs) associated with properties for closure.
- Weston indicated we will compare to unrestricted use criteria for all sites and may include industrial/commercial criteria as additional line of evidence, where appropriate.
- Weston asked if BB&E would be doing field oversight on all projects. BB&E indicated they would be available for oversight, as requested by ANG, and will coordinate priority sites with ANG. Weston to keep them in the loop regarding schedule so that they can prepare. BB&E requested at least 2-3 weeks advance notice to coordinate fieldwork.
- John S. mentioned that under the state's Superfund program, risk assessments are basic compared to what United States Environmental Protection Agency (USEPA) requires. The state requires comparison against state groundwater/soil cleanup standards; using risk-based analysis to determine cleanup standards. Krista R. said that Weston typically uses the lowest of state/federal cleanup standards when determining risk.
- Discussed DIGSAFE and ANG's internal dig permit process requirements. Dig permits must be initiated at least one week in advance.
- Hancock will require flight line coordination and escort, along with some training to be completed same day as mobilization.

- For Gabreski USTs, NYSDEC normally does not coordinate with Suffolk County even though they control all County tank registrations. Capt. Denton will contact the County to confirm involvement in this project.
- Access badges required for all personnel. They are typically provided for 30-day durations, but may be adjusted depending on required duration. May require a new badge for each mobilization, but will coordinate needs with ANG Environmental Managers.
- Lt. Col. Randall will email Schenectady badge information to Joe G. He recommended Schenectady and Hancock site visits to occur before winter weather sets in.
- The state asked about direct push technology (DPT) well installation procedures. They prefer surge/pumping in lieu of just pumping when developing the wells. Krista R. ensured that Weston will discuss with field geologists and Work Plans will detail proper installation procedures for all temporary/permanent wells. NYSDEC agreed with an approximate 24-hour waiting period between well installation, well development and well sampling.
- The state asked about well abandonment procedures. Jody M. indicated that well abandonment will be completed as part of a separate task order. The state indicated they have well abandonment guidance. Subsequent to the meeting, it was determined that well abandonment for sites reaching NFA status will be conducted by Weston as part of this Contract.
- Weston asked if the state accepted at least eight samples for evaluating background. They indicated that is sufficient.
- All meeting attendees agreed with electronic deliverables for draft and draft final versions; and hard copies will be distributed for final versions. BB&E does not require hard copies for any version.
- Weston indicated that Stanley Moore, during the NGB Program Kickoff Meeting, agreed to use the most current (Uniform Federal Policy for Quality Assurance Project Plan) UFP-QAPP document guidance (e.g., the work plan is integrated into the UFP-QAPP). All meeting attendees agreed as long as the required information is present.

Meeting Adjourned: 1015-hrs.

Attachments to the Meeting Minutes:

- Attachment 1 – 11/05/2015 Kickoff Meeting Agenda (with revised Attendee/Contact List)

Attendee/Contact List

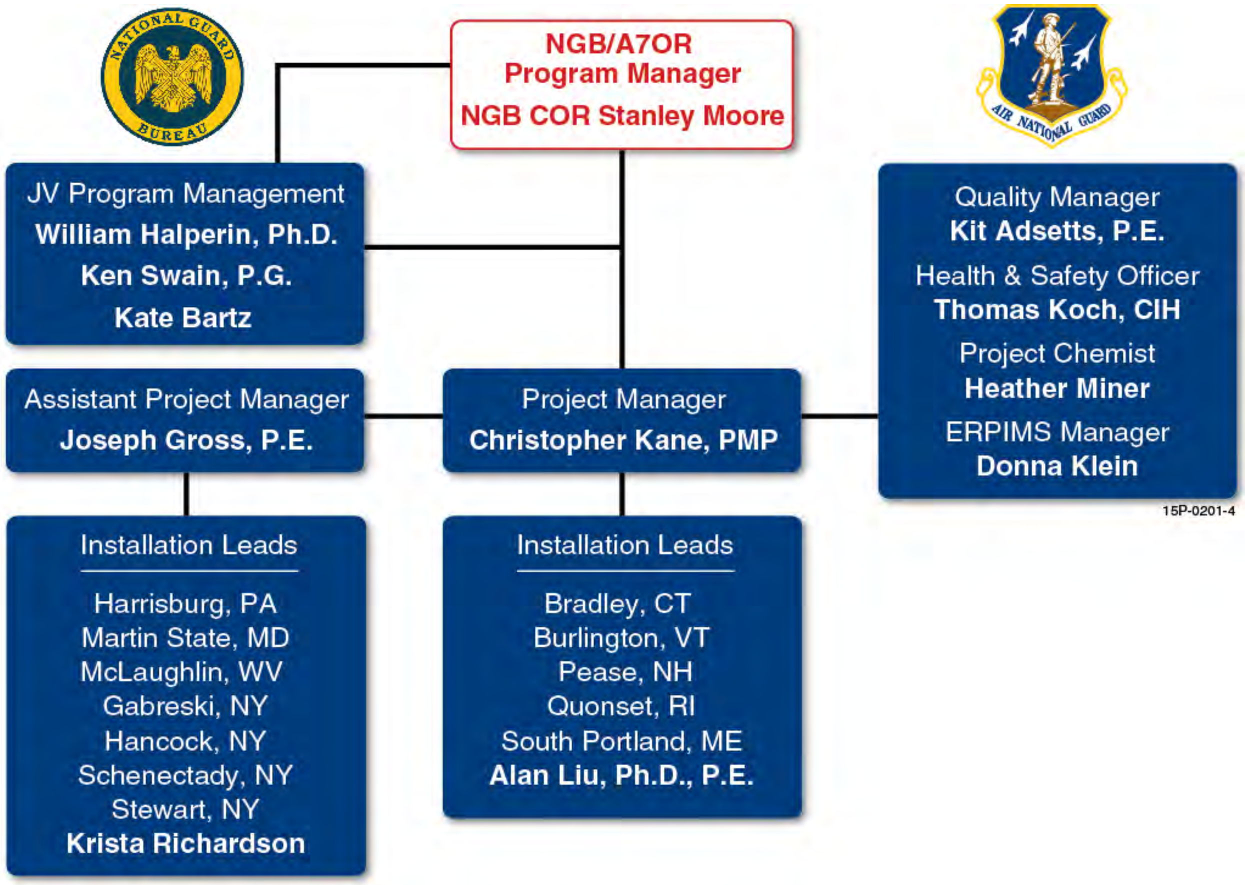
Name	Title/ Role	Installation	Organization	Phone	E-Mail
Key Points of Contact for the NGB and ANG					
Stanley Moore	Contracting Officer's Representative	JB Andrews, MD	NGB/A7OR	240-612-8504	stanley.j.moore6.civ@mail.mil
*Jody Murata	Program Manager	Gabreski, NY Hancock, NY Schenectady, NY Stewart, NY	NGB/A7OR	240-612-8120	jody.a.murata.civ@mail.mil
*Veronica Allen	ANG Consultant	Gabreski, NY Hancock, NY Schenectady, NY Stewart, NY	BB&E, Inc.	248-489-9636 (x304)	vallen@bbande.com
*Capt. Shaun Denton	Environmental Manager	Gabreski, NY	106th LRS/EM, Gabreski ANG Installation	631-723-7349	shaun.f.denton.mil@mail.mil
*Capt. Brent Lynch	Environmental Manager	Hancock, NY	174th CE/EMO, Hancock ANG Installation	315-233-2111	brent.r.lynch.mil@mail.mil
*Lt Col Ty Randall	Environmental Manager	Schnectady, NY	109th CES/CES, Schenectady ANG Installation	518-344-2505	ty.a.randall.mil@mail.mil
*Maj. Nicolas Caputo	Environmental Manager	Stewart, NY	105th LRS/EMO, Stewart ANG Installation	845-563-2366	nicolas.caputo.mil@mail.mil
Key Points of Contact for the NY State DEC					
*John Swartwout	Section Chief	Gabreski, NY Hancock, NY Schenectady, NY Stewart, NY	625 Broadway Albany, NY 12233	518-402-9620	john.swartwout@dec.ny.gov
*Heather Bishop	State Regulator	Gabreski, NY Stewart, NY	625 Broadway Albany, NY 12233	518-402-9692	heather.bishop@dec.ny.gov
*Robert Corcoran	State Regulator	Hancock, NY	625 Broadway Albany, NY 12233	518-402-9658	bob.corcoran@dec.ny.gov
*Brian Jankauskas	State Regulator	Schnectady, NY	625 Broadway Albany, NY 12233	518-402-9626	brian.jankauskas@dec.ny.gov
Key Points of Contact for the TEC-Weston JV Team					
*Joseph Gross	Project Manager	Gabreski, NY Hancock, NY Schenectady, NY Stewart, NY	TEC-Weston JV	410-612-5910	joseph.gross@westonsolutions.com
*Krista Richardson	Installation Lead	Gabreski, NY Hancock, NY Schenectady, NY Stewart, NY	TEC-Weston JV	417-719-4834	krista.richardson@westonsolutions.com

***Meeting Attendees**

Contract Award Details

Notice to Proceed:	24 September2015
Period of Performance:	4 Years (9/24/15 – 9/24/19)

Project Roles and Responsibilities



NGB/A7OR
Program Manager
NGB COR Stanley Moore

JV Program Management
William Halperin, Ph.D.
Ken Swain, P.G.
Kate Bartz

Quality Manager
Kit Adsetts, P.E.
Health & Safety Officer
Thomas Koch, CIH
Project Chemist
Heather Miner
ERPIMS Manager
Donna Klein

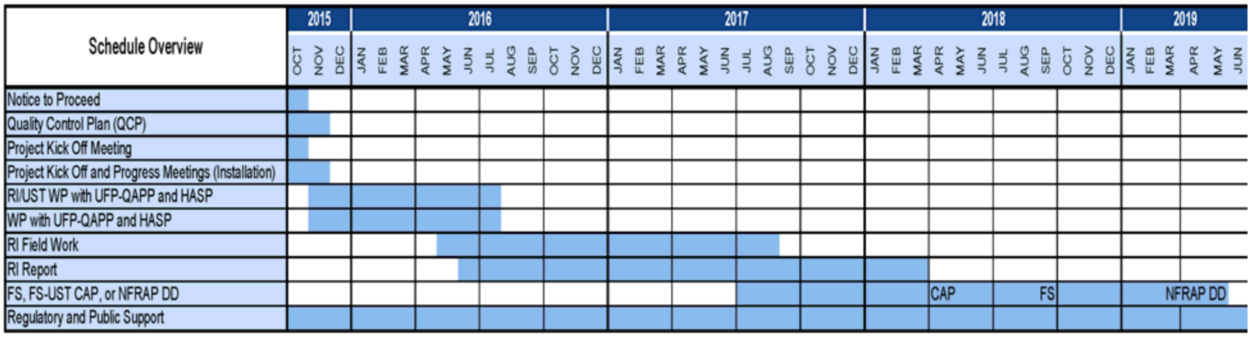
Assistant Project Manager
Joseph Gross, P.E.

Project Manager
Christopher Kane, PMP

Installation Leads
Harrisburg, PA
Martin State, MD
McLaughlin, WV
Gabreski, NY
Hancock, NY
Schenectady, NY
Stewart, NY
Krista Richardson

Installation Leads
Bradley, CT
Burlington, VT
Pease, NH
Quonset, RI
South Portland, ME
Alan Liu, Ph.D., P.E.

Project Schedule



Schedule Overview	2015			2016												2017												2018												2019					
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Notice to Proceed	▨																																												
Quality Control Plan (QCP)	▨	▨																																											
Project Kick Off Meeting	▨																																												
Project Kick Off and Progress Meetings (Installation)	▨	▨																																											
RI/UST WP with UFP-QAPP and HASP		▨	▨	▨	▨	▨	▨	▨	▨	▨																																			
WP with UFP-QAPP and HASP		▨	▨	▨	▨	▨	▨	▨	▨	▨																																			
RI Field Work								▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨																						
RI Report									▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨															
FS, FS-UST CAP, or NFRAP DD																						▨	▨	▨	▨	▨	▨	▨	▨	▨	CAP	▨	▨	▨	▨	FS	▨	▨	▨	▨	▨	▨	▨	NFRAP DD	
Regulatory and Public Support	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

General Logistics

- Installation-specific requirements (access, coordination procedures, badging)
- State requirements for well installations/development and abandonment
- State requirements on field SOPs
- Additional State requirements for UST sites

INSTALLATION SUMMARIES

HANCOCK, NY-HAAW20159200

<u>Former UST in Former Building 1600 (TU019)</u>

- End State: Feasibility Study
- Site History:
  - Former Building 1600, which is now Building 646, was used for corrosion control and aircraft painting.
  - UST #011, an 8,000-gallon fuel oil tank, was reported to have been removed in the 1990s but based on information obtained during the PA, closure documents do not appear to be available.
  - Its approximate location adjacent to the east side of Building 646 was determined based on historical drawings.
- Previous Investigation (PA/SI in 2014)
  - Soil
    - Four borings were advanced to 15 ft bgs on each side of the former UST area; one sample collected from vadose zone at each boring and analyzed for VOCs & SVOCs. Sample intervals ranged from 1 to 6 ft bgs.
    - 17 VOCs and 11 SVOCs detected in soil; no concentrations above PALs (EPA Residential RSLs & NYSDEC Part 375 Unrestricted Use SCOs)
  - Groundwater
    - Groundwater collected from temporary wells installed at each boring location from 11 to 15 ft bgs.
    - Contamination was detected above PALs (EPA RSLs, MCLs, or NYSDEC TOGS Ambient Water Quality Standards) at all four wells: 1,2-dichloroethane, benzene, cis-1,2-dichloroethene, dichlorodifluoromethane, trans-DCE, TCE, VC, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene.
  - Conclusions/Recommendations:
    - The HRS groundwater migration pathway score was 19.20 and the overall site score was 9.60. The most toxic contaminant present is VC.
    - Further investigation is recommended for TU019; TCE and its daughter products, DCE and VC were detected at concentrations exceeding their PALs. The estimated (i.e., reported below their LODs) of several SVOCs also exceed their PALs.

- Proposed RI Investigation:
    - The presence of dissolved-phase chlorinated solvents in groundwater will require a review of historical site uses and building features potentially serving as a source of non-petroleum hydrocarbon contaminants as well as vertical profiling of groundwater contaminants to determine contaminant conditions at lower depths within the water table aquifer.
    - Soil: Native soil underlying the former UST was not sampled during the SI. Incomplete lateral & vertical delineation of VOCs and SVOCs.
    - GW: Incomplete lateral & vertical delineation of VOCs and SVOCs.
- Proposed Field Work (Planned June-November 2016)
    - 1st Mobilization
        - Advance 4 borings and collect 8 soil samples (2 per boring).
        - Install 1 permanent GW MW via HSA technology at the former UST location.
        - Install 2 temporary GW MWs to characterize shallow groundwater conditions at suspected chlorinated solvent source areas within Former Building 1600 and confirm groundwater flow direction.
        - Analyze all 8 soil and 3 GW samples for VOCs and SVOCs.
    - 2nd Mobilization
        - Based on lab results, well gauging, and flow direction calculations, install 3 additional permanent GW MWs via HSA technology in the “upper” and “deep” zones of the water table aquifer and at the downgradient edge of the plume.
        - Analyze 3 GW samples for VOCs and SVOCs.
        - Slug test all permanent MWs.
    - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
    - Draft Work Plan/QAPP – December 2015
    - RI – Final – July 2017
    - FS – Final – February 2018

GABRESKI, NY-WKVB20159200

Former USTs in Former Building 218 (TU014)

- End State: NFRAP DD
- Site History:
  - Two USTs were reported to have been removed from Building 218 in 1996, including UST #2: 550-gallon No. 2 fuel oil and UST #DE2: 275-gallon diesel. USTs are approximately 40-ft apart.
  - Closure documents for these tanks are not available.
  - The approximate locations of the former USTs were determined based on historical drawings and reference to existing structures.
- Previous Investigation (PA/SI in 2014)
  - Soil
    - Ten borings were advanced; one on each side of each former UST area and one in the center. Twenty soil samples (two per boring) were collected and analyzed for VOCs and SVOCs.
    - Only acetone exceeded the PALs (EPA residential RSLs, NYSDEC Part 375 Unrestricted Use SCOs) in two of the samples near UST #DE2.
  - Groundwater
    - Groundwater at 35 ft bgs.
    - Two groundwater samples were collected from center borings and analyzed for VOCs and SVOCs.
    - Concentrations of 1,2,4-Trimethylbenzene, 1,3,5-trimethylbeznene, 4-isopropyltoluene, ethylbenzene, isopropylbenzene, naphthalene, n-propylbenzene, and sec-butylbenzene exceeded their respective PALs (EPA RSLs, MCLs, or NYSDEC TOGS Drinking Water Standards) in groundwater at UST #2.
  - Conclusions/Recommendations:
    - The HRS groundwater migration pathway score was 2.67 and the overall site score was 1.34.
    - Further investigation is recommended for acetone in soil and VOCs in groundwater.
- Proposed RI Investigation:
  - Soil, UST#2: No soil exceedances reported in the soil samples. Lithology indicates highly permeable soils; therefore, samples will be collected to determine soil contamination closer to possible former UST piping locations and at bottom of former UST#2.
  - Soil, UST#DE2: Incomplete lateral and vertical delineation of acetone.
  - GW: Incomplete delineation of VOCs and SVOCs.

- Proposed Field Work (Planned May 2016-January 2017)
  - 1st Mobilization – UST#2
    - Advance 2 borings via DPT to 10 ft and collect 4 soil samples (2 per boring); analyze soil samples for VOCs and SVOCs.
    - Install 1 permanent GW well at former location with elevated VOCs and 1 temporary well/piezometer in presumed upgradient position near UST#DE2 to confirm the SI results, GW flow direction, and potential upgradient source.
    - Collect and analyze GW samples for VOCs and SVOCs.
  - 1st Mobilization – UST#DE2
    - To delineate the acetone, collect2 soil samples at the newly installed temp well/piezometer at UST#2 as a step-out boring from the northern boring where acetone was detected. Install a 2nd boring by stepping out to the west from the other boring with acetone detection and collect 2 soil samples.
  - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
  - Draft Work Plan/QAPP – November 2015
  - RI – Final –August 2017
  - NFRAP DD – Final – October 2018

Former UST in Former Building 374 (TU017)

- End State: Feasibility Study
- Site History:
  - One 2,500-gallon diesel UST (UST #68) was reportedly removed from Building 374 in 1996. Closure documents for this tank are not available.
  - Building 374 was demolished and a new Building 324 and a transformer pad have been constructed in the area.
  - The approximate location of the former UST was determined based on historical drawings and reference to existing structures.
- Previous Investigation (PA/SI in 2014)
  - Soil
    - Four borings were advanced; five soil samples were collected and analyzed for VOCs and SVOCs.
    - Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3- cd)pyrene exceeded their respective PALs (EPA residential RSLs, NYSDEC Part 375 Unrestricted Use SCOs) in one sample. Concentrations did not exceed in deeper sample collected at the boring location.

  - Groundwater
    - One groundwater sample was collected and analyzed for VOCs and SVOCs.
    - Bis(2-ethylhexyl)phthalate exceeded the PAL (EPA RSLs, MCLs, or NYSDEC TOGS Drinking Water Standards).
  - Conclusions/Recommendations:
    - The groundwater migration pathway received an HRS score of 1.61, the soil exposure pathway received a score of 1.20, and the overall site score was 1.00.
    - Further investigation is recommended for SVOCs in soil and bis(2-ethylhexyl)phthalate in groundwater.
- Proposed RI Investigation:
  - Soil: Incomplete lateral & vertical delineation of SVOCs.
  - GW: Incomplete lateral & vertical delineation of SVOCs.
- Proposed Field Work (Planned May 2016-January 2017)
  - 1st Mobilization
    - Advance 2 borings via HSA technology and collect 4 soil samples (2 per boring).
    - Install 1 permanent GW well via HSA technology at former TU14SB34 boring and 1 temporary well/piezometer to the southeast; collect GW from both wells; confirm GW flow direction.
    - Collect 2 soil samples from each well during installation
    - Analyze all 8 soil and 2 GW samples for VOCs and SVOCs.
  - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
  - Draft Work Plan/QAPP – November 2015
  - RI – Final – August 2017
  - FS – Final – April 2018

STEWART, NY-WHAY20159200

Pesticides in Monitoring Well-1 (SS005)

- End State: Feasibility Study
- Site History:
  - Elevated concentrations of chlorinated pesticides (i.e., 4,4'-DDD) have been detected in monitoring well MW-1, located hydraulically up gradient of Installation Restoration Program (IRP) Site 2, which was a former pesticide disposal burial pit that has been remediated.
  - Well MW-1 is not considered to have been impacted from IRP Site 2 activities. The source of pesticide concentrations in MW-1 is unknown.
  - Obvious source areas were not identified during the November 2013 site visit.
- Previous Investigation (PA/SI in 2014)
  - Soil
    - Three borings were conducted to install three monitoring wells surrounding existing monitoring well MW-1.
    - Two soil samples were collected at each boring location, one from 0 to 4 ft bgs and one from the depth interval immediately above the soil/groundwater interface from 30 to 31 ft bgs. Soil samples were analyzed for pesticides.
    - Pesticides note detected exceeding their respective PALs (EPA residential RSLs, NYSDEC Part 375 Unrestricted Use SCOs).
  - Groundwater
    - Groundwater at 33 ft bgs
    - Groundwater samples were collected from each of 4 wells and analyzed for pesticides.
    - Three pesticides (4,4'-DDD, 4,4'-DDE, and 4,4'-DDT) exceeded PALs (EPA RSLs, MCLs, or NYSDEC TOGS Drinking Water Standards) in one sample from the original monitoring well, MW-1.
    - The SI installed 3 MWs within 35 ft downgradient and crossgradient of the well that contains concentrations of pesticides, and the results were non-detect.
  - Conclusions/Recommendations:
    - The HRS groundwater migration pathway score was 2.67 and the overall site score was 1.34.
    - Further investigation is recommended for pesticides detected in groundwater at MW-1. The results are not sufficient to identify a source area for the pesticides detected at MW-1. Although the results for pesticides in soil do not exceed PALs, further soil sampling is recommended at proposed groundwater sample locations to provide additional horizontal and vertical characterization of the

soils and define any potential relationship with pesticides detected in the recommended groundwater samples.

- Proposed RI Investigation:
    - Investigate unknown source of pesticides
- Proposed Field Work (Planned August 2016-April 2017)
    - 1st Mobilization
        - Install 3 permanent MW upgradient of impacted well by air rotary method to evaluate a potential, unknown source area.
        - Collect 6 soil samples, 2 from each well installation boring.
        - Collect 2 rounds of GW samples from all 7 permanent wells (includes previously installed wells).
        - Analyze 6 soil samples and 14 GW samples for pesticides.
    - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
    - Draft Work Plan/QAPP – February 2016
    - RI – Final –November 2017
    - FS – Final – June 2018

SCHENECTADY, NY-VBDZ20159200

Former Building 13 Area (ZZ007)

- End State: Feasibility Study
- Site History:
  - Hazardous materials were used and hazardous waste generated at the former Building 13 area, which was demolished in the mid-1990s.
  - The building was utilized as a maintenance facility at times with drum storage. No sampling or closure information could be located for this area.
  - Former Building 13 was located near the current Building 12.
- Previous Investigation (PA/SI in 2014)
  - Soil
    - Five borings were advanced until refusal was met, which occurred 7.5 to 9 ft bgs. One soil sample was collected from the dry soils above the water table interface in borings where groundwater was encountered. Two soil samples were collected from the remaining three borings; one from the upper portion of the borehole and one from the bottom of each boring.
    - There was no visual, olfactory, or PID evidence of contamination in any of the borings.
    - Samples were analyzed for VOCs, SVOCs, and metals.
    - One metal, iron, exceeded PALs (EPA residential RSLs, NYSDEC Part 375 Unrestricted Use SCOs) in all samples. Iron is likely naturally occurring in the soils and is not considered to be associated with base industrial activities.
  - Groundwater
    - GW at 2 to 3 ft bgs in 2 borings and was not encountered above refusal in other borings.GW at site appears to be perched and intermittent.
    - Seventeen metals in both total and dissolved forms (aluminum, iron, magnesium, sodium, arsenic, barium, beryllium, chromium, cobalt, copper, lead, manganese, nickel, thallium, vanadium, zinc, and mercury), one metal in total form only (cadmium), and one metal in dissolved form only (selenium) exceeded PALs (EPA RSLs, MCLs, or NYSDEC TOGS Drinking Water Standards) in one or more samples.
    - Comparison of total and dissolved concentrations of metals in GW indicates that turbid samples were collected. Samples from developed permanent wells may have lower concentrations of metals.
  - Conclusions/Recommendations:
    - HRS scoring was conducted for the groundwater migration pathway; the resulting score was 4.80 and the overall site score was 2.40.

        - Further investigation is recommended to address metals in soil and groundwater.
- Proposed RI Investigation:
    - Delineate extent of metals
- Proposed Field Work (Planned July 2016-March 2017)
    - 1st Mobilization
        - Advance 4 borings via DPT and collect 8 soil samples for statistical calculation to establish background concentration of iron.
        - Install 3 permanent GW MWs via DPT.
        - Conduct 2 GW sampling events at 4 wells (includes sampling the previously installed well).
        - Analyze 8 soil samples and 8 GW samples for metals.
    - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
    - Draft Work Plan/QAPP – January 2016
    - RI – Final –October 2017
    - FS – Final –May 2018

Former Heating Oil UST #41 at Former Building 4 (TU008)

- End State: NFRAP DD
- Site History:
    - Former Building 4 was utilized as a vehicle maintenance facility before its removal in the early 1995.
    - UST #41 was a 6,000-gallon heating oil tank associated with the building. Records of removal and/or sampling of the tank pit during removal are not available.
- Previous Investigation (PA/SI in 2014)
    - Soil
        - DGM was used to confirm the absence of the former fuel oil UST prior to field sampling.
        - Five borings were advanced until refusal, which occurred between 7 to 9 ft bgs in each boring. One soil sample was collected from each boring in the dry soils above the water table interface.
        - There was no visual, olfactory, or photoionization detector (PID) evidence of contamination in three of the borings. Odors and elevated PID measurements were detected in borings TU08SB08 [peak of 178 parts per million (ppm) at 5 ft bgs] and TU08SB09 (peak of 97.1 ppm at 4 ft bgs); measurements decreased with depth in each boring.

        - Samples were analyzed for VOCs and SVOCs.
        - Detected chemicals did not exceed PALs (EPA residential RSLs, NYSDEC Part 375 Unrestricted Use SCOs).
    - Groundwater
        - The groundwater table was encountered between 5 to 6 ft bgs throughout the area.
        - One groundwater sample was collected from each boring in the 5 to10 ft bgs interval.
        - Samples were analyzed for VOCs and SVOCs with the exception of TU08GW10. SVOCs were not collected at TU08GW10 due to lack of sufficient groundwater volume.
        - Four VOCs (naphthalene, n-butylbenzene, sec-butylbenzene, and tert-butylbenzene) and three SVOCs [2-methylnaphthalene, bis(2-ethylhexyl) phthalate, and naphthalene] exceeded screening criteria in one or more samples.
    - Conclusions/Recommendations:
        - HRS scoring was conducted for the groundwater migration pathway; the resulting score was zero and the overall site score was zero.
        - Further investigation is recommended to address VOCs and SVOCs in groundwater. Although PA/SI soil sample results are below screening criteria, additional soil sampling is recommended at proposed groundwater sampling locations to verify groundwater results at that location are related to TU008 and not influenced by unknown soil impacts beyond the TU008 footprint.
- Proposed RI Investigation:
    - Groundwater - Incomplete delineation of VOCs and SVOCs.
- Proposed Field Work (Planned July 2016-March 2017)
    - 1st Mobilization
        - Install 4 permanent GW MWs via DPT.
        - Collect 8 soil samples during well installation.
        - Conduct 2 GW sampling events at 4 wells.
        - Analyze 8 soil samples and 8 groundwater samples for VOCs and SVOCs.
    - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
    - Draft Work Plan/QAPP – January 2016
    - RI – Final –October 2017
    - NFRAP DD – Final –December 2018

<u>WWTP Bypass UST near IRP Site 6 (TU009)</u>

- End State: Feasibility Study
- Site History:
    - A 7,000-gallon UST was utilized by the WWTP for bypass during 1982 – 1983 when the lagoons were being emptied for cleaning.
    - The tank had one inlet pipe and was pumped out daily. The WWTP was demolished in 2002.
    - According to Schenectady ANG personnel, the UST is still in place and partially filled with sand.
- Previous Investigation (PA/SI in 2014)
    - Soil
        - DGM was used to locate the outline of the WWTP bypass UST at TU009 prior to field sampling.
        - Four borings were advanced until refusal was met, which occurred between 7.5 and 8.5 ft bgs. One soil sample was collected from the dry soils above the water table interface in borings where groundwater was encountered. Two soil samples were collected from the remaining two dry borings; one from the upper portion of the borehole and one from the bottom of each boring.
        - There was no visual, olfactory, or PID evidence of contamination in any of the borings.
        - Samples were analyzed for VOCs, SVOCs, and metals.
        - One metal, iron, exceeded screening criteria in all samples. Iron is likely naturally occurring in the soils and is not considered to be associated with base industrial activities.
    - Groundwater
        - The groundwater table was encountered between 5 to 5.5 ft bgs
        - A groundwater sample was also collected two of the borings.
        - Samples were analyzed for VOCs, SVOCs, and metals.
        - Three SVOCs [benzo(a)anthracene, benzo(b)fluoranthene, and bis(2-ethylhexyl) phthalate], six metals in both total and dissolved forms (iron, magnesium, sodium, cobalt, lead, and manganese), and ten metals in total form only (aluminum, arsenic, barium, beryllium, chromium, copper, nickel, thallium, vanadium, and mercury) exceeded screening criteria in one or more samples.
    - Conclusions/Recommendations:
        - HRS scoring was conducted for the groundwater migration pathway; the resulting score was 4.80 and the overall site score was 2.40.

        - Further investigation is recommended to address SVOCs and metals in soil and groundwater. Although PA/SI soil results indicate only iron exceeds screening criteria, additional soil sampling is recommended at proposed groundwater sampling locations to verify groundwater results at that location are related to TU009 and not influenced by unknown soil impacts beyond the TU009 footprint.

- Proposed RI Investigation:
    - Comparison of total and dissolved concentrations of metals indicates that turbid samples were collected. Samples from permanent wells may have lower concentrations of metals.
- Proposed Field Work (Planned July 2016-March 2017)
    - 1st Mobilization
        - Advance 4 borings via DPT and collect 8 soil samples for statistical calculation to establish background concentration of iron.
        - Install 4 permanent GW wells via DPT.
        - Conduct 2 GW sampling events at 4 wells.
        - Analyze 8 soil samples and 8 GW samples for VOCs, SVOCs and metals.
    - Additional mobilizations as needed to delineate extent of contamination
- Reporting:
    - Draft Work Plan/QAPP – January 2016
    - RI – Final –October 2017
    - FS – Final –May 2018

APPENDIX B
RELEVANT RECORDS FILES

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Table 5-1. Detected Analytes in Soil at ZZ007

Location	**NYSDEC 375-6 Soil Cleanup Objectives (Unrestricted)**	**ZZ007**							
Sample ID		ZZ07SB01	ZZ07SB01	ZZ07SB02	ZZ07SB03	ZZ07SB03	ZZ07SB04	ZZ07SB04	ZZ07SB05
Sample Date		11/13/2014	11/13/2014	11/13/2014	11/13/2014	11/13/2014	11/13/2014	11/13/2014	11/13/2014
Sample Depth (ft bgs)		2 - 6	6 - 8	2 -4	2 -4	6 - 9	2 - 4	6 - 8	1 - 3
Media		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
VOCs (µg/kg)									
1,2,4-Trimethylbenzene	***3600***	2.1	28 U	0.48 U	0.26 J	0.49 U	0.53 U	0.16 J	0.55 U
1,3,5-Trimethylbenzene	***8400***	0.95 J	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
1,4-Dichlorobenzene	***9800***	0.2 U	28 U	0.19 U	0.17 J	0.2 J	0.21 U	0.17 J	0.22 U
2-Butanone (MEK)	***120***	4.6 J	280 U	4.8 U	2.6 J	4.9 U	2.2 J	2.7 J	2.2 J
4-Isopropyltoluene	***10000****	0.47 J	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
Acetone	***50***	36	280 U	18	27	4.7 J	26	46	35
Benzene	***60***	3.1	28 U	0.2 J	0.21 J	0.16 J	0.3 J	0.18 J	0.2 J
Carbon Disulfide	NS	3.4	28 U	0.51 J	2.2	0.6 J	0.76 J	0.68 J	1.5
cis-1,2-Dichloroethene	***5900***	1.2	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
Dichlorodifluoromethane	NS	0.46 J	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.71 J
Ethylbenzene	***1000***	0.99	28 U	0.55 J	0.63 J	0.48 J	0.83 J	0.71 J	0.6 J
Isopropylbenzene	***2300****	0.99	28 U	0.19 U	0.19 U	0.2 U	0.21 U	0.19 U	0.22 U
Methylene Chloride	***50***	0.98 U	31 UJ	0.96 U	0.97 UJ	0.98 U	1.1 U	5.8 UJ	10
n-Butylbenzene	***12000***	5	210 UJ	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
n-Propylbenzene	***3900***	1.3	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
sec-Butylbenzene	***11000***	4.1	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
tert-Butylbenzene	***5900***	1.7	28 U	0.48 U	0.49 U	0.49 U	0.53 U	0.48 U	0.55 U
Toluene	***700***	4.5	28 U	2.4	2.6	2	3.2	2.4	2.2
Vinyl Chloride	***20***	0.64 J	28 U	0.48 U	0.49 U	0.49 U	0.4 J	0.48 U	0.55 U
Xylene, Meta + Para	***260***	3.2	57 U	2.3	2.5	1.9 J	3.3	2.7	2.2 J
Xylene, Ortho	***260***	0.84 J	28 U	0.51 J	0.51 J	0.5 J	0.94 J	0.62 J	0.54 J
SVOCs (µg/kg)									
Benzo(b)fluoranthene	***1700***	10 U	8.9 U	11 U	2.6 J	8.9 U	11 U	9.4 U	11 U
Bis(2-ethylhexyl) Phthalate	NS	24 J	18 U	22 J	24 J	14 J	17 J	19 U	24 J
Metals (mg/kg)									
Aluminum, Total	NS	16000	16000	19000	22000	16000	17000	17000	21000
Calcium, Total	NS	6200	1500	1600	1200	1400	1700	1600	1100
Iron, Total	NS	31000	45000	43000	41000	46000	32000	47000	42000
Magnesium, Total	NS	5300	7700	6000	4000	7400	3800	7500	4500
Potassium, Total	NS	2100	3000	2400	2300	2700	1600	2900	1900
Sodium, Total	NS	85	67	88	83	65	110	92	180
Antimony, Total	NS	0.35	0.65	0.53	0.55	0.66	0.39	0.83	0.63
Arsenic, Total	***13***	7.3	13	8.9	8.3	12	7.9	**14**	9.1
Barium, Total	***350***	110	150	100	120	120	84	120	110
Beryllium, Total	***7.2***	0.56	0.67	0.72	0.69	0.72	0.69	0.77	0.56
Cadmium, Total	***2.5***	0.15	0.27	0.14	0.078	0.21	0.11	0.4	0.033 J
Chromium, Total	***30***	20	24	25	25	24	20	24	27
Cobalt, Total	NS	12	22	12	9.5	22	11	23	8.1
Copper, Total	***50***	32	46	36	37	44	25	44	37
Lead, Total	***63***	15	21	16	18	21	16	24	18
Manganese, Total	***1600***	530	980	350	510	900	750	990	280
Nickel, Total	***30***	29	**56**	**37**	20	**48**	21	**64**	24
Selenium, Total	***3.9***	0.39	0.75	0.5	0.31	0.9	0.26	0.61	0.2
Silver, Total	***2***	0.042 J	0.066 J	0.06 J	0.042 J	0.074 J	0.071	0.085 J	0.04 J
Thallium, Total	NS	0.2	0.26	0.23 J	0.27	0.22 J	0.17	0.27	0.26
Vanadium, Total	NS	24	23	28	29	22	27	22	29
Zinc, Total	***109***	78 B	**130 B**	88 B	74 B	**110 B**	68 B	**120 B**	70 B
Mercury, Total	***0.18***	0.051	0.069	0.067	0.094	0.074	0.039 J	0.09	0.089

Notes:
Only compounds detected one or more times are presented in table
Italicized and bolded value indicates screening criterion used
Highlighted cell indicates analyte was detected
Bold value indicates analyte detected above screening level
µg/kg = micrograms/kilogram
mg/kg = milligrams/kilogram

Data Qualifiers:
J = Estimated concentration
U = Not detected at concentration shown, the associated number indicates the analyte LOD
UJ = Not detected at estimated concentration shown, the quantitation is an estimated value below the LOQ
NS = No screening criteria available
DUP = Duplicate sample
NA = Not applicable
B = Analyte in the method blank

Table 5‑3. Detected Analytes in Soil at TU008

Location	**NYSDEC 375-6 Soil Cleanup Objectives (Unrestricted)**	**TU008**					
Sample ID		TU08SB06	TU08SB07	TU08SB08	TU08SB08DUP	TU08SB09	TU08SB10
Sample Date		11/14/2014	11/14/2014	11/14/2014	11/14/2014	11/14/2014	11/14/2014
Sample Depth (ft bgs)		2 - 6	2 - 6	2 - 6	2 - 6	4 - 6	2 - 5
Media		Soil	Soil	Soil	Soil	Soil	Soil
VOCs (µg/kg)							
1,2,4-Trimethylbenzene	***3600***	0.54 U	0.47 U	15 J	0.93 J	55	0.32 J
1,3,5-Trimethylbenzene	***8400***	0.54 U	0.47 U	28 U	0.41 U	21 J	0.52 U
2-Butanone (MEK)	***120***	6.9	6.5	280 U	5.8	250 U	5.3
4-Isopropyltoluene	***10000***	0.54 U	0.47 U	28 U	0.3 J	9 J	0.52 U
Acetone	***50***	77	47	280 U	49	250 U	73
Benzene	***60***	0.33 J	0.29 J	28 U	0.34 J	15 J	0.23 J
Bromochloromethane	NS	0.54 U	0.47 U	11 U	0.34 J	10 U	0.52 U
Carbon Disulfide	***NS***	0.34 J	1.8	28 U	1	25 U	1.1
Chloroform	NS	0.54 U	0.47 U	11 U	0.21 J	10 U	0.52 U
Dichlorodifluoromethane	NS	0.54 UJ	0.47 UJ	28 U	0.41 UJ	25 U	0.48 J
Ethylbenzene	***1000***	0.54 U	0.47 U	28 U	0.29 J	25 U	0.52 U
Isopropylbenzene	***2300***	0.21 U	0.19 U	28 U	0.88	47 J	0.21 U
Naphthalene	***12000***	0.54 U	0.47 U	810 J	46 J	730	1.9 UJ
n-Butylbenzene	***12000***	0.54 U	0.47 U	320 UJ	26 J	1100 UJ	1.3
n-Propylbenzene	***3900***	0.54 U	0.47 U	28 U	1.1	97	0.52 U
sec-Butylbenzene	***11000***	0.54 U	0.47 U	62 J	11 J	600	0.41 J
tert-Butylbenzene	***5900***	0.54 U	0.47 U	15 J	4.3 J	390	0.92 J
Toluene	***700***	0.37 J	0.19 U	28 U	1	17 J	0.21 U
Trichlorofluoromethane	NS	0.54 U	0.47 U	28 U	0.72 J	32 J	0.52 U
Xylene, Meta + Para	***260***	0.22 J	0.19 J	56 U	0.57 J	25 J	0.41 U
Xylene, Ortho	***260***	0.21 U	0.19 U	28 U	0.16 U	23 J	0.21 U
SVOCs (µg/kg)							
2-Methylnaphthalene	***410***	72 U	94 U	360	310	470 U	76 U
Acenaphthene	***20000***	72 U	94 U	88 J	140 J	620	76 U
Acenaphthylene	***100000***	72 U	94 U	59 J	61 J	370 J	76 U
Anthracene	***100000***	72 U	94 U	190 U	53 J	230 J	76 U
Benzo(a)anthracene	***1000***	33 J	25 J	94 U	92 U	230 U	38 U
Benzo(a)pyrene	***1000***	40 J	35 J	94 U	92 U	230 U	11 J
Benzo(b)fluoranthene	***1000***	49 J	45 J	94 U	92 U	230 U	11 J
Benzo(g,h,i)perylene	***100000***	30 J	25 J	94 U	92 U	230 U	38 U
Benzo(k)fluoranthene	***800***	33 J	33 J	94 U	92 U	230 U	9.4 J
Bis(2-ethylhexyl) Phthalate	NS	72 U	94 U	190 U	180 U	470 U	1400
Chrysene	***1000***	34 J	33 J	190 U	180 U	470 U	76 U
Fluoranthene	***100000***	67 J	43 J	190 U	180 U	470 U	76 U
Fluorene	***30000***	72 U	94 U	96 J	170 J	1100	76 U
Indeno(1,2,3-cd)pyrene	***500***	24 J	20 J	94 U	92 U	230 U	38 U
Naphthalene	***12000***	72 U	94 U	200	150 J	340 J	76 U
Phenanthrene	***100000***	20 J	94 U	210	330	1800	76 U
Pyrene	***100000***	60 J	43 J	190 U	180 U	150 J	76 U

Notes:
Only compounds detected one or more times are presented in table
Italicized and bolded value indicates screening criterion used
Highlighted cell indicates analyte was detected
Bold value indicates analyte detected above screening level
µg/kg = micrograms/kilogram
mg/kg = milligrams/kilogram

Data Qualifiers:
J = Estimated concentration
U = Not detected at concentration shown, the associated number indicates the analyte LOD
UJ = Not detected at estimated concentration shown, the quantitation is an estimated value below the LOC
NS = No screening criteria available
DUP = Duplicate sample
NA = Not applicable

Table 5-5. Detected Analytes in Soil at TU009

Location	**NYSDEC 375-6 Soil Cleanup Objectives (Unrestricted)**	**TU009**						
Sample ID		TU09SB11	TU09SB11	TU09SB12	TU09SB12 DUP	TU09SB13	TU09SB14	TU09SB14
Sample Date		11/13/2014	11/13/2014	11/13/2014	11/13/2014	11/14/2014	11/14/2014	11/14/2014
Sample Depth (ft bgs)		0 - 3	7 - 8	0 - 2	0 - 2	0 - 5	4 - 6	7 - 8
Media		Soil	Soil	Soil	Soil	Soil	Soil	Soil
VOCs (µg/kg)								
1,2,4-Trimethylbenzene	***3600***	0.51 U	0.52 U	0.55 U	0.49 U	0.47 J	0.43 U	27 U
2-Butanone (MEK)	***120***	12	5.2 U	7.2	5.9	4.8 J	8.6	270 U
2-Hexanone	NS	0.51 U	0.52 U	0.55 U	0.49 U	0.56 U	1.1 J	54 U
4-Chlorotoluene	NS	0.2 U	0.21 U	0.22 U	0.2 U	0.24 J	0.17 U	27 U
Acetone	***100000***	140	46	110	100	74 J	110	270 U
Benzene	***60***	0.19 J	0.24 J	0.55 U	0.24 J	0.7 J	0.18 J	27 U
Carbon Disulfide	NS	0.63 J	0.33 J	1.7 J	3.2 J	2.1	0.58 J	27 U
cis-1,2-Dichloroethene	***5900***	0.51 U	0.52 U	0.55 U	0.49 U	0.53 J	0.43 U	27 U
Dichlorodifluoromethane	NS	0.51 U	0.52 U	0.55 U	0.58 J	0.71 J	0.43 UJ	27 U
Ethylbenzene	***1000***	2	4	1.8 J	0.71 J	0.56 U	0.43 U	27 U
n-Butylbenzene	***12000***	0.51 U	0.52 U	0.55 U	0.49 U	0.31 J	0.43 U	27 U
Toluene	***700***	3	4.5	2.4	2.8	0.54 J	0.17 U	27 U
Trichloroethene	***470***	0.51 U	0.52 U	0.55 U	0.49 U	1.1 J	0.43 U	27 U
Xylene, Meta + Para	***260***	7.2	17	7.8 J	2.8 J	0.88 J	0.35 U	54 U
Xylene, Ortho	***260***	1.6	4.1	2.5 J	0.63 J	0.22 U	0.17 U	27 U
SVOCs (µg/kg)								
Benzo(a)anthracene	***1000***	5.1 J	9.6 U	48 J	44 J	30 J	63 J	72 U
Benzo(a)pyrene	***1000***	4.3 J	9.6 U	37 J	51 J	30 J	56 J	72 U
Benzo(b)fluoranthene	***1000***	7.4 J	9.6 U	66 J	53 J	45 J	45 J	72 U
Benzo(g,h,i)perylene	***100000***	9.8 U	9.6 U	26 J	22 J	30 J	45 J	72 U
Benzo(k)fluoranthene	***800***	3.9 J	9.6 U	33 J	47 J	32 J	60 J	72 U
Bis(2-ethylhexyl) Phthalate	NS	17 J	16 J	180 U	90 U	2100 J	180 U	140 U
Chrysene	***1000***	5.1 J	19 U	180 U	47 J	35 J	52 J	140 U
Di-n-butyl Phthalate	NS	39 U	39 U	370 U	180 U	77 J	370 U	290 U
Fluoranthene	***100000***	7.4 J	19 U	51 J	67 J	49 J	63 J	140 U
Indeno(1,2,3-cd)pyrene	***500***	9.8 U	9.6 U	92 U	26 J	24 J	30 J	72 U
Phenanthrene	***100000***	5.4 J	19 U	180 U	90 U	94 U	180 U	140 U
Pyrene	***100000***	8.2 J	19 U	55 J	71 J	47 J	67 J	140 U
Metals (mg/kg)								
Aluminum, Total	NS	14000	17000	13000	12000	20000 J	14000	17000
Calcium, Total	NS	1900	1300	12000	14000	8400 J	6900	2100
Iron, Total	NS	24000	55000	26000	25000	42000 J	29000	48000
Magnesium, Total	NS	3300	7100	7200	8000	6800	6400	7600
Potassium, Total	NS	1100	2700	1700	1700	2000	1900	2900
Sodium, Total	NS	55	73	48	57	72	45 J	54
Antimony, Total	NS	0.21	0.69	0.55	0.4	0.43	0.4	0.78
Arsenic, Total	***13***	4.4	13	7	6.6	9.1	7.1	**15**
Barium, Total	***350***	80	94	76	74	110 J	66	130
Beryllium, Total	***7.2***	0.56	0.74	0.52	0.53	0.64	0.56	0.73
Cadmium, Total	***2.5***	0.11	0.15	1.2	1.4	0.26	0.11	0.23
Chromium, Total	***30***	15	24	19	17	19 J	22	24
Cobalt, Total	NS	8.2	22	12	13	15	12	25
Copper, Total	***50***	14	40	25	23	30 J	26	**52**
Lead, Total	***63***	12	22	34 J	21 J	22 J	14	25
Manganese, Total	***1600***	660	830	670 J	920 J	750 J	350	1200
Nickel, Total	***30***	18	**39**	25	24	**31 J**	28	**62**
Selenium, Total	***3.9***	0.2	0.42	0.44	0.45	0.64	0.55	0.91
Silver, Total	***2***	0.06	0.03 J	0.27 J	0.073 J	0.13 J	0.035 J	0.043 J
Thallium, Total	NS	0.16	0.18 J	0.15 J	0.16 J	0.21 J	0.13 J	0.28
Vanadium, Total	NS	23	23	21	21	25 J	23	24
Zinc, Total	***109***	59 B	100 B	89 J	**110 J**	98 J	81 B	**130 B**
Mercury, Total	***0.18***	0.035 J	0.11	0.047	0.034 J	0.047 J	0.046 J	0.078

Notes: Only compounds detected one or more times are presented in table
Italicized and bolded value indicates screening criterion used
Highlighted cell indicates analyte was detected
Bold value indicates analyte detected above screening level
µg/kg = micrograms/kilogram
mg/kg = milligrams/kilogram
* = CP-51 Guidance Value

Data Qualifiers: J = Estimated concentration
U = Not detected at concentration shown, the associated number indicates the analyte LOD
UJ = Not detected at estimated concentration shown, the quantitation is an estimated value below the LOQ
NS = No screening criteria available
DUP = Duplicate sample
NA = Not applicable
B = Analyte in the method blank

Table 5-2. Detected Analytes in Groundwater at ZZ007

Location	**NYSDEC TOGS Ambient Water Quality Standards and Guidance Values**	**ZZ007**		
Sample ID		MWUNK	ZZ07GW02	ZZ07GW05
Sample Date		11/18/2014	11/13/2014	11/13/2014
Media		Groundwater	Groundwater	Groundwater
VOCs (µg/L)				
2-Butanone (MEK)	***50***	1 U	1.2 J	4.5 J
2-Hexanone	***50***	1 U	1 U	1.3 J
Carbon Disulfide	NS	0.2 U	0.2 U	2.8 J
cis-1,2-Dichloroethene	***5***	0.5 U	0.19 J	0.25 J
Ethylbenzene	***5***	0.2 U	0.2 U	0.4 J
Methylene Chloride	***5***	0.73 J	1 U	1 U
Naphthalene	***10****	0.5 U	0.5 U	0.25 J
Xylene, Meta + Para	***5***	0.4 U	0.4 U	1.8 J
Xylene, Ortho	***5***	0.5 U	0.5 U	0.9 J
SVOCs (µg/L)				
Benzyl Alcohol	NS	0.05 J	0.2 U	1 U
Bis(2-ethylhexyl) Phthalate	***5***	0.71	0.86 J	1.7 J
Butyl Benzyl Phthalate	***50***	0.07 J	0.4 U	2 U
Diethyl Phthalate	***50***	0.2 J	0.5 U	2.5 U
Dimethyl Phthalate	***50***	0.1 J	0.2 U	1 U
Di-n-butyl Phthalate	***50***	0.28 J	0.29 J	10 U
Naphthalene	***10****	0.1 U	0.063 J	1 U
Phenanthrene	***50***	0.1 U	0.17 J	1 U
Metals (µg/L)				
Aluminum, Dissolved	NS	50 U	130000	160000
Aluminum, Total	NS	92 J	240000	310000
Calcium, Dissolved	NS	92000	650000	1300000
Calcium, Total	NS	89000	2000000	3100000
Iron, Dissolved	***300****	80	**310000**	**490000**
Iron, Total	***300****	730	**660000**	**1000000**
Magnesium, Dissolved	***35000***	**36000**	**120000**	**210000**
Magnesium, Total	***35000***	**35000**	**310000**	**440000**
Potassium, Dissolved	NS	2300	23000	27000
Potassium, Total	NS	2200	32000	38000
Sodium, Dissolved	***20000***	**43000**	11000	8900
Sodium, Total	***20000***	**40000**	14000	12000
Antimony, Dissolved	***3***	0.21 J	2.5 U	1.3 J
Antimony, Total	***3***	0.5 U	2.5 J	1.6 J
Arsenic, Dissolved	***25***	0.41 J	**140**	**240**
Arsenic, Total	***25***	0.78 J	**220**	**340**
Barium, Dissolved	***1000***	61	**1500**	**1200**
Barium, Total	***1000***	77	**2900**	**2500**
Beryllium, Dissolved	***3***	0.4 U	**11**	**12**
Beryllium, Total	***3***	0.4 U	**22**	**22**
Cadmium, Dissolved	***5***	0.091 J	2.9	**5.5**
Cadmium, Total	***5***	0.28 J	**9.9 J**	**13 J**
Chromium, Dissolved	***50***	0.2 J	**460**	**320**
Chromium, Total	***50***	0.82 J	**1200**	**610**
Cobalt, Dissolved	NS	0.12 J	230	220
Cobalt, Total	NS	0.6 J	490	430
Copper, Dissolved	***200***	1.4	**580**	**1000**
Copper, Total	***200***	2.4	**1500**	**1900**
Lead, Dissolved	***25***	0.5 U	**220**	**310**
Lead, Total	***25***	0.31 J	**570**	**640**
Manganese, Dissolved	***300****	140	**11000**	**7200**
Manganese, Total	***300****	**910**	**34000**	**46000**
Nickel, Dissolved	***100***	3.2	**520**	**490**
Nickel, Total	***100***	13	**1100**	**1000**

Table 5-2. Detected Analytes in Groundwater at ZZ007

Location	**NYSDEC TOGS Ambient Water Quality Standards and Guidance Values**	**ZZ007**		
Sample ID		MWUNK	ZZ07GW02	ZZ07GW05
Sample Date		11/18/2014	11/13/2014	11/13/2014
Media		Groundwater	Groundwater	Groundwater
Selenium, Dissolved	***10***	0.37 J	**24**	**34**
Selenium, Total	***10***	0.37 J	9.3 J	15 J
Silver, Dissolved	***50***	0.1 U	1.1	1.7
Silver, Total	***50***	0.1 U	2.1	2.8
Thallium, Dissolved	***0.5***	0.047 J	**2.4**	**3.9**
Thallium, Total	***0.5***	0.056 J	**6**	**6.7**
Vanadium, Dissolved	NS	0.14 J	330	440
Vanadium, Total	NS	0.61 J	810	840
Zinc, Dissolved	***2000***	58	1300	**2300**
Zinc, Total	***2000***	120	**3400**	**4600**
Mercury, Dissolved	***0.7***	0.1 U	**1**	**1.7**
Mercury, Total	***0.7***	0.1 U	**2.6**	**4.5**

Notes:
Only compounds detected one or more times are shown
Italicized and bolded value indicates screening criterion used
Highlighted cell indicates analyte was detected
Bold value indicates analyte detected above screening level
µg/L = micrograms/liter
*Values exist solely for aesthetic considerations

Data Qualifiers:
J = Estimated concentration
U = Not detected at concentration shown
UJ = Not detected at estimated concentration shown
NS = No screening criteria available
NA = Not applicable

Table 5-4. Detected Analytes in Groundwater at TU008

Location	**NYSDEC TOGS Ambient Water Quality Standards**	**TU008**					
Sample ID		TU08GW06	TU08GW07	TU08GW07DUP	TU08GW08	TU08GW09	TU08GW10
Sample Date		11/14/2014	11/14/2014	11/14/2014	11/14/2014	11/14/2014	11/14/2014
Media		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
VOCs (µg/L)							
1,2,4-Trimethylbenzene	***5***	0.5 U	0.5 U	0.5 U	0.26 J	0.5 U	0.5 U
2-Butanone (MEK)	***50***	1 U	1 U	1 U	1.5 J	1 U	1 U
cis-1,2-Dichloroethene	***5***	0.5 U	0.5 U	0.5 U	0.5 U	0.28 J	0.58 UJ
Isopropylbenzene	***5***	0.5 U	0.5 U	0.5 U	0.98 J	0.36 J	0.5 U
Naphthalene	***10****	0.5 U	0.5 U	0.5 U	**71**	0.5 U	0.5 U
n-Butylbenzene	***5***	0.2 U	0.2 U	0.2 U	**5.1**	**8**	0.2 U
n-Propylbenzene	***5***	0.5 U	0.5 U	0.5 U	0.36 J	0.27 J	0.5 U
sec-Butylbenzene	***5***	0.5 U	0.5 U	0.5 U	4.4	**8**	0.5 U
tert-Butylbenzene	***5***	0.5 U	0.5 U	0.5 U	1.4	**9.3**	0.5 U
Toluene	***5***	0.2 U	0.2 U	0.2 U	0.31 J	0.2 U	0.26 J
Xylene, Meta + Para	***5***	0.4 U	0.4 U	0.4 U	0.25 J	0.4 U	0.4 U
SVOCs (µg/L)							
2-Methylnaphthalene	NS	0.068 UJ	0.064 U	0.1 U	110	2.3 J	NA
Acenaphthene	***20****	0.14 UJ	0.13 U	0.2 U	11	8.1 J	NA
Acenaphthylene	NS	0.068 UJ	0.064 U	0.1 U	4.2 J	1.2 U	NA
Anthracene	***50***	0.27 UJ	0.26 U	0.4 U	3.9 J	4.7 U	NA
Benzoic Acid	NS	1.1 J	2.6 U	4 U	24 U	47 U	NA
Benzyl Alcohol	NS	0.082 J	0.14 J	0.2 U	1.2 U	2.3 U	NA
Bis(2-ethylhexyl) Phthalate	***5***	**67 J**	0.44 UJ	0.51 UJ	5.9 U	12 U	NA
Dibenzofuran	NS	0.14 UJ	0.13 U	0.2 U	6	2.3 U	NA
Diethyl Phthalate	***50***	0.14 J	0.19 UJ	0.5 U	2.9 U	5.8 U	NA
Di-n-butyl Phthalate	***50***	2.6 J	0.36 UJ	0.34 UJ	12 U	23 U	NA
Di-n-octyl Phthalate	***50***	0.18 J	0.26 U	0.4 U	2.4 U	4.7 U	NA
Fluorene	***50***	0.14 UJ	0.13 U	0.2 U	11	2.3 U	NA
Naphthalene	***10****	0.14 UJ	0.13 U	0.2 U	**63**	2.3 U	NA
Phenanthrene	***50***	0.14 UJ	0.13 U	0.2 U	20	12	NA
Phenol	***2****	0.068 J	0.064 J	0.2 U	1.2 U	2.3 U	NA

Notes:

Only compounds detected one or

Italicized and bolded value indicates screening crit

Highlighted cell indicates analyte was detected

Bold value indicates analyte detected above screen

TU08GW10 was not collected for SVOCs

µg/L = micrograms/liter

*Values exist solely for aesthetic considerations

Data Qualifiers:

J = Estimated concentration

U = Not detected at concentration shown

UJ = Not detected at estimated concentration shown

NS = No screening criteria available

DUP = Duplicate sample

NA = Not applicable

Table 5-6. Detected Analytes in Groundwater at TU009

Location	**NYSDEC TOGS Ambient Water Quality Standards**	**TU009**	
Sample ID		TU09GW12	TU09GW13
Sample Date		11/14/2014	11/14/2014
Media		Groundwater	Groundwater
VOCs (µg/L)			
cis-1,2-Dichloroethene	***5***	0.5 U	0.21 J
Ethylbenzene	***5***	0.2 U	0.57 J
Xylene, Meta + Para	***5***	0.4 U	2.7
Xylene, Ortho	***5***	0.5 U	0.9 J
SVOCs (µg/L)			
Benzo(a)anthracene	***0.002***	0.23 U	**0.12 J**
Benzo(a)pyrene	ND	0.23 U	**0.15 J**
Benzo(b)fluoranthene	***0.002***	0.45 U	**0.15 J**
Benzo(g,h,i)perylene	NS	0.45 U	0.11 J
Benzo(k)fluoranthene	***0.002***	0.45 U	0.12 J
Bis(2-ethylhexyl) Phthalate	***5***	**7**	0.44 UJ
Carbazole	NS	0.45 U	0.11 J
Chrysene	***0.002***	0.23 U	0.11 J
Di-n-butyl Phthalate	***50***	2.3	2.6
Fluoranthene	***50***	0.45 U	0.2 J
Phenanthrene	***50***	0.23 U	0.1 J
Phenol	***2****	0.23 U	0.045 J
Pyrene	***50***	0.45 U	0.21 J
Metals (µg/L)			
Aluminum, Dissolved	NS	8800	2400
Aluminum, Total	NS	76000	180000 J
Calcium, Dissolved	NS	150000	120000
Calcium, Total	NS	160000	180000 J
Iron, Dissolved	***300****	**15000**	**3200**
Iron, Total	***300****	**170000**	**330000 J**
Magnesium, Dissolved	***35000***	**36000**	**26000**
Magnesium, Total	***35000***	**61000**	**83000**
Potassium, Dissolved	NS	6000	3700
Potassium, Total	NS	17000	20000
Sodium, Dissolved	***20000***	**26000**	**22000**
Sodium, Total	***20000***	**24000**	**20000**
Antimony, Dissolved	***3***	0.35 J	0.17 J
Antimony, Total	***3***	0.51 J	0.5 J
Arsenic, Dissolved	***25***	5.4	1.4
Arsenic, Total	***25***	**47**	**65**
Barium, Dissolved	***1000***	130	65
Barium, Total	***1000***	830	**1800 J**
Beryllium, Dissolved	***3***	0.35 J	0.4 U
Beryllium, Total	***3***	**3.5**	**7.2**
Cadmium, Dissolved	***5***	0.22	0.05 J
Cadmium, Total	***5***	1.5 J	2.6 J
Chromium, Dissolved	***50***	14	3.6
Chromium, Total	***50***	**120**	**220 J**
Cobalt, Dissolved	NS	9.3	3.8
Cobalt, Total	NS	87	150
Copper, Dissolved	***200***	19	6.5
Copper, Total	***200***	190	**280 J**
Lead, Dissolved	***25***	8.8	2.6
Lead, Total	***25***	**92**	**210 J**
Manganese, Dissolved	***300****	**490**	**1200**
Manganese, Total	***300****	**3700**	**7600 J**
Nickel, Dissolved	***100***	20	5.7
Nickel, Total	***100***	**190**	**310 J**

Table 5-6. Detected Analytes in Groundwater at TU009

Location	**NYSDEC TOGS Ambient Water Quality Standards**	**TU009**	
Sample ID		TU09GW12	TU09GW13
Sample Date		11/14/2014	11/14/2014
Media		Groundwater	Groundwater
Selenium, Dissolved	***10***	1.3	1.2
Selenium, Total	***10***	1.2 J	3.5 J
Silver, Dissolved	***50***	0.067 J	0.1 U
Silver, Total	***50***	0.18 J	1.1
Thallium, Dissolved	***0.5***	0.19 J	0.065 J
Thallium, Total	***0.5***	**1.1**	**2**
Vanadium, Dissolved	NS	16	5
Vanadium, Total	NS	110	280 J
Zinc, Dissolved	***2000***	46	20
Zinc, Total	***2000***	400	800 J
Mercury, Total	***0.7***	0.36	**0.79**

Notes:
Only compounds detected one or more times are shown
Italicized and bolded value indicates screening criterion used
Highlighted cell indicates analyte was detected
Bold value indicates analyte detected above screening level
µg/L = micrograms/liter
*Values exist solely for aesthetic considerations
Data Qualifiers:
J = Estimated concentration
U = Not detected at concentration shown
UJ = Not detected at estimated concentration shown
NS = No screening criteria available
ND - standard is any detectable concentration

ZZ07GW05 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Iron, Dissolved	**490,000**	300*
Iron, Total	**1,000,000**	300*
Magnesium, Dissolved	**210,000**	35,000
Magnesium, Total	**440,000**	35,000
Arsenic, Dissolved	**240**	25
Arsenic, Total	**340**	25
Barium, Dissolved	**1,200**	1000
Barium, Total	**2500**	1000
Beryllium, Dissolved	**12**	3
Beryllium, Total	**22**	3
Cadmium, Dissolved	**5.5**	5
Cadmium, Total	**13 J**	5
Chromium, Dissolved	**320**	50
Chromium, Total	**610**	50
Copper, Dissolved	**1000**	200
Copper, Total	**1900**	200
Lead, Dissolved	**310**	25
Lead, Total	**640**	25
Manganese, Dissolved	**7200**	300*
Manganese, Total	**46,000**	300*
Nickel, Dissolved	**490**	100
Nickel, Total	**1000**	100
Selenium, Dissolved	**34**	10
Thallium, Dissolved	**3.9**	0.5
Thallium, Total	**6.7**	0.5
Zinc, Dissolved	**2,300**	2000
Zinc, Total	**4,600**	2000
Mercury, Dissolved	**1.7**	0.7
Mercury, Total	**4.5**	0.7

*Indicates values exist solely for aesthetic considerations.

ZZ07SB01 - Soil (6 - 8 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Nickel, Total	**56**	30
Zinc, Total	**130**	109

ZZ07GW02 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Iron, Dissolved	**310,000**	300*
Iron, Total	**660,000**	300*
Magnesium, Dissolved	**120,000**	35,000
Magnesium, Total	**310,000**	35,000
Arsenic, Dissolved	**140**	25
Arsenic, Total	**220**	25
Barium, Dissolved	**1,500**	1000
Barium, Total	**2900**	1000
Beryllium, Dissolved	**11**	3
Beryllium, Total	**22**	3
Cadmium, Total	**9.9 J**	5
Chromium, Dissolved	**460**	50
Chromium, Total	**1200**	50
Cobalt, Dissolved	**230**	6^
Copper, Total	**1500**	200
Lead, Dissolved	**220**	25
Lead, Total	**570**	25
Manganese, Dissolved	**11,000**	300*
Manganese, Total	**34,000**	300*
Nickel, Dissolved	**520**	100
Nickel, Total	**1100**	100
Selenium, Dissolved	**24**	10
Thallium, Dissolved	**2.4**	0.5
Thallium, Total	**6**	0.5
Zinc, Total	**3,400**	2000
Mercury, Dissolved	**1**	0.7
Mercury, Total	**2.6**	0.7

*Indicates values exist solely for aesthetic considerations.

ZZ07SB02 - Soil (2 - 4 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Nickel, Total	**37**	30

ZZ07SB03 - Soil (6 - 9 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Nickel, Total	**48**	30
Zinc, Total	**110**	109

ZZ07SB04 - Soil (6 - 8 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Arsenic, Total	**14**	13
Nickel, Total	**64**	30
Zinc, Total	**120**	109

MWUNK - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Magnesium, Dissolved	**36,000**	35,000
Magnesium, Total	**35,000**	35,000
Sodium, Dissolved	**43,000**	20,000
Sodium, Total	**40,000**	20,000
Manganese, Total	**910**	300*

*Indicates values exist solely for aesthetic considerations.

Legend

⌖ Existing Monitoring Well

⊗ Field Sampling Locations

Only exceedances are shown.
The criteria used for soil are the NYSDEC 375-6 Soil Cleanup Guidance.
The criteria used for groundwater are the NYSDEC TOGS Ambient Water Quality Standards.

CONTRACT NO 60308608	
CARTOGRAPHY BY B. Perrigo	
CHECKED BY A. Martin	DATE February 2015
SCALE 1" = 30'	SHEET 1 of 1
Fig_5-1_Schenectady_Sampling_Locations_ZZ007.mxd	

Schenectady Air National Guard Base

Figure 5-1
Schenectady Air National Guard Base
ZZ007 SI Field Sampling Location
Scotia, New York

AECOM

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

TU08GW06 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Bis(2-ethylhexyl) Phthalate	**67 J**	5

TU08GW08 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Naphthalene (VOC)	**71**	10*
n-Butylbenzene	**5.1**	5
Naphthalene (SVOC)	**63**	10*

*Indicates values exist solely for aesthetic considerations.

TU08GW09 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
n-Butylbenzene	**8**	5
sec-Butylbenzene	**8**	5
tert-Butylbenzene	**9.3**	5

Legend

⊗	Field Sampling Locations
▨	Approximate Location of Feature

Only exceedances are shown.
The criteria used for groundwater are the NYSDEC TOGS Ambient Water Quality Standards.

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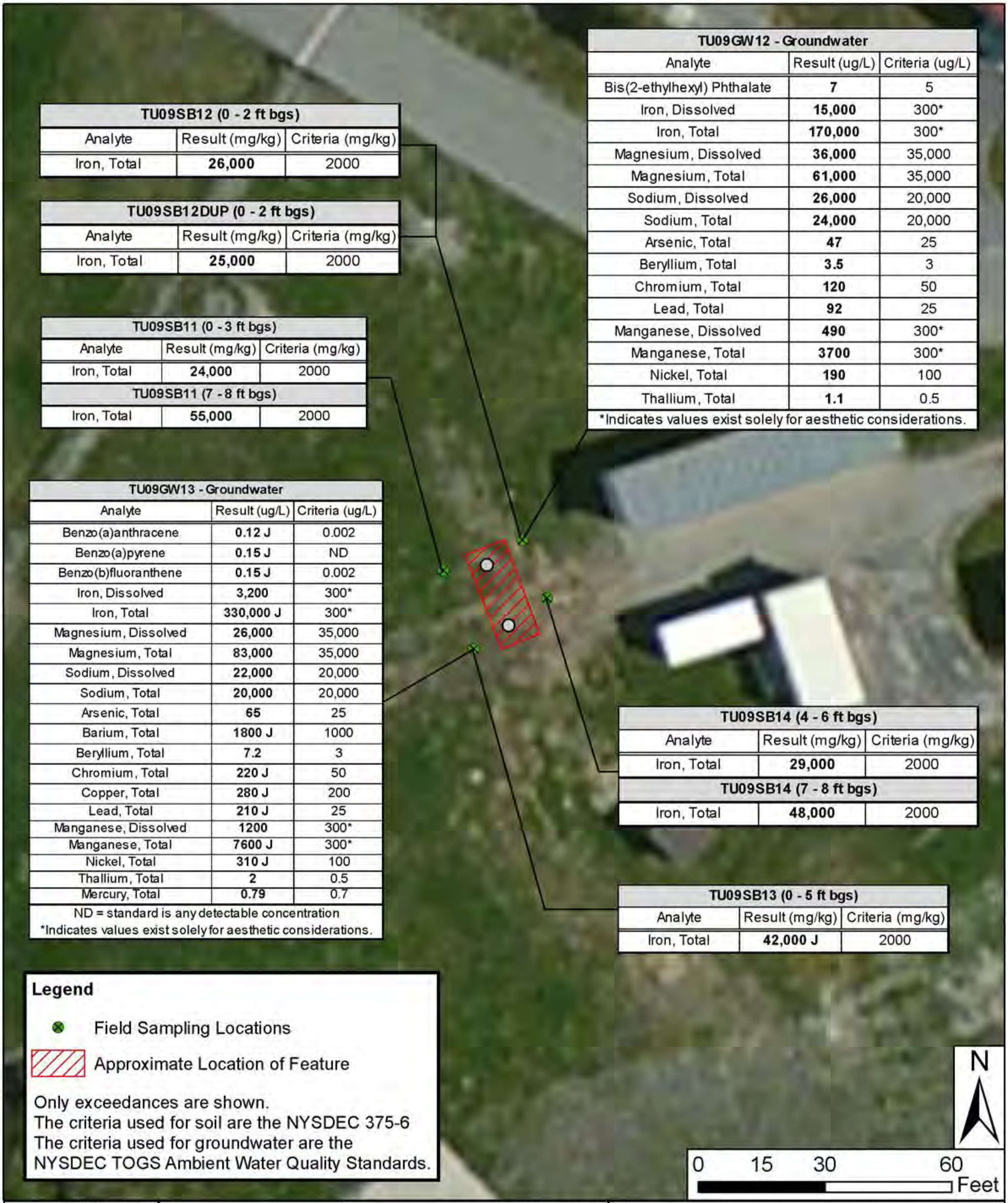
A. Martin
DATE
February 2015
SCALE
1" = 30'
SHEET
1 of 1
Fig_5-2_Schenectady_Field_Sampling_Locations_TU008.mxd

Schenectady Air National Guard Base

Figure 5-2
Schenectady Air National Guard Base
TU008 SI Field Sampling Location
Scotia, New York

AECOM

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



TU09GW12 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Bis(2-ethylhexyl) Phthalate	**7**	5
Iron, Dissolved	**15,000**	300*
Iron, Total	**170,000**	300*
Magnesium, Dissolved	**36,000**	35,000
Magnesium, Total	**61,000**	35,000
Sodium, Dissolved	**26,000**	20,000
Sodium, Total	**24,000**	20,000
Arsenic, Total	**47**	25
Beryllium, Total	**3.5**	3
Chromium, Total	**120**	50
Lead, Total	**92**	25
Manganese, Dissolved	**490**	300*
Manganese, Total	**3700**	300*
Nickel, Total	**190**	100
Thallium, Total	**1.1**	0.5

*Indicates values exist solely for aesthetic considerations.

TU09SB12 (0 - 2 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Iron, Total	**26,000**	2000

TU09SB12DUP (0 - 2 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Iron, Total	**25,000**	2000

TU09SB11 (0 - 3 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Iron, Total	**24,000**	2000
TU09SB11 (7 - 8 ft bgs)		
Iron, Total	**55,000**	2000

TU09GW13 - Groundwater

Analyte	Result (ug/L)	Criteria (ug/L)
Benzo(a)anthracene	**0.12 J**	0.002
Benzo(a)pyrene	**0.15 J**	ND
Benzo(b)fluoranthene	**0.15 J**	0.002
Iron, Dissolved	**3,200**	300*
Iron, Total	**330,000 J**	300*
Magnesium, Dissolved	**26,000**	35,000
Magnesium, Total	**83,000**	35,000
Sodium, Dissolved	**22,000**	20,000
Sodium, Total	**20,000**	20,000
Arsenic, Total	**65**	25
Barium, Total	**1800 J**	1000
Beryllium, Total	**7.2**	3
Chromium, Total	**220 J**	50
Copper, Total	**280 J**	200
Lead, Total	**210 J**	25
Manganese, Dissolved	**1200**	300*
Manganese, Total	**7600 J**	300*
Nickel, Total	**310 J**	100
Thallium, Total	**2**	0.5
Mercury, Total	**0.79**	0.7

ND = standard is any detectable concentration
*Indicates values exist solely for aesthetic considerations.

TU09SB14 (4 - 6 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Iron, Total	**29,000**	2000
TU09SB14 (7 - 8 ft bgs)		
Iron, Total	**48,000**	2000

TU09SB13 (0 - 5 ft bgs)

Analyte	Result (mg/kg)	Criteria (mg/kg)
Iron, Total	**42,000 J**	2000

Legend

- ⊗ Field Sampling Locations
- ▨ Approximate Location of Feature

Only exceedances are shown.
The criteria used for soil are the NYSDEC 375-6
The criteria used for groundwater are the
NYSDEC TOGS Ambient Water Quality Standards.

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SCALE 1" = 30'	SHEET 1 of 1
Fig_5-3_Schenectady_Field_Sampling_Locations_TU009.mxd	

Schenectady Air National Guard Base

Figure 5-3
Schenectady Air National Guard Base
TU009 SI Field Sampling Location
Scotia, New York

AECOM

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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APPENDIX C
FIELD STANDARD OPERATING PROCEDURES

Reference Number	SOP Title
SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-3	Sample Chain-of-Custody
SOP G-4	Sample Packing and Shipping
SOP G-5	Surveying
SOP G-6	Decontamination
SOP G-7	Management of Investigation Derived Waste
SOP G-8	Utility Location
SOP G-9	Field Filtration
SOP SS-1	Soil Sampling
SOP SS-3	Soil Sampling Using Hollow Stem Auger Technology
SOP W-1	Groundwater Monitoring Well Installation
SOP W-2	Well Development
SOP W-3	Water Level and Well Depth Measurements
SOP W-4	Low Stress (Low Flow) Groundwater Purging and Sampling
SOP W-5	Borehole/Well Abandonment
SOP W-6	Slug Test Aquifer Testing

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STANDARD OPERATING PROCEDURE G-1

FIELD DOCUMENTATION

1. SCOPE AND APPLICATION

This SOP describes procedures for proper field documentation. When samples are collected for chemical or physical characteristics analysis, field surveys or measurements are performed, or oversight of field activities is undertaken, field documentation must be completed. The field logbook serves as a permanent and traceable record of all field activities related to a project and will become a part of the project files. The information presented in this SOP focuses on the completion of field logbooks and/or field forms for documenting field activities conducted by the field personnel.

All data collection will be documented in either a bound field logbook or on appropriate field forms. Field logbooks will be assigned to individual field personnel for daily entries. Notes in the bound field logbooks will be made legibly, written in black or blue ink, and be as detailed and descriptive as possible so that a particular situation may be recalled without reliance on the collector's memory. No blank pages or sections of pages will be allowed. If a page is not completely filled in, a line will be drawn through the blank portion and initialed by the person keeping the log. There should be no erasure or deletions from the field notes. At the end of each day, the logbook will be signed and dated.

2. EQUIPMENT

Field logbooks
Field forms

3. PROCEDURES

3.1 FIELD LOGBOOK

The field logbook is the primary means of documenting field activities. It must be completed concurrent with field activities and present a thorough but concise summary of the activities conducted. The field logbook should enable the field activities to be reconstructed without relying on the field member's memory. Refer to the “Logbook Operating Practices” provided at the end of this SOP for detailed descriptions of field logbook entry procedures. Logbooks should be kept in the field member's possession or in a secure place during field work. General provisions for field logbooks include:

- Project name/location and sequential logbook number should appear on the cover.
- Contact information should be recorded inside the front cover in case the logbook is misplaced.
- Write legibly and use a black or blue ink pen for all logbook entries.
- Corrections should be made by crossing out the data with a single strike mark, which will be initialed and dated by the person making the correction. Ensure that the original entry being struck out is still readable.
- Each page of the logbook should be sequentially numbered, dated, and signed by the field team member.
- Time should be recorded in military time (24-hour clock).
- For field sampling or data collection events documented in the logbook, entries should include but not be limited to:
    - Name of author, date, and time of entry.
    - Name, company/agency affiliation, and responsibility of field team members.
    - Names, titles, and arrival/departure times of any site visitors.
    - Weather (e.g., temperature, cloud cover, humidity, wind).
    - Health and safety briefings, personal protection equipment (PPE) level, or changes or issues encountered.
    - Calibration of field equipment.
    - Description of task.
    - Sample or data collection method.
    - Number and volume of sample(s) taken.
    - Date and time of collection.

  - Sample identification number(s) (IDs).
  - Information concerning sampling changes, scheduling modifications, and change orders.
  - Details of sampling locations and visual observations of matrix sampled (e.g., soil description, odors, discolorations).
  - Site sketch of sample locations.
  - Sample preservation.
  - Sample matrix.
  - Sample analysis to be performed.
  - Field observations.
  - Any field measurements made.
  - Decontamination procedures.
  - Documentation for investigation derived wastes (IDW) (e.g., contents and approximate volume of waste, disposal method).
  - Documentation of any scope of work changes required by field conditions.
  - Description of photographs taken.
- For oversight activities of consultants and contractors, entries should include, but not be limited to:
  - Name of author, date, and time of entry.
  - Name, company/agency affiliation, and responsibility of field team members.
  - Oversight location and task.
  - Names, titles, and arrival/departure times of any site visitors.
  - Weather (e.g., temperature, cloud cover, humidity, wind).
  - Arrival and departure times of oversight staff.
  - Observations of ongoing activities.
  - Compliance with or deviation from approved plans.

- Details of sampling locations and visual observations of matrix sampled (e.g., soil description, odors, discolorations).

- Details of any split samples collected, including location, matrix, field sample IDs.

- Description of photographs taken.

3.2 FIELD FORMS

Various field data collection forms may be used to streamline the documentation of field data. Field forms may also be customized for large data collection efforts. If field data are recorded on a field form, this data entry should be documented in the daily field logbook entry. Field form data entry should be executed with the same quality standards as field logbook data entry. Entries should be neatly written in black or blue ink and corrections made with single line strike-out and initials. Original field forms should be submitted daily to the Task Manager and be incorporated into the project file.

Examples of field forms that may be used for documenting field activities are summarized in the following sections and included in the UFP-QAPP Appendix D “Field Forms”.

3.2.1 Soil Boring Log

A Soil Boring Log for Direct Push Technology (e.g., Geoprobe) or hollow-stem auger split spoon sampling (see UFP-QAPP Appendix D) may be completed during the soil boring installation. Information documented on the Soil Boring Log will include:

- Sample depths.
- Penetration/recoveries.
- Analytical sample IDs.
- Blow counts (if applicable).
- Soil classification and lithological description.
- Material origin (natural or fill).
- Observed product, odor, or sheen.
- Instrument readings.

3.2.2 Well Construction Log

In the event that a borehole is completed as a groundwater monitoring well or piezometer, details of the construction may be documented in a Well Construction Log (see UFP-QAPP Appendix D). Information documented on the Well Construction Log includes:

- Total well depth.
- Well diameter.
- Well construction materials.
- Screen interval.
- Construction details.
- Graphic depiction of well construction.

3.2.3 Well Development

Development of a newly installed monitoring well or redevelopment of an existing monitoring well may be documented on a Well Development Form (see UFP-QAPP Appendix D). Information documented on the Well Development Form includes:

- Well ID and construction details.
- Purge rates.
- Headspace readings.
- Turbidity readings.
- Field notes or observations.

3.2.4 Low Flow Groundwater Sampling Record

Low flow groundwater sampling will be documented on a Low Flow Groundwater Sampling Record (see UFP-QAPP Appendix D). Information documented on the sampling record includes:

- Well ID and construction details.
- Times, purge rates, and parameter readings during purging.
- Final parameter values.
- Well condition survey.
- Additional field notes or observations.

Logbook Operating Practices

Procedure

- Logbooks are permanently bound, all pages numbered.
- Entries should begin on page 1.
- Use only blue or black ink (waterproof).
- Sign entries at the end of the day, or before someone else writes in the logbook.
- If a complete page is not used, draw a line diagonally across the blank portion of the page and initial and date the bottom line.
- If a line on the page is not completely filled, draw a horizontal line through the blank portion.
- Ensure that the logbook clearly shows the sequence of the day’s events.
- Do not write in the margins or between written lines, and do not leave blank pages to fill in later.
- If an error is made, draw a single line through the error and initial it.
- Maintain control of the logbook and keep in a secure location.

General Information

- Date on every page.
- Team members and initials listed at beginning of day.
- Other personnel and affiliation (e.g. OSC-Smith, OSC-Jones).
- Written legibly.
- Signatures of author at bottom of every page.
- Signatures when change of recorder.
- Corrections are single lined and corrections are initialed.
- Team members’ site entries and exits are documented.
- Chargeable off-site activities are documented.
- Note End of Logbook on last page (“End of Logbook”).
- Late entries noted appropriately.

Field Logbooks

- General information.
- Name, location of site, and work order number.
- Name of the Site Manager or Field Team Leader.
- Names and responsibilities of all field team members using the logbook (or involved with activities for which entries are being made).
- Weather conditions.
- Objective narratives written.
- Field observations.
- Names of any site visitors, including entities that they represent.

Sampling

- Time collected.
- Grab/composite.
- Sample location.
- Type of analysis.
- Shipping information.
- Number and types of collected samples.
- Sample location with an emphasis on any changes to documentation in governing documents (i.e., Work Plan, QAPP). This may include measurements from reference points or sketches of sample locations with respect to local features.
- Sample identification numbers, including any applicable cross-references to split samples or samples collected by another entity.
- A description of sampling methodology, or reference to any governing document (i.e., Work Plan, QAPP).
- Summary of equipment preparation and decontamination procedures.
- Sample description including depth, color, texture, moisture content, and evidence of waste material or staining.
- Air monitoring (field screening) results.
- Types of laboratory analyses requested.

Photo Logs

- Camera and PDA (IDs).
- Date of pictures.
- Time of pictures.
- Directions of photos.
- Description of photos.
- Photographer/witness.

Safety

- All safety, accident, and/or incident reports.
- Real-time personnel air monitoring results, if applicable, or if not documented in the HASP.
- Heat/cold stress monitoring data, if applicable.
- Level of protection for tasks.
- Reasons for upgrades or downgrades in personal protective equipment.
- Health and safety inspections, checklists (drilling safety guide), meetings/briefings.
- Equipment make, model, and serial number for monitoring instruments
- Calibration records for monitoring instruments.
- Site safety meeting (time/topics).
- Site objectives/ plan of activities.
- Chemical/physical hazards.
- Personnel attending.
- Special personnel information (allergies, etc.).

Equipment

- Equipment type (make and model).
- Serial nos.
- Calibration records.
- Background readings and locations.
- Monitoring readings and locations.
- Sampler(s) initials.

Contractor Oversight Activities

- Progress and activities performed by contractors including operating times.
- Deviations of contractor activities with respect to project governing documents (i.e., specifications).
- Contractor sampling results and disposition of contingent soil materials/stockpiles.
- Excavation specifications and locations of contractor confirmation samples.
- General site housekeeping and safety issues by site contractors.
- Equipment and personnel on-site.
- Duration of equipment use vs. standby.
- Inventory of shipments received (or verification of items on packing slip).
- Document inspection of disposal trucks arriving at site (e.g., visual observation of clean tankers or truck trailers, etc.).

STANDARD OPERATING PROCEDURE G-2

CALIBRATION AND USE OF FIELD INSTRUMENTS

1. SCOPE AND APPLICATION

This SOP presents the procedures for the calibration and use of various field instruments used for screening or characterization purposes (i.e. headspace screening, water quality).

The field equipment must be properly calibrated, charged, and in good general working condition prior to the start of each workday. Calibration will provide quality assurance checks on all field equipment used during implementation of the field investigations. Each instrument will have an individual identification number and each standard will have a lot number and expiration date. These numbers will be transcribed on field data records when using a particular instrument for a sampling event. All calibration, repair, and service records will be kept in individual equipment log books maintained for each type of instrument. Field equipment that consistently fails to meet calibration standards or exceeds manufacturer’s critical limits will be promptly repaired or replaced.

All field instruments will be appropriately protected against inclement weather during the field investigation. Each instrument is especially designed to maintain its operating integrity during variable temperature ranges representative of those that will be encountered at the site. At the end of each work day, all field equipment will be stored in a cool and dry secure location.

This procedure outlines the technical requirements and operational use of the field instruments that will be used for field screening and characterization activities.

2. SCREENING EQUIPMENT

The following are examples of equipment procedures that may be performed during field investigations.

2.1 PHOTO IONIZATION DETECTOR

The PID will be calibrated per manufacturer instructions each day prior to the start of field activities. Instrument calibration will be performed using isobutylene calibration gas of known concentration (100 or 250 parts per million [ppm]). All adjustments to instrument settings will be recorded in a field log book.

2.2 CONDUCTIVITY, PH, TEMPERATURE, DISSOLVED OXYGEN, OXIDATION-REDUCTION POTENTIAL AND TURBIDITY

Each of these water quality parameters will be calibrated twice a day by on-site field personnel – once before field work begins and once at the end of the work day. All values will be documented in the field logbook or calibration field forms.

The pH function will be calibrated immediately before well development and purging using at least two buffer solutions that bracket the expected pH.

The conductivity function will be calibrated using two solutions of known value that bracket the expected ranges of conductivities.

The dissolved oxygen function will be calibrated against temperature-compensated, air-saturated water.

The oxidation-reduction potential will be calibrated using a supplied solution of known value.

The calibration of the portable turbidimeter will be evaluated by using two supplied standards within the range of anticipated sample turbidities. These standards have been carefully manufactured and are guaranteed to be accurate within one percent.

2.3 GLOBAL POSITIONING SYSTEM DEVICE

Any hand-held global position system (GPS) devices need to be in the same location coordinate system as the maps and/or reference points for each site. This will allow it to be easier to transfer data collected by the device to databases for map and report generation. In addition, the consistent coordinate systems will help the field team locate previously sampled locations if they need to return to resample.

3. FIELD QUALITY ASSURANCE / QUALITY CONTROL PROGRAM

To ensure that sampling and monitoring activities meet data quality objectives (DQOs), quality control (QC) checks will be implemented for parameters measured in the field. All QC control check information will be recorded in project-specific field log books and/or forms.

3.1 CONTROL PARAMETERS

Several parameters will be controlled during the field sampling and measurement activities. As previously described, calibration of field instruments and operational checks will be conducted periodically. The frequency of field control check duplicates will be a minimum of 10 percent of all field measurements. Temperature, pH, conductivity, dissolved oxygen, oxidation-reduction potential and turbidity will be checked at the same frequency. As applicable, the materials used to verify control parameter measurements will be from certified sources. Instrument use, maintenance, and calibration will follow manufacturer guidelines.

3.2 CONTROL LIMITS

Field instrument calibration accuracy and duplicate precision for field measurements must meet acceptance criteria, or instrument readings will be considered suspect. Appropriate corrective actions will be taken whenever field instruments fail to meet acceptance for accuracy and precision.

3.3 CORRECTIVE ACTION

The corrective action required for field instruments that are used to measure water quality parameters will include recalibrating and re-measuring the parameter. Corrective action for all field instruments will involve a review of the operator’s manual. If necessary, instrument maintenance and repairs will be performed as corrective actions in addition to normally scheduled maintenance operations. Any maintenance will be recorded in the field log book.

STANDARD OPERATING PROCEDURE G-3

SAMPLE CHAIN-OF-CUSTODY

1. SCOPE AND APPLICATION

Chain-of-custody (COC) records provide documentation of the handling of each sample. Sample custody will be initiated by the sampling team upon collection of samples and maintained until samples are relinquished to the shipping carrier for delivery to the laboratory. COC forms will be placed in waterproof plastic bags and taped to the inside lid of the cooler. The cooler will be sealed with COC seals. COC forms will be used for recording pertinent information about the types and numbers of samples collected and shipped for analysis. Sample identification numbers will be included on the COC form to ensure that no error in identification is made during shipment.

2. EQUIPMENT

COC forms
Waterproof plastic resealable bags
COC seals
Labels
Pen
Markers
Tape
Scissors

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-4	Sample Packing and Shipping

4. DOCUMENTATION

4.1 CHAIN-OF-CUSTODY RECORDS

COC procedures provide documentation of the handling of each sample. COC procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by the laboratory that will analyze the sample is maintained. The COC record serves as a legal record of possession of the sample. The COC record is initiated with the acquisition of the sample. The COC record remains with the sample at all times and bears the name of the person (field investigator) assuming responsibility for the samples. The field investigator is tasked with ensuring secure and appropriate handling of the bottles and samples. To simplify the COC record and eliminate potential litigation problems, as few people as possible should handle the sample or physical evidence during the investigation. A sample is considered to be under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession.
- The sample is in the sampler's view after being in possession.
- The sample was in the sampler's possession and then was locked up to prevent tampering.
- The sample is in a designated secure area.

4.1.1 Transfer of Custody and Shipment

All sample sets should be accompanied by a COC record. This form records each sample and the individuals responsible for sample collection, transfer, shipment, and receipt by the laboratory. The form must also contain pertinent information about the sampling location, date, and times, signature of sampling technician, types and numbers of samples collected and shipped for analysis in each lot and the project name.

Samples shall be accompanied by an approved and completed COC form during each step of custody, transfer, and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving the samples should sign, date, and note the time that he/she received the samples on the COC record. This COC record documents transfer of custody of samples from the field investigator to another person, other laboratories, or other organizational units.

Samples sent off-site for analysis must be properly packaged for shipment, and delivered or shipped to the designated laboratory for analyses. Coolers must be secured by using nylon strapping tape and custody seals (see Section 4.2). The custody seals must be placed on the container so that it cannot be opened without breaking the seals. The seal must be signed and dated by the field investigator.

One copy of the COC will be retained by the field team leader. This copy will become a part of the project file. If sent by mail, the package should be registered with return receipt requested. If sent by common carrier, an air bill should be used. Receipts from post offices and air bills should be retained. The air bill number or registered mail serial number should be recorded in the remarks section of the COC record.

4.2 CHAIN-OF-CUSTODY SEALS

The COC seal is an adhesive seal placed in areas such that if a sealed cooler is opened, the seal would be broken. The COC seal ensures that no sample tampering occurred between the field and the laboratory analysis.

These signed and dated seals will be placed across the opening crease on the lid of the cooler by the person responsible for packaging. If the coolers are opened before receipt at the laboratory, the seals will not be intact. If the COC seals are not intact, the Laboratory Project Manager will notify the contractor’s Project Chemist within 24 hours of receipt of the container. The contractor’s Project Chemist will then follow the corrective action procedures.

4.3 SAMPLE LABELS

Every sample container will receive a label. Labels will be completed using waterproof ink and will include the following information:

- Project name.
- Unique sample number.
- Sampling date and time.
- Initials of sampler.

- Sample media (soil, groundwater, etc.).
- Sample collection method (grab or filtered/unfiltered for groundwater).
- Analysis requested/chemical analysis parameters (analytes and laboratory method number).
- Method of sample preservation/conditioning.
- Remarks (such as photoionization detector readings) are useful.

4.4 POTENTIAL PROBLEMS

Although most sample labels are made with water-resistant paper and are filled out using waterproof ink, inclement weather and general field conditions can affect the legibility of sample labels. It is recommended that, after sample labels are filled out and affixed to the sample container, the container be placed in a plastic resealable bag. This will preserve the label, keep it from becoming illegible, and if the label falls off, the identification of the sample will still be known. In addition to label protection, COC and analysis request forms should also be protected when samples are shipped in iced coolers. Typically, these forms should be placed inside a plastic resealable bag or similar waterproof protection and taped to the inside lid of the secured shipping container with the samples.

5. CORRECTIONS

If an error is made, a single line should be drawn through the entry, and the entry initialed and dated. The erroneous information should not be obliterated. Any errors found in documentation should be corrected by the person who made the entry.

STANDARD OPERATING PROCEDURE G-4

SAMPLE PACKING AND SHIPPING

1. SCOPE AND APPLICATION

This section describes procedures for properly packaging and shipping environmental samples. The procedures described in this section are performed after samples have been collected and placed in the proper containers and correctly preserved. Only non-hazardous samples will be discussed in this standard operating procedure (SOP).

2. EQUIPMENT

Chain-of-custody
Custody seals
Fiber strapping tape
Ice
Waterproof cooler
Plastic resealable bags
Paper towels
Bubble wrap or other inert packing material
Air bills

3. RELATED PROCEDURES

SOP G-3	Sample Chain-of-Custody

4. PROCEDURE

Environmental samples are defined as those samples collected from environmental matrices (that are known or expected to be non-contaminated) such as soil, groundwater, or sediments that are being shipped for further testing. Environmental samples should be packaged for shipment as follows:

1. The sample container is checked to determine if it is adequately identified, and sample labels are compared to chain-of-custody.

2. All bottles are checked to ensure that the contents are secured.

3. A waterproof cooler is typically used as a shipping container. In preparation for shipping samples, if the cooler has a drain plug, the drain plug is taped shut from the outside. Approximately 3 inches of inert packing material such as bubble wrap is placed in the bottom of the container.

4. The bottles are placed upright in the cooler in such a way that they do not touch and will not touch during shipment. Bubble wrap or cardboard separators may be placed between the bottles at the discretion of the shipper.

5. All samples should be shipped to the laboratory on ice and chilled to < 6 degrees Celsius (°C), except for any samples that do not require shipment with ice. A temperature blank should be placed in the cooler so that it can be easily found by the laboratory when the cooler is first opened upon receipt.

6. Additional inert packing material is placed in the cooler to partially cover the sample bottles (more than halfway), to ensure they do not shift during transport. If samples are required to be shipped to the laboratory with ice, ice must be double bagged and placed around, among, and on top of the sample bottles. The cooler should then be filled with ice or inert packing material to prevent shifting and breakage of the contents.

7. The paperwork going to the laboratory (e.g. chain-of-custody, return air bills) is placed inside a plastic bag. The bag is sealed and taped to the inside of the cooler lid. The air bill must be filled out before the samples are handed over to the carrier. The contract laboratory should be notified by telephone of the shipment along with the estimated time of arrival. If another sample is being sent to another laboratory for analysis, or if the shipper suspects that the sample contains any other substance that would require laboratory personnel to take additional safety precautions, the individual laboratory must be notified. Also, be sure to discuss with the appropriate laboratory whether samples will be accepted by the laboratory on Saturday. If the laboratory isn't open on Saturdays, one either couldn't sample on Friday or would have to drive the samples to the laboratory so that they were received by the laboratory before closing.

8. The cooler is closed and taped shut with strapping tape.

9. Custody seals are placed on the cooler. Additional seals may be used if the sampler or shipper thinks more seals are necessary.

10. While packing each cooler for shipment, the weight limit set by the shipper is not to be exceeded.

11. The cooler is handed over to the overnight carrier. A standard air bill is necessary for shipping environmental samples. The shipper should be aware of carrier weight or other policy limitations. "Environmental Samples" may be included on the air bill to indicate

the nature of the goods. Be sure to select the “Saturday Delivery” check box on the carrier air bill if Saturday delivery is needed.

STANDARD OPERATING PROCEDURE G-5

SURVEYING

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide technical guidance for the surveying of environmental sampling locations. Sampling locations/stations covered in this operating practice include wells, piezometers, soil borings, surface soil and sediment stations, and staff gauges.

This operating practice, however, can also be referenced for surveying other data points, as necessary. The objective of this operating practice is to identify the specific data and reporting requirements for the measuring of coordinates and elevations for environmental sampling locations.

The objective of a sample location surveying effort is to provide accurate and well documented coordinate and elevation information that is referenced to an appropriate benchmark. It is equally important that the calculated coordinate and elevation information is reported in a pre-established format to facilitate the timely uploading of this information into a project's locational database. An increasing number of environmental projects have begun to use integrated geological, hydrological, analytical, and geographical databases to effectively manage, analyze, and report the large amounts of technical information. The link between the project's technical databases and the locational database provides a system for the generation of accurate data presentations (including maps and cross-sections). Thus, when planning for a survey effort, or preparing a survey Request for Proposal (RFP), the scope of work (SOW) should include a detailed explanation of the deliverable format for the survey information.

2. EQUIPMENT

Surveying equipment

3. RELATED PROCEDURES

SOP W-3 Water Level and Well Depth Measurements

4. PROCEDURE

All surveying activities shall be performed under the direct supervision of a certified land surveyor. Locations and elevations surveyed shall be measured as the distance in feet from a reference location(s), which is tied to the applicable state plane coordinate system (SPCS). The surveys shall be third order Class II control surveys in accordance with the *Standards and Specifications for Geodetic Control Networks* (Federal Geodetic Control Committee, 1984). Horizontal precision shall be to the nearest 0.1 foot. The survey data will be collected in the applicable zone of the State Plane Coordinate System, using the World Geodetic System of 1984 (WGS, 1984) as the earth datum with units of English feet or as defined by the base Common Installation Picture if one has been developed (ANG, 2009). In the SPCS, the x-coordinate is the east-west axis, and the y-coordinate is the north-south axis. All x and y values shall be positive. Elevations shall be surveyed to a precision of ± 0.01 foot and referenced to the National Geodetic Vertical Datum of 1929 (NGVD of 1929) or North American Vertical Datum, 1988 Adjustment (NAVD 88) depending on project requirements. These surveys should be connected by third order leveling to the NGVD of 1929 or NAVD 1988 in accordance with the *Standards and Specifications for Geodetic Control Networks.*

4.1 SURVEYING DRILLING/SAMPLING LOCATIONS

The surveyor will survey the location (referenced to the applicable coordinate system) and ground elevations of soil borings and surface soil sampling points. Wells and piezometers will require the following survey measurements:

- Adjacent ground surface elevation.
- Adjacent concrete pad surface elevation (center of pad).
- Top of inner casing elevation.
- State plane coordinate location of inner casing.

In most instances, wells and piezometers will have a locking cap, and will be opened and re-locked by the surveyor using keys supplied by the site or contracted personnel. Elevations for both the natural ground surface (not the concrete well pad) and inner well casings will be surveyed from pre-established reference points. Either a notch of the casing rim or an arrow point painted on the inside well casing, just below the rim, will designate a casing reference point. If no reference point is observed, the surveyor will establish a reference point. Well locations will be surveyed from the inner casing reference point.

For borings and soil samples the reference elevation equals the ground surface elevation.

The surveyor will provide only the state plane coordinates for surface water/sediment sampling points; no elevation control is required. The top of each staff gage will be surveyed for state plane coordinate and elevation information.

4.2 ELECTRONIC DELIVERABLE

Details for delivery of geospatial data are specified in the Air National Guard (ANG) A7CV Policy 08-01 (January 2008). A copy of this document is included in Appendix B of the ANG *Environmental Restoration Program Investigation Guidance* (ANG, 2009).

Each electronic file must contain the following fields or entries for each drilling/sampling location surveyed:

- Client name.
- Site name.
- Site number (NA if not applicable).
- Location ID number.
- Location type (e.g., piezometer, soil boring).
- Northing (state plane coordinate in feet).
- Easting (state plane coordinate in feet).
- Ground surface elevation (excluding surface water/sediment sampling locations).
- Concrete pad surface elevation (excluding surface water/sediment sampling locations).
- Top of inner casing elevation (for wells and piezometers only).
- Reference elevation (see below for definitions).

All fields must be filled out. If a particular field is not applicable, such as top of inner casing elevation for a soil boring location, then “NA” should be placed in that particular field.

4.3 SURVEYOR NOTES

One copy of all field notes collected during the performance of the survey effort plus any survey data reduction notes will be delivered to the contracted personnel, along with the survey electronic deliverable, and will be maintained in the project file.

All topographic survey efforts conducted under contract will be certified by a state-certified surveyor with a current surveyor’s license.

The topographic survey will be completed as near to the time of field work completion as possible. Survey field data (as corrected), including loop closures and other statistical data in accordance with the Standards and Specifications referenced above, will be provided. Closure will be within the horizontal and vertical limits given above. These data will be clearly listed in tabular form: the coordinates (and system) and elevation (ground surface and top of well), as appropriate, for all borings, wells, and reference marks. All permanent and semipermanent reference marks used for horizontal and vertical control (e.g., benchmarks, caps, plates, chiseled cuts, rail spikes) will be described in terms of their name, character, physical location, and reference value. These field data will become part of the project records.

5. BIBLIOGRAPHY

ANG (Air National Guard). 2008. *A7CV 08-01 Policy on Air National Guard Environmental Geospatial Data Deliverables.* January 2008.

ANG (Air National Guard). 2009. *Environmental Restoration Program Investigative Guidance.* September 2009.

Federal Geodetic Control Committee. 1984. *Standards and Specifications for Geodetic Control Networks.*

STANDARD OPERATING PROCEDURE G-6

DECONTAMINATION

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the normal decontamination of sampling and site equipment. To minimize the possibility of cross-contamination of samples (contamination of a sample by chemicals picked up at another area and transferred to an analytical sample by sampling or drilling equipment), proper decontamination procedures must be followed consistently. All personnel or equipment involved in intrusive sampling or entering an area during intrusive sampling must be thoroughly decontaminated prior to sampling and prior to leaving the site to minimize the spread of contamination and prevent adverse health effects.

Generally, solvents are used to remove organic compounds, such as volatile organic compounds (VOCs); nitric acid (HNO_3) is used to remove residual metals; and detergent wash and/or steam cleaning are used to remove gross contamination and soil. All material and equipment should arrive intact and in clean condition. Recommended procedures for equipment decontamination during drilling, sampling, and other field investigation procedures are described in the following sections.

2. EQUIPMENT

Plastic sheeting, buckets, etc. to collect wash water and rinsates
Approved potable water
Deionized (DI) water
Medical-grade isopropanol or equivalent
Reagent grade 0.10N nitric acid (HNO_3)
Non-phosphate laboratory detergent (Liquinox)
Aluminum foil or clean plastic sheeting
Pressure spraying, rinse bottles, brushes
Plastic garbage bags

3. RELATED PROCEDURES

G-7 Management of Investigation Derived Waste

4. PROCEDURE

4.1 SAMPLE BOTTLES

At the completion of each sampling activity, the exterior surfaces of the sample bottles must be decontaminated as follows:

- Be sure the bottle lids are on tight.
- Wipe the outside of the bottle with a paper towel to remove gross contamination.

4.2 SOIL SAMPLING EQUIPMENT

Sampling equipment that will be used includes materials such as stainless steel bowls, trowels, scoops, and split-spoons. Equipment to be used during sampling will be decontaminated at a centralized decontamination area site at which the equipment is being used. All sampling equipment will be decontaminated after use to prevent cross-contamination between sampling points. Decontaminated equipment will then be wrapped in aluminum foil with the shiny side facing out. No sampling debris will be left on any site.

The procedure for decontaminating sampling equipment is as follows:

- Place dirty equipment on a plastic ground sheet at the head of the decontamination line.
- Rinse equipment with potable water to remove surface dirt and mud if necessary.
- Scrub equipment with a bristle brush using a non-phosphate detergent (e.g., Liquinox) and potable water. To clean the inside of a bailer, use a bottlebrush pulled through the bailer with a polypropylene cord.
- Rinse off soap with potable water.
- Using a squirt bottle, rinse with 10% ultrapure HNO_3 (use 1% HNO_3 for metallic sampling materials) if equipment will be used for the collection of metals samples. Collect HNO_3 rinsate in a tub or bucket.

- Rinse with American Society for Testing and Materials (ASTM) Type II reagent-grade water.

- For equipment used to collect samples analyzed for organics, rinse with medical-grade isopropanol or equivalent. Collect solvent rinsate in a tub or bucket separate from the HNO_3 rinsate.

- Rinse with ASTM Type II reagent-grade water.

- Allow equipment to air dry.

- Wrap equipment with aluminum foil (shiny side facing out).

- Sampling equipment used to collect samples for organic analyses will not be allowed to contact any type of plastic after decontamination.

- Equipment that can not be washed and rinsed (e.g., PID) should be covered with a plastic bag while sampling, with only the probe tip exposed.

At the end of the decontamination procedures, the proper disposal of the decontamination liquids will include the following steps:

- Discharge potable water in the decontamination area.

- Rinse soapy washtub in the decontamination area only.

- Dilute the detergent wash water and discharge it in the decontamination area.

- Overturn tubs to allow them to drain.

- Rinse tub bottoms and stack tubs for future use.

- The isopropanol, HNO_3, and DI rinse should be placed in a designated 55-gallon drum or other designated container for future characterization and disposal.

4.3 DRILLING EQUIPMENT

Drilling rigs will arrive on-site in clean condition and will be inspected by a field geologist. After arrival at the site, all equipment, tools, and tool storage areas that will be used in the drilling, sampling, and completion of the soil borings and monitor wells will be steam cleaned before initiating drilling at any site to remove road dirt. The frequency and procedures for decontamination of drilling equipment are as follows:

- The drill rig and all equipment will be steam cleaned when they are moved to new sites, or more often if required by the field personnel.

- The drill rig (i.e., deck derrick and undercarriage) will not be steam cleaned between soil borings and wells at the same site unless gross contamination is present on the rig that could fall off and enter subsequent boreholes. It is very important during this initial decontamination of the rig to check the threads of the drilling rods and drilling bits for grease, and to remove it (with a wire brush and Liquinox detergent) if it is present. The only allowable "lubricant" on the threads is Teflon tape.

- The surfaces of the drilling equipment, including drill rods, augers, bits, and associated tools (including any tape measures), will be decontaminated at a central site-specific decontamination area using the following procedures:

  - Remove gross amounts of mud/soil using a shovel, wire brush, or other tools.

  - Transport drill rig and tools to site decontamination area.

  - Steam clean the equipment thoroughly, using a brush to remove any particulate matter or surface film. If the equipment is still not clean, proceed to the following steps. Otherwise allow the equipment to air dry.

  - If necessary, use a brush and a phosphate-free detergent/potable water solution to scrub the drilling tools that may enter a subsequent borehole. Use a brush to remove any clinging soil or surface film. If the soil/mud on the tools can be easily removed by steam cleaning, this step can be skipped.

  - Rinse the equipment thoroughly with potable water and allow it to air dry.

  - Drill rods and manmade well construction materials will be decontaminated on a steel rack (one set per rig on-site), provided by the driller, that keeps the piping 2 or 3 feet above the ground. Precautions should then be taken, by using plastic sheeting, to ensure that decontaminated casing, augers, and other equipment do not come into contact with the ground and that the storage areas on the drill rig or tender are clean.

- During split-spoon sampling, subcontractor personnel may be required to help decontaminate the used split-spoons by performing the initial gross cleaning of the split-spoon using a Liquinox (or equivalent) solution and scrub brushes. Field personnel will supervise the initial cleaning and then complete the balance of the decontamination procedures. If, because of sample preparation or description activities, the on-site field personnel are unable to complete the decontamination in a timely manner and subcontractor personnel are waiting for split-spoons, standby charges will not be incurred. It will be the responsibility of the subcontractor personnel to complete the split-spoon decontamination, including solvent rinse, under supervision.

4.4 FIELD PARAMETER EQUIPMENT

- Water level indicators and transducers used for measurement of water in wells and in surface waters will be decontaminated after each use by flushing with ASTM Type II reagent-grade water prior to and after each use. If floating product or high levels of organic contamination are evident, or known to exist in a well, the full sampling decontamination procedure outlined in Subsection 4.2 will be employed.
- Water quality instrument probes will be flushed with ASTM Type II reagent-grade water between measurements. No solvents will be used to clean these probes.
- Turbidimeter sample vials will be wiped dry after being filled with a sample and prior to insertion into the turbidimeter. After the measurement is taken, the sample vial and the turbidimeter will be flushed with ASTM Type II reagent-grade water.

4.5 SUBMERSIBLE PUMP

All submersible pumps used for sampling or for well development will be decontaminated after use to prevent cross-contamination between wells. The procedure for decontaminating submersible pumps is as follows:

- Scrub pump and cord in a tub of Liquinox and potable water.
- Pump (or recirculate) at least 20 gallons of the soapy water through the pump.
- Rinse with potable water.
- Pump (or recirculate) at least 20 gallons of rinse water through the pump.
- Rinse with DI water.
- Place pump in a decontaminated, plastic garbage can, or wrap it in clean plastic.

After decontamination, the proper disposal of the decontamination liquids includes the following steps:

- Drain wash water and rinse in decontamination area.
- Rinse decontamination containers with potable water.
- Allow containers to dry overnight.

5. PRECAUTIONS

- Dispose of all wash water, rinse water, rinsates, and other sampling wastes (e.g., tubing, plastic sheeting) in properly marked, sealable containers, or as directed.
- Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.
- Follow the health and safety plan in regard to personal protective equipment (PPE), especially with regard to eye protection and gloves.

STANDARD OPERATING PROCEDURE G-7

MANAGEMENT OF INVESTIGATION DERIVED WASTE

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

The purpose of this SOP is to describe the requirements for investigation derived waste (IDW) management. The requirements of these procedures are applicable to management for wastes generated as a result of field sampling and characterization activities and not yet characterized by laboratory analysis as hazardous or non-hazardous wastes. The goal of IDW management is to minimize the amount of waste generated while following applicable regulations. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to commencing sampling of remediation, management of the IDW must be discussed with the on-site Environmental Manager and regulatory agencies For example, possible alternatives to storage of a large quantity of drums (which may be disruptive to some sites) should be identified, and concurrence obtained, before such wastes are generated (ANG, 2009). The storage location must be selected in consultation with the on-site Environmental Manager.

Any container used for IDW will be U.S. Department of Transportation (DOT) approved. Drums will not be stacked on top of each other and will be stored in rows not larger than two drums wide, with labels facing outward for identification. Decontamination fluids and other low-volume fluids may be temporarily stored and transported in 5-gallon buckets with lids.

Different residual materials (e.g., soil and water) will not be drummed together, but will be placed in separate drums. Field screening will be used to drum materials with similar levels of contamination together, if possible.

2. EQUIPMENT

DOT-approved drums or other containers
Funnels
5-gallon buckets
Photoionization detector (PID) or other appropriate instrumentation
Labeling material

3. RELATED PROCEDURES

SOP G-2	Calibration and Use of Field Instruments
SOP G-6	Decontamination

4. IDW MANAGEMENT

All soil cuttings, excess samples, water from well sampling and development, and decontamination water will be placed in drums or other appropriate containers. Drums will be sealed and labeled in accordance with labeling procedures. Liquids drums will contain removable bungs. Funnels will be used to prevent spillage when adding liquids to the drums. As necessary, IDW-filled drums will be transported to the secure staging area at the site in accordance with applicable DOT, federal, and state regulations.

The IDW-filled drums will be sampled to determine whether they contain materials classified as Resource Conservation and Recovery Act (RCRA) hazardous wastes as required by the local disposal facilities. IDW-filled drums containing RCRA hazardous wastes must be shipped off-site within 90 days.

The Air National Guard policy *CEV Policy 05-1 for IDW/RDW* (March 2005) or *Environmental Restoration Program Investigation Guidance,* Appendix B (September 2009) will be used to assist the contractor in IDW management where necessary.

4.1 PERSONAL PROTECTIVE EQUIPMENT AND OTHER DISPOSABLES

Project-specific provisions should be made prior to disposal of IDW. Do not assume bagged waste can be disposed of in any dumpster. All non-contaminated disposable wastes such as bags, washed gloves, and material scrap, will be kept separate from other wastes. This material will be bagged or otherwise contained and disposed of in a site dumpster or other appropriate and approved location.

Contaminated disposable wastes may include disposable personal protective equipment (PPE) and contaminated equipment. This material will be placed in wrangler-type boxes unless field screening results of soil and/or waste residuals indicate non-elevated results.

5. DISPOSAL OPTIONS

Wastes that have been drummed based on field criteria may be sampled for laboratory analysis to determine the appropriate type of disposal facility. The number of samples collected will depend on the homogeneity of the drummed material, the nature of the source areas, and the requirements of the disposal facility.

IDW characterized or listed as hazardous waste will be managed and disposed of in a manner consistent with local and state guidance, and federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and/or RCRA or Toxic Substances Control Act (TSCA) guidelines.

IDW determined to be non-hazardous waste will be managed and disposed of in accordance with state and/or local guidelines.

5.1 IDW SAMPLING

Soil cuttings, groundwater, and rinse water generated during soil and groundwater sampling will be sampled and analyzed in accordance with local disposal requirements.

For soil cuttings placed in drums, each drum will be opened and scanned using a PID. A soil column from each drum will be removed, and a composite sample will be collected from grab samples from all drums using the following methods when required for waste characterization:

- For volatile analyses, four aliquots will be randomly collected from each drum. The aliquots will be composited in a separate 4-ounce jar for IDW analysis of Resource Conservation and Recovery Act (RCRA) VOCs by toxicity characteristic leaching procedure (TCLP).
- For nonvolatile analyses, sample aliquots will be collected and placed in a new disposable bucket liner and homogenized for one minute. One sample will then be collected directly into the sample container for each analysis.
- Samples will be analyzed for parameters in accordance with local landfill requirements.

Investigation-derived water will be containerized into one or more drums per site. Water from each drum in the IDW storage for each site will be composited in a new, clean bucket-liner and then an IDW sample will be collected from the composited bucket-liner into containers specific for each analysis as required by local disposal facility requirements.

Following soil and water collection samples will be labeled, preserved and shipped as per sample handling and shipping specified in UFP-QAPP Worksheet #27. These IDW samples will then be treated as any other water sample being sent to the laboratory.

The field personnel will provide a preliminary waste characterization for the containerized IDW based on RCRA characteristics and flash point. The Project Chemist will review the analytical data to determine if the waste exhibits a hazardous waste characteristic as identified at 40 Code of Federal Regulations, Part 261, Subpart C and recommend a disposal option. The preliminary waste characterization will be submitted to the on-site Environmental Manager or representative for review and for waste determination (including determination on whether the IDW is regulated as a listed hazardous waste).

If wastes are determined to be protective for onsite disposal, the on-site Environmental Manager or representative will designate an onsite disposal area for soil and water disposal. If wastes require off-site disposal, once the manifest(s) and other appropriate documentation is signed by the on-site Environmental Manager or representative, the contractor will coordinate the pickup and provide the transporter with the relevant portions of the manifest on behalf of the site. The Contractor will provide the on-site Environmental Manager or representative with the original generator copy of the waste manifest subsequent to release of the shipment. The treatment/disposal facility-signed generator copy should be returned directly to the Project Manager by the treatment/disposal facility within 30 days of shipment. The Project Manager will forward the required copy to the client and/or appropriate agency contacts.

5.2 LABELING

Pending a determination of whether the IDW is hazardous or non-hazardous, containers will be labeled on the side using a weather-resistant paint pen. The following information will be included:

1. Container number.
2. Contract and delivery order number.
3. Contents (development water and well identifiers).
4. Dates of development activities.
5. On-site Environmental Manager name and phone number.

Only IDW pending analysis may be labeled. Any wastes known to be RCRA or TSCA wastes based on knowledge of the waste material must be managed as RCRA or TSCA at the point of generation. Upon receipt of analytical results for those IDW containers, the respective containers must immediately be managed appropriately.

6. BIBLIOGRAPHY

ANG (Air National Guard). 2005. *CEV 05-1 Policy on Air National Guard Investigation or Remediation Derived Waste Management.* March 2005.

ANG (Air National Guard). 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

STANDARD OPERATING PROCEDURE G-8

UTILITY LOCATION

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide technical guidance for locating underground utilities that may lie within the study area. It is imperative that all efforts be made to locate possible utilities so there would be little risk of damaging the utilities when the field work is underway.

2. PROCEDURE

2.1 FIELD WORK PREPARATION

Prior to any intrusive work, the contractor will work with the Site Environmental Manager to follow project-specific requirements and current Facility requirements for Dig Permits. Careful planning plays an important role and is the first step in utility damage prevention efforts. Health and Safety Plans for projects that include subsurface drilling or excavation will include a Site-Specific Hazard Analysis for, but not limited to, safety and provisions for utility line damage prevention.

In addition to following the project-specific and facility-specific requirements for dig permitting, the contractor will subcontract a third-party utility location subcontractor whose task will be to determine the actual location of all known and unknown utilities through:

(a) Careful review of the civil/utility drawings;

(b) Careful evaluation aboveground features such as, but not limited to, manhole investigation (lifting manhole covers), valve boxes and pipe and cable risers, which indicate the location of underground utilities; and

(c) Use of geophysical techniques to identify subsurface utilities and manmade underground features.

The utility location subcontractor will mark all utilities in a work area and provide utility maps of their utilities location determinations prior to subsurface work. Surface marking will use stakes, flags, paint or other clearly identifiable materials to show the field location of underground utilities in accordance with current color code standards such as the American Public Works Association.

It is mandatory that the pertinent State utility location service center be notified and that each location of intrusive work is cleared by the proper authority prior to conducting subsurface work. The service center must be called at least two days before excavation and clearance. This process is initiated with a call to the local utility locate service center, requesting locates be made and providing accurate location of the drill site.

2.2 DURING FIELD EFFORTS

If there is any indication that the drill may have encountered a man-made obstruction within the first 10 feet below ground surface, operations will stop immediately, and the excavation will be investigated prior to proceeding with subsurface work to determine if an unknown or improperly located utility may have been encountered.

If an existing utility is damaged, the contractor project manager will be notified immediately. The onsite Field Manager will document the damage and pertinent circumstances surrounding the incident as soon as possible (in writing and with photographs or video), and a detailed incident/accident report will be prepared. The utility will be repaired immediately by a licensed contractor with final approval of the repair given to the owner of the utility.

STANDARD OPERATING PROCEDURE G-9

FIELD FILTRATION

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) outlines techniques for the filtration of liquid media (i.e., groundwater and surface water). There are two general methodologies for liquid filtration, (1) in-line filtration, where the filter assembly is under positive pressure, and (2) vacuum filtration, where the filter assembly is under negative pressure. This procedure will address only in-line filtration. Filtration of aqueous samples is performed when the removal of silt, algae, particulate, and other debris is desired. Filtration is employed predominantly when water samples are to be tested for dissolved metals. Filtered samples for metals (dissolved fraction) and other strongly sorbed contaminants should be analyzed in conjunction with non-filtered samples to determine the concentration in solution versus metals associated with solids.

Because most filtration will be for the purpose of determining “dissolved” versus total metals, these instructions assume a filter pore size of 0.45 micrometer (µm). Analytical methods used to determine dissolved contaminant concentrations have historically used 0.45-µm filters to separate dissolved and particulate phases. Filters with pore sizes less than 0.45 µm may be necessary in certain circumstances.

2. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-6	Decontamination

3. PROCEDURE

3.1 POSITIVE PRESSURE FILTRATION

Aqueous samples that may require positive pressure filtration include groundwater samples and surface water samples. To filter an aqueous sample using the positive pressure technique, a pump, filter, and tubing are required. The following are examples of equipment that may be used for positive pressure in-line filtration. Positive pressure filtration is the preferred filtering method.

3.1.1 Pump

Pump System
High Flow Range: 3 - 2,300 milliliters per minute (mL/min)
Low Flow Range: 6 - 460 mL/min
System Flow Control: ± 10%

3.1.2 Filter Assembly

Groundwater Sampling Capsule
Pore Size: 0.45-µm or less
Tapered Barb Fitting: ¼-inch to ½-inch
Continuous Use Pressure: 60 pounds per square inch (psi) @ Ambient
Maximum Momentary Pressure: 100 psi @ Ambient

3.1.3 Filtration Procedure

- Use polytetrafluoroethylene (PTFE) tubing for pump and filter connections.
- Connect the 0.45-µm in-line filter to the discharge tubing from the pump. Ensure that the flow arrow on the filter is pointing in the correct direction.
- Place the pump into the water body (e.g., groundwater, surface water) to be sampled. This placement of the pump will prevent the water from coming into contact with the atmosphere, which might cause the dissolved metals to precipitate out, thus biasing the data low. If a peristaltic pump is used, the end of the pump's tubing is placed below the water body surface.
- Apply pressure to the liquid sample (via pump) to force it through the filter into a sample container.

- Replace the in-line filter when the flow becomes too restricted because of buildup on the filter. To replace the filter:
    - Discontinue pumping (turn off pump).
    - Relieve the pressure in the system (line between the pump and the filter).
    - Disconnect the filter and replace with a new one.

4. POTENTIAL PROBLEMS

One inherent problem associated with the filtration of aqueous environmental samples is the filter becoming clogged. The following are some considerations regarding liquid filtration:

- Always have extra filters available at the sampling site.
- Pre-filter dirty samples with a larger pore size filter.
- For highly turbid samples, a negative filtration system may be more efficient.

When the filtrate flow becomes too slow because of filter loading, change the filter. Avoid increasing the pressure and rupturing the filter membrane.

STANDARD OPERATING PROCEDURE SS-1

SOIL SAMPLING

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

Instructions presented in this SOP are for collecting representative soil samples. Soil sampling can be classified into two primary types: surficial and subsurface. Instructions for sampling surficial soil included in this section utilize the spade and scoop. Instructions for sampling subsurface soil included in this section utilize the following techniques: split spoon sampler and thin-walled (Shelby) tube. There are also specific sampling protocols presented for riverbank and/or floodplain sampling using hand augering.

2. EQUIPMENT

Field logbook
Muncell color chart
Grain size card
Clipboard
Folding rule (in feet and tenths)
Pocket penetrometer (if required)
Indelible ink markers
Squirt bottle (with deionized water)
Plastic sheeting
Paper towels
Pens (blue or black)
Eye protection
Work gloves
Surgical or nitrile gloves

Sample jars
Sample jar labels
Chain-of-custody forms
Photoionization detector (PID)
Decontamination materials
Appropriate sampling device

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-3	Sample Chain-of-Custody
SOP G-5	Surveying
SOP G-6	Decontamination
SOP G-7	Management of Investigation Derived Waste
SOP W-5	Borehole/Well Abandonment

4. PROCEDURE

4.1 SAMPLING LOCATIONS

Sampling at sites is usually conducted in an attempt to discover contamination and to define its extent. With such an objective, it is most logical to choose sample locations that will yield the most information about site conditions. Because of the nature of the media, soil samples can vary considerably across a site. Physical properties of the soil, including grain size and cohesiveness, may limit the depth from which samples can be collected and the method required to collect them. In most soil, hand-powered equipment can be used only to a depth of approximately 4 to 5 feet. At greater depths, soil sampling is normally performed with a drill rig or other mechanically driven device.

4.2 SAMPLE TYPES

The type of sample should be designated when selecting a sampling method. Application techniques for sample methods include discrete (grab) or composite samples. A discrete (grab) sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected immediately and at one particular point in the sample matrix. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease. Composites are samples composed of two or more specific aliquots (discrete samples) collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask the presence of contaminants by diluting isolated concentrations of analytes that may be present in the environmental matrix.

4.3 SAMPLE COLLECTION

Each sampling technique presents various advantages and disadvantages for its application. For example, sample disturbance, sample volume, chemical/physical reactivity between potential contaminants and sampling tool materials, and ease of decontamination vary from technique to technique. Subsurface soil conditions themselves will restrict the application of certain samples. For example, the thin-walled tube sampler is not applicable for sampling sands.

Typically, a minimum of 2 soil samples are collected from each soil boring and sent to a laboratory for confirmatory testing. Soil sample intervals and quantities must be selected based on data objectives, site-specific conditions and the nature of the suspected source. Typically, one sample is collected at the surface (0 to 6 inches below ground surface or as specified by the applicable regulatory agency). A second sample is typically collected from just above the water table or bedrock interface or the bottom of the borehole, as appropriate. Additional samples are typically collected at intermediate depths from the most contaminated interval based on PID readings, visual/olfactory indications, or based on a change in lithology or other distinguishing physical characteristics of the material (ANG, 2009).

Presented below are sampling instructions for the most common techniques of collecting soil samples. Prior to sample collection, the soil sampling location and characteristics (e.g., soil type, depth) should be recorded in the field logbook. Selection of soil sampling equipment is usually based on the depth of the samples. Manual techniques are usually selected for surface or shallow subsurface soil sampling. At greater depths, mechanically driven equipment is usually required to overcome torque induced by soil resistance and depth.

4.3.1 Surficial Sampling

4.3.1.1 Spade and Scoop

The spade and scoop method is a very accurate, representative method for collecting surface and shallow subsurface soil samples. This method is usually limited to soil depths less than 1 foot.

Method Summary and Equipment

The simplest, most direct method of collecting surface soil samples is to use a spade and stainless steel or plastic scoop. A typical garden spade can be used to remove the top cover of soil to the required depth, and the smaller stainless steel scoop can be used to collect the sample.

Sampling Procedure

- Carefully remove the top layer of soil to the desired sample depth with a pre-cleaned or decontaminated spade.
- Using a pre-cleaned or decontaminated stainless steel scoop or trowel, collect the sample aliquot for volatile organic compound (VOC) analysis first (if applicable), then homogenize enough soil in a stainless steel bowl for the remaining sample containers.
- Transfer sample into the appropriate sample bottle with a stainless steel laboratory spoon or equivalent.
- Remove any soil clinging to the bottle threads or rim, and secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Complete the label carefully and clearly, addressing all the categories or parameters.
- Place filled sample containers on ice immediately.
- Complete all chain-of-custody documents and record in the field.
- Prepare samples for shipping.
- Decontaminate sampling equipment after use.

4.3.2 Subsurface Sampling

Soil samples must be collected in accordance with applicable state requirements. If state guidance does not specify how soil samples must be collected, standard grab samples may be collected from the DPT liner or HSA split spoon, as applicable.

4.3.2.1 Split-Spoon Sampler

The split spoon sampler is used for sampling subsurface soil in cohesive and non-cohesive type soils. It is used extensively for collecting subsurface soil samples for chemical analysis. The split spoon sampler will require a drill rig and crew for collecting samples at a depth greater than 5 feet. The split-spoon sampler will be the primary subsurface sampling device used.

Method Summary and Equipment

The split spoon sampler is typically a 2- or 3-inch-diameter, thick-walled, steel tube that is split lengthwise. If a 2-inch-diameter split spoon sampler is used, then standard penetration tests can be taken to determine the density of the soil (ASTM D1586). A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to the drill rods. When a boring is advanced to the point that a sample is to be taken, drill tools are removed, and the sampler is lowered into the hole on the bottom of the drill rods. The sampler is driven into the ground in accordance with the standard penetration test.

Sampling Procedure

- Assemble the sampler by aligning both sides of the barrel and then screwing the drive shoe on the bottom and the heavier headpiece on top.
- Place the sampler in a perpendicular position on the material to be sampled.
- Drive the tube, utilizing a sledge hammer or drill rig if available. Do not drive past the bottom of the headpiece because this will result in compression of the sample.
- Record the length of the tube that penetrated the material being sampled and the number of blows required to obtain this depth. Typically, the number of blows per 6 inches of depth is recorded.

- Withdraw the sampler and open it by unscrewing the drive shoe and head, and splitting the barrel. If split samples are desired, a decontaminated stainless steel knife should be utilized to split the tube contents in half longitudinally.
- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media.
- If homogenization of the sample location is appropriate for the remaining analytical parameters or if compositing of different locations is desired, the sample is transferred to the stainless steel bowl for mixing.
- Transfer sample into an appropriate sample bottle with a stainless steel laboratory spoon or equivalent.
- Remove any soil clinging to the bottle threads or rim, and secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Be sure to label the bottle carefully and clearly, addressing all the categories or parameters.
- Place filled sample containers on ice immediately.
- Complete all chain-of-custody documents and record in the field.
- Prepare samples for shipping.
- Decontaminate sampling equipment after use and between sampling locations.

4.3.2.2 Thin-Walled (Shelby) Tube Sampler

Applicability

Thin-walled tube samplers allow collection of undisturbed samples in cohesive type soil (i.e., clays). They are primarily used for collecting soil samples for certain geotechnical tests. Thin-walled tube samplers are not the ideal container for transporting samples to the laboratory for chemical analysis. The opportunity for describing the soil is diminished because most of the soil is concealed in the tube. The Shelby Tube will be used only in clayey material where an undisturbed sample is required, and the field crew has specifically been instructed to use a Shelby Tube sampler.

Method Summary and Equipment

The thin-walled tube sampler is designed to take undisturbed samples in cohesive type soils. The thin-walled tube sampler is available in brass, galvanized steel, plain steel, or stainless steel, and is manufactured in either 30- or 36-inch lengths. It is available in 2-, 3-, and 5-inch diameters; however, the 3-inch diameter is the most commonly used. Thin-walled tube samplers are usually used for sampling cohesive soils for geotechnical evaluation, rather than chemical analysis.

Sampling Procedure

- Place the sampler in a perpendicular position on the material to be sampled.
- Push the tube into the soil by a continuous and rapid motion, without impact or twisting. In no instance should the tube be pushed further than the length provided for the soil sample.
- When the soil is so hard that a pushing motion will not penetrate the sample sufficiently for recovery, it may be necessary to collect a disturbed sample with the split-spoon sampler. Extremely dense and hard soil may result in damage to the thin-walled tube sampler.
- Before pulling out the tube, rotate the tube at least two revolutions to shear off the sample at the bottom. For geotechnical analysis, seal the ends of the tube with wax or rubber packers to preserve the moisture content. In such instances, the procedures and preparation for shipment should be in accordance with ASTM Method D1587. For chemical samples, seal the ends of the tube with teflon-lined plastic caps or equivalent. Seal each end cap with plastic electrical tape.
- Label the sample tube with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents and record in the field.
- Prepare samples for shipping.
- Decontaminate sampling equipment after use and between sampling locations.

4.3.2.3 Hand Augering—Riverbank and Floodplain Sampling

Instructions presented in this SOP are for collecting representative soil samples at riverbank and/or floodplain locations.

Applicability

Hand augering is an accurate and efficient method for sampling soil. Soil samples are removed at discrete depths. Hand augering proves inefficient where the subsurface contains large gravel, or when the surface and subsurface are frozen.

Method Summary and Equipment

The auger is attached to an auger handle. Typically, there are three standard size augers available for use (with internal diameters of 4, 2, and 1 inch, respectively). A single auger can be used to collect a discrete sample at a specified depth or the augers can be used in succession (from highest to lowest internal diameter) to take discrete samples at different depths at the same location.

Sampling Procedure (discrete samples/different depths)

- Attach the 4-inch internal diameter auger on the auger handle.
- Clear the area of any vegetation, if necessary.
- Begin augering at the sample location. Auger to a depth of 6 inches.
- Remove all soil from the auger and place in a clean stainless steel bowl for homogenizing. This is the first sample with a depth of 0 to 6 inches bgs.
- If it is too difficult to auger to a depth of 6 inches, remove soil sequentially until reaching the 6-inch depth.
- After collecting the first sample, use the same auger (4-inch internal diameter) to auger the soil from 6 to 12 inches bgs and intervals beyond.
- Replace surgical gloves (to prevent cross-contamination) between sample intervals.
- Document the soil description and place soil in desired jars as necessary. Label the jars with the correct sample identifier (ID) number and other necessary information.
- Place the sample jars in a cooler filled with ice as soon as possible.
- Repeat this procedure for other soil samples. If any soil remains, place in the same sampling hole to avoid spreading possible contamination.
- Prepare samples for shipping.
- Decontaminate all sampling equipment after use and between sampling locations.

4.4 FIELD MEASUREMENT PROCEDURES

The purpose of this section is to identify methods for field screening soil. Visual assessment and instrument readings will be used to screen field samples and residual samples. Residual materials may include excess samples, cuttings, and other materials.

4.4.1 Preparation

- Review screening procedures and equipment operation manuals.
- Calibrate field screening instruments in accordance with the manufacturer's instructions and operating procedures (see **SOP G-2**).
- Document calibrations in the field logbook.
- Determine the ambient air temperature. If the ambient air temperature is below 15 C, select an area where soil samples can be kept warm for head space readings.

4.4.2 Field Screening

Prior to and during collection of a soil or sediment sample, visually observe the sampling area, and sample for signs of releases that include the following:

- Surface discoloration or staining.
- Stressed or discolored vegetation.
- Physical evidence of hydrocarbons or other contamination.

Record visual observations of the sampling area in the field logbook. Include a sketch and dimensions of any area where visual signs of a release are observed.

4.4.3 Instrument Readings

Take instrument readings prior to sampling to monitor ambient air for health and safety purposes. Record this information in the field logbook.

Soil and/or sediment headspace readings are taken in the following manner:

- Each soil core will be field screened for VOCs by collecting an aliquot from every each 2-ft interval of the core.
- If the ambient temperature is low, bring the bagged samples to an area where they can be warmed.
- Place the representative aliquots into a small, plastic, sealable bag and allow soil to volatilize.
- Insert the probe into a small opening in the bag, but not into the sample since this will clog the instrument. Record the instrument reading of the area on the log reserved for headspace readings.

- Dispose of the bagged sample in accordance with residual management protocols.

4.5 SOIL SAMPLING FOR VOLATILE ORGANIC COMPOUNDS AND GASOLINE RANGE ORGANICS

4.5.1 Terra Core^{TM} Sampler

The Terra Core^{TM} Sampler has been approved for collection of samples, and this method is the preferred sampling method for use at the site. The Terra Core Sampler (or equivalent) selects a small volume (about 5 grams) of soil that is submitted to the analytical laboratory.

Three Terra Core ^{TM} sampling kit per sample includes:

- One Terra Core^{TM} sampler that collects a 5-gram aliquot
- One methanol-preserved 40-mL volatile organic analyte (VOA) vial for high level analysis
- Two 40-mL VOA vials containing stir bars for undiluted/low level analysis
- One 2 or 4-ounce sample jar for moisture determination.

The following is the procedure for using the Terra Core^{TM} kit

- With the plunger seated in the handle, push the Terra Core^{TM} sampler into freshly exposed soil until the sample chamber is filled. A filled chamber will deliver approximately 5 grams of soil.
- Wipe all soil or debris from the outside of the Terra Core^{TM} sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.
- Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the 40 mL VOA vials and extrude the sample by pushing the plunger down.
- Quickly place the lid back on the 40-mL VOA vial. When capping the 40-mL VOA vial, be sure to remove any soil or debris from the top and/or threads of the vial.
- Collect sample for the 2 or 4-ounce jar using the bulk soil collection technique.

4.5.2 EnCore^{TM} Sampler

The EnCore^{TM} Sampler can also be used for collection of samples. The EnCore Sampler (or equivalent) selects a small volume (about 5 grams) of soil that is stored in a chamber that is submitted to the analytical laboratory. *The sample must be received, prepped, and analyzed within 2 days of collection; therefore, all samples must be shipped the day they are collected.*

Two or three EnCore^{TM} samplers will be required per analytical sample:

- One EnCore^{TM} sampler for low-concentration analysis.
- One EnCore^{TM} sampler for high-concentration analysis or low-concentration duplication.
- One EnCore^{TM} sampler for repreparation.
- One 2 or 4 ounce jar for moisture determination.

The EnCore^{TM} Sampler is a single use device. It can not be cleaned and/or reused. The following is the procedure for using the EnCore^{TM} Sampler:

- Hold the coring body and push the plunger rod down until the small o-ring rests against the tabs. This will ensure that the plunger moves freely.
- Depress the locking lever on the EnCore^{TM} T-Handle. Place the coring body, plunger end first, into the open end of the T-Handle, aligning the two slots on the coring body with the two locking pins in the T-Handle.
- Twist the coring body clockwise to lock the pins in the slots. Check to ensure the sampler is locked in place. The sampler is now ready for use.
- Turn the T-Handle with the T up and the coring body down. This positions the plunger bottom flush with the bottom of the coring body (ensure that the plunger bottom is in position).
- Using the T-Handle, push the sampler into the soil until the coring body is completely filled. When full, the small o-ring will be centered in the T-Handle viewing hole.
- Remove the sampler from the soil and wipe any excess soil from the exterior of the coring body.
- Place a cap on the coring body while it is still in the T-Handle. Push and twist the cap over the bottom until the grooves on the locking arms seat over the ridge on the coring body. The cap must be seated to seal the sampler.

- Remove the capped sampler by depressing the locking lever on the T-Handle while twisting and pulling the sampler from the T-Handle.
- Lock the plunger by rotating the extended plunger rod fully counter-clockwise until the wings rest firmly against the tabs.
- Attach a completed circular label from the EnCore™ Sampler bag to the cap on the coring body.
- Complete the outside label on the EnCore™ Sampler bag and add a custody seal.
- Return the full EnCore™ Sampler to a resealable plastic bag. Seal the bag and place on ice.

It should be noted that EnCore™ Samplers can be used for all soil sampling activities, i.e., surface soil, sediment, etc., by sub-sampling the sampling device (e.g., shovel, coring device, split spoon). In a soil matrix that is noncohesive, the EnCore™ Sampler's plunger can be retracted, filled with the required sample volume, and then capped.

5. BIBLIOGRAPHY

ANG (Air National Guard), 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

STANDARD OPERATING PROCEDURE SS-3

SOIL SAMPLING USING HOLLOW STEM AUGER TECHNOLOGY

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

The objective of this SOP is to provide guidance and general reference information on soil sampling using hollow stem auger technology (HSA) and collecting representative soil samples at depth and recovering them for visual inspection and/or chemical analysis.

HSA drilling techniques use large diameter (up to 14-inch outside diameter [OD]) continuous-flight augers, which mechanically excavate drilled materials from the hole. These augers are built with a large (up to 10.25-inch inside diameter [ID]) axial opening to allow access to the bottom of the hole without withdrawing the auger string. The augers act as temporary casing during and at the completion of drilling to facilitate the sampling of sediment and water and the installation of monitoring wells.

2. EQUIPMENT

HSA drill rig and tooling
Vinyl end caps and Teflon tape (if required)
Trash bags
Paper towels
Field logbook
Work plan
Folding ruler marked in tenths of an inch
Tape measure
Grain size chart
Munsell color chart

Appropriate sampling device
Stainless steel trowels
Stainless steel bowls
Plastic resealable bags (1 quart + 1 gallon size)
Sharpies or other permanent marker
Flagging
Photo ionization detector (PID) or flame ionization detector (FID)

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-3	Sample Chain-of-Custody
SOP G-4	Packing and Shipping of Samples
SOP G-5	Surveying
SOP G-6	Decontamination
SOP G-7	Management of Investigation Derived Waste
SOP SS-1	Soil Sampling
SOP W-5	Borehole/Well Abandonment

4. PROCEDURE

4.1 GENERAL PROCEDURE

Prior to drilling, the contracted geologist and master driller will develop a communication protocol, including hand signals, safe distance for soil logging, procedures for sample delivery, evacuation locations, and health and safety protocol, such as breathing zone monitoring.

Drilling will commence once the lead end of the auger column is fitted with an auger head (i.e., cutter head) that contains replaceable teeth or blades, which break up formation materials during drilling. A pilot assembly, which is commonly comprised of a solid center plug and pilot bit (i.e., center head), is inserted within the hollow center of the auger head. The purpose of the center plug is to prevent formation materials from entering the hollow stem of the lead auger, and the pilot bit assists in advancing the auger column during drilling. A center rod, which is attached to the pilot assembly, passes through the hollow axis of the auger column. The assembly is attached to the over-head rotating drive, centered on the boring location and excavation drilling commences with rotating and pressure moving the assembly downward. The cuttings are carried upward by the flights, which are welded onto the hollow stem. Once the borehole is advanced to a desired depth for either sampling the formation or installing the monitoring well, the center rod is used to remove the pilot assembly.

Soil samples are collected using downhole hammers to drive the split spoon sampler. The samples will be collected using stainless steel, continuous drive, split-spoon samplers, or equivalent. These samplers are 18 to 24 inches in length with a 3-inch OD to accommodate three to four 2-inch diameter brass/stainless steel rings, each of which is 6 inches in length.

Each time a split-spoon sample is taken, a standard penetration test shall be performed in accordance with ASTM D-1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." (ASTM, 1999). The sample is obtained by driving the sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer, free falling a distance of 30 inches. The sampler is first driven 6 inches to seat it in undisturbed soil, then the test is performed. The number of hammer blows for seating the spoon and making the test are then recorded for each 6 inches of penetration on the drill log (i.e., 5/7/8). The standard penetration test result (N) is obtained by adding the last two figures (i.e., 7+8=15 blows per foot). The sampler is then driven an additional 6 inches to fill the remainder of the split-spoon prior to retrieval.

As soon as the split-spoon is opened, the open ends of the brass/stainless steel rings shall be monitored for organic vapors using the PID or FID. Air monitor results shall be recorded on the Drill Log and in the field log book.

After a sample of the formation has been collected, the center rod is used to reinsert the pilot assembly into the auger head prior to continue drilling to the next sampling interval.

4.2 GENERAL CONSIDERATIONS

1. Ensure that a collapsible table or stand is available to hold decontaminated sampler tubes and liners. Equipment must be protected from contamination by placing it on a sheet of plastic on the ground.
2. Ensure that all soil is removed from inside the sample tube. Sand particles can bind liners in the sampler. Full liners are difficult to remove under such conditions. In extreme cases, the soil sample must be removed from the liner before it can be freed from the sample tube.
3. Obtain information about the subsurface and depth to bedrock before driving the sampler. Damage may occur if the sampler is driven into rock or other impenetrable material. The pilot hole should be made only to a depth above the sampling interval.

4.3 DECONTAMINATION

Before and after each use, thoroughly clean all parts of the soil sampling system according to project requirements (see **SOP G-6**). A new, clean liner is required for each sample interval.

Thoroughly clean the sampler before assembly, not only to remove contaminants but also to ensure correct operation. Dirty threads complicate assembly and may lead to sampler failure. Sand is particularly troublesome because it can bind liners in the sample tube resulting in wasted time and lost samples.

4.4 EQUIPMENT RINSATE BLANK

An equipment rinsate blank may be required to be taken on a representative sample liner prior to starting a project and at regular intervals. Because liners can become contaminated in storage, an equipment rinsate blank will prove that the liners do not carry contaminates which can be transferred to soil samples.

If an equipment rinsate blank is required, the following procedure may be used:

1. Place an end cap or other appropriate device on one end of the liner.
2. Pour distilled water (or other suitable extracting fluid) into the liner.
3. Place an end cap on the open end of the liner.

4. From the vertical position, repeatedly invert the liner so that the distilled water contacts the entire inner surface. Repeat this step for one minute.
5. Remove one end cap from the liner, empty contents into an appropriate sample container, and cap the container.
6. Perform analysis on the rinsate water for the analytes of interest to the investigation.

5. BIBLIOGRAPHY

ANG (Air National Guard), 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

American Society for Testing and Materials (ASTM). 1999. ASTM D-1586. Standard Test Method for Penetration Test and Split-Spoon-Barrel Sampling of Soils. (D-1586-99).

STANDARD OPERATING PROCEDURE W-1

GROUNDWATER MONITORING WELL INSTALLATION

1. SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to delineate the quality control measures required to ensure the accurate installation of groundwater monitoring wells. The term "monitoring well" is used to denote any environmental sampling well, including temporary piezometers.

All groundwater wells will be installed in accordance with American Society for Testing and Materials (ASTM) Standard D5092, "Standard Practice for Design and Installation of Ground Water Monitoring Wells," the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance* (ANG, 2009), and any applicable local or state -specific requirements.

2. EQUIPMENT

2.1 DRILLING EQUIPMENT

- Appropriately sized drill rig adequately equipped with augers, bits, and drill stem
- Steam cleaner and water obtained from an approved source for decontaminating drilling equipment
- Photoionization detector (PID) or flame ionization detector (FID)
- Water level indicator
- Steel drums for investigation derived waste (IDW) [e.g., drill cuttings, contaminated personal protective equipment (PPE), decontamination solution (if necessary)]
- Source of approved water
- Heavy plastic sheeting
- Decontamination area

2.2 WELL INSTALLATION MATERIALS

The specifications for the following materials are included in the well construction:

- Well screen
- Riser pipe
- Plugs/caps
- Filter pack
- Bentonite
- Portland cement
- Steel protective casing
- Submersible pump
- Surge block
- Concrete

2.3 DOCUMENTATION

- Accident Prevention Plan (APP)
- Excavation permits
- Utility clearances
- Borehole logging form
- Well completion forms
- Appropriate work plan

2.4 PERSONAL EQUIPMENT

- Appropriate PPE (see APP)
- Munsell color chart (if required)
- First aid kit
- Fire extinguisher

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-5	Surveying
SOP G-6	Decontamination
SOP G-7	Management of Investigation Derived Waste
SOP G-8	Utility Location
SOP SS-3	Soil Sampling

SOP W-3 Water Level and Well Depth Measurements

SOP W-5 Borehole/Well Abandonment

4. WELL DRILLING PROCEDURE

4.1 RATIONALE

Sound groundwater sample integrity is dependent primarily on strict adherence to properly conceived monitoring well construction and development procedures. In addition, it is equally important that boreholes (i.e., soil borings, wells, and piezometers) be abandoned properly, when necessary, to preclude the possibility of cross-contamination of water-bearing zones. To ensure that these goals are met, the following monitoring well drilling and completion procedures will be utilized.

4.2 PRELIMINARY PROCEDURES

It should not be assumed that the rig will arrive on-site completely decontaminated from the previous job; therefore, the rig should always be inspected. Between holes and on-site locations, dirty tools should be decontaminated before being returned to these compartments.

Standard field procedures should be followed at each borehole location:

- Check the location and number of the drilling location against a map and against the flag or stake. A good rule of thumb is to measure twice, and drill once. Make sure there is a utility clearance for that location (see **SOP G-8**).
- Back the rig into position to avoid driving over the finished well when completed.
- Check the condition of the driller's downhole measuring device. Often these devices are missing several inches, tenths of inches, or feet, and, if used, will result in contradictory hole and well completion information. Remove any electrical tape or materials from any devices that, if lost downhole, could result in possible contamination of groundwater. Ensure that the measuring device is decontaminated each time it is used.
- Drilling is a team effort that includes the contractor and the driller. Arrange with the driller before activities begin to share any pertinent information that they encounter during the drilling process. For example, the driller can often tell when the soil is getting harder or softer, or when they are losing or gaining fluids (the hole is making

water). These comments often may be related later to lithologic and hydrostratigraphic changes and, therefore, may verify well installation logs.

4.3 HOLLOW STEM AUGER DRILLING

Hollow-stem auger (HSA) drilling techniques will be employed to advance most of the borings. HSA drilling uses a series of interlocking auger flights that consist of a continuous spiral or thread that is wrapped around and welded to a central hollow (tubular) stem or axle. The finished tool resembles a wood or machine screw, but without the taper. The lead auger has a set of teeth that cut into the penetrated earth materials. The auger threads then convey the cuttings to the surface. Hollow-stem augers are specified by their inside diameter and not the outer diameter of the hole they drill. All HSA drilling will be conducted in accordance with ASTM Standard D5784, "Standard Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices."

4.3.1 Advantages

- Usually the HSA is a smaller-sized rig than other drilling methods, resulting in more mobility. Its shorter boom also allows this type of rig to drill in areas of low clearance.
- Generally, HSA drilling is less messy than mud rotary techniques that require a water supply and may result in the need to containerize drilling fluids (e.g., muds) as well as cuttings.
- Because no drilling muds are used (introduced to the hole), soil and groundwater samples are considered more accurate or representative. Well development time should also be less than for the methods that use mud.
- Sample moisture content is more likely to be representative of the formation.
- Small-diameter monitoring wells can be installed quickly and efficiently. The augers provide a temporary casing that prevents borehole collapse, and there are no extra drilling fluids with which to contend.

4.3.2 Limitations

- Limited in depth of penetration to approximately 75 feet (even less as auger size increases), depending on the materials encountered and the size of the drill rig.
- Difficult to drill through running or heaving sands.

- Can smear a layer of fine-grained soil on the side of borehole that may prevent groundwater from entering. In tight formations or in areas of difficult drilling, the friction of the augers may bake this skin, resulting in the finished well having limited or no recharge. The finer the matrix, the greater the chance for smearing the side of the hole.

- Can carry contamination down the hole during the drilling process.

- In many formations, the auguring process can be slower than other methods.

- Not effective in gravelly or in bouldery soils.

- Limits the size of hole that can be drilled.

- Generally limited to overburden, weathered, or extremely soft bedrock.

4.3.3 Procedures

- Once the rig is in place, ensure that it is level by insisting that the driller have a carpenter's level on each rig. Use the level on the rig and the auger. Some rigs have built-in bubble levels. Hanging the first auger and visually assessing its plumbness is not as acceptable, particularly on holes expected to be 15 feet or greater in depth.

- The first split-spoon is generally taken outside the augers. Standard blow count procedures, including the ASTM-prescribed hammer weight and fall distances, must be followed and documented. Samples within the first 1 to 2 feet of the surface are often compressed by the split-spoon advancement process, resulting in what appears to be reduced recoveries.

- Measure and record the outer diameter of the augers (these may be worn and quite a bit less than the manufacturer's claim). These data are required for Soil Boring Log input (borehole width).

- Do not allow the driller to double spoon during sampling. This is done by sampling an interval (e.g., 5 to 7 feet below ground surface (ft bgs)) and, without auguring over that interval, immediately sampling the next interval (e.g., 7 to 9 ft bgs) using the previous split-spoon's hole for guidance. This usually results in soil from the upper hole collecting in the second spoon, thereby compromising the sample.

- After the first sample is collected, a 5-foot length of auger is advanced, and a split-spoon sample is collected from 5 to 7 feet. This is referred to as a 5-foot sampling interval. Continuous sampling is performed by split-spooning an interval (e.g., 10 to 12 feet), then advancing the augers over that same interval, so the next sample would be taken ahead of the augers, from 12 to 14 feet, and so on.

- A center plug, which prevents earthen materials from moving up into the augers, should be used in all but the hardest of materials. The center plug is connected to the drive head of the rig by rods to ensure that the plug and rods rotate with the auger flights.

- The rods used to lower the split-spoon into the augers are also used, along with the auger count, to measure the relative position of the spoon from the surface. Inspect the rods prior to use to ensure that they are the lengths the drillers perceive them to be.

- Carefully watch the progression of the spoon while recording blow counts and note irregularities in the penetration rate. The use of "fingers" or sand catchers in the sampler may help produce better retrieval volumes in non-cohesive soils.

- Record observations of:

  - Auger penetration rates.

  - Characteristics of auger cuttings (i.e., moisture content, color, and texture), including changes in the nature (behavior) of the cuttings. For example, if the soil begins to form balls or rope, moisture in the soil has probably increased at that depth.

  - Gravel, boulders, and competent bedrock will make the rig bounce or vibrate as well as chatter.

  - Steam coming off the augers. Slow the rig down if possible to prevent baking.

  - Remember that the cuttings appear at the surface after a time lag, and that this lag increases with the depth of the hole; therefore, it is not possible to correlate cuttings with the exact depth being drilled.

- Running, heaving, or flowing sands occur when augers intercept a saturated soil unit whose fluid or formational pressure pushes its materials out into the boring and up the augers. The use of a center plug can help prevent this, but not after the fact. If running sands are encountered, the following techniques may be used:

  - Remove augers and continue the hole using the rotary-flush (case-and-wash or drive-and-wash) technique (this technique will be used unless directed otherwise; see Subsection 4.4).

  - Fill the augers with potable water to apply a reverse/positive pressure against that of the sands.

  - Drill down below the running sand unit and muck out the augers using a sand pump, dart bailer, and/or roller bit wash.

- Drilling into or through sand (flowing and non-flowing), gravel, or expanding clay (i.e., clay units that, because of overburden pressures, expand into the hole) can lock up and bind the augers. Avoid leaving the augers in the hole for any prolonged period (e.g., overnight) if any of these conditions are encountered. This may be difficult when rock coring is required.

- Record on a routine basis the levels of any fluids (depth to water and/or product) in the auger string.
- Depth to bedrock is based on a combination of both split-spoon and auger refusal. If spoon refusal (50 blows with no penetration) is met and the recovered sample does not verify bedrock, attempt to auger deeper. A cobble or boulder may have stopped the spoon. Continuing the borehole using the augers may push the obstruction aside. If the augers advance, continue to the next scheduled sampling interval and attempt to collect another spoon sample. Continue this process until both the spoon and augers have met refusal. Document all refusals (being careful to label them as being either spoon or auger refusal), rig gyrations, and physical conditions of spoons. The only certain way to determine bedrock refusal is to take a core.
- If a boulder is struck with the augers and the target depth has not been achieved, move approximately 5 feet away from the hole if you are installing a well (10 feet away if you are not) and begin drilling a new borehole. Ensure that the original borehole is properly abandoned (see **SOP W-5**).
- The 6-inch inside diameter augers used for 2-inch diameter groundwater monitoring well placement can generally be used to a depth of 50 feet. At locations where the overburden is greater than 50 or where heaving sands are expected, hollow-stem auger methods may be replaced with the case-and-wash drilling method described in the following subsections.

4.4 DIRECT PUSH DRILLING

Direct Push Technology (DPT) devices are investigative tools that drive or ‘push’ small-diameter rods into the subsurface via hydraulic or percussive methods without the use of conventional drilling. Monitoring wells installed using DPT can either be field-constructed, similar to conventionally drilled and installed wells, or installed using pre-packed well screens. The pre-packed well screen assemblies consist of an inner slotted screen surrounded by a wire mesh sleeve which acts as a support for filter media (sand). The sand is packed between the slotted screen and the mesh.

4.4.1 Advantages

- The smaller size of DPT rigs enables well installation and sampling in areas not accessible to traditional large auger rigs.

- As DPT methods utilize a smaller diameter boring than conventional drilling, less solid waste is generated. Similarly, less liquid waste will be generated from smaller diameter monitoring wells.

- Overall, there is minimal disturbance to the natural formation using DPT in comparison with auger drilling.

- Short-term and long-term groundwater monitoring studies conducted by others have produced results demonstrating that water samples collected from DPT installed wells are comparable in quality to those obtained from conventionally constructed wells.

4.4.2 Limitations

- DPT is only useful at generally shallow depths (less than 100 feet below surface grade) and in unconsolidated formations.

- DPT is not suitable for formations containing excessive gravel, cobbles, boulders, etc., or for bedrock drilling due to the obvious lack of augering capabilities. At sites where there exists a potential for flowing sands, DPT should not be utilized. Each time the string of rods are removed from the borehole for sampling purposes, the lack of a coherent sand lens in the strata would cause the borehole to collapse.

- DPT is inappropriate for monitoring well installation below confining layers or as ‘nested’ wells. Since DPT does not provide for the advancement of casing to keep the borehole open and seal off each separate zone of saturation, DPT can potentially allow for the mixing of separate zones of saturation when the push rods are withdrawn from the borehole. Therefore, the threat of cross-contamination from separate zones of saturation above clean zones of saturation is great.

- If large volumes of aqueous sample are required, DPT installed monitoring wells may not be suitable due to the small diameter of the well screen.

- Since DPT causes smearing and compaction of the borehole sides, proper well development techniques are vital to ensure that natural hydraulic permeabilities are maintained. Several studies have demonstrated that hydraulic conductivities can vary by an order of magnitude lower for wells installed by DPT versus wells installed by conventional HSA.

- Proper well development is critical in order to collect samples that accurately represent groundwater quality.

4.4.3 Procedure

- Back carrier vehicle to probing location, set vehicle to park, shut off ignition, set parking brake, and block rear tires.

- Ensure exhaust blows downwind of the sampling location.

- Start engine using the remote ignition at the Geoprobe operator position. When positioning the probe, always use the slow speed.

- Check for clearance on vehicle roof before folding hydraulics out of the carrier vehicle.

- Extend the hydraulics and lower the derrick to the ground surface. When the probe axis is vertical and the weight of the vehicle is on the probe unit, probing is ready to begin. If ground-cover is concrete or asphalt, a Carbide drill tip should be inserted into hammer and ground-cover shall be cored via rotation.

- The base of the drilling device is positioned on the ground over the drilling location and the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven through dense materials.

4.5 AIR ROTARY DRILLING

Air rotary drilling involves pumping air down a drill string to the bottom of the borehole and out through a rotating bit (roller bit). The cuttings are collected in a pan or sump where they are shoveled out at intervals as the pan is filled. Competent bedrock wells will be drilled by air rotary methods using a truck-mounted rig. The major advantage of the use of air rotary drilling is that it minimizes the introduction of drilling fluids.

4.5.1 Advantages

- Capable of larger borehole diameters and depths than HSA drilling techniques. Therefore, larger and deeper wells can be constructed using this method.

- Does not require a major supply of water as does mud rotary techniques. Less waste is generated and, therefore, there is less of a need for containerization. In short, it is a cleaner process than mud rotary.

- Since mud is not introduced into the hole, sample integrity from these holes is less questionable to most regulatory agencies. In addition, these holes require less development time than mud rotary boreholes.

- Allows inspector to map water entry zones, fractures, and voids by logging air losses with penetration.

- Relatively clean, quick, efficient way to cut through stiff or dense overburden without the use of casing.

4.5.2 Limitations

- Less effective than mud in cleaning out cuttings from the borehole, particularly in larger diameter and deeper holes, thereby restricting well diameter and depth.
- Potentially high volatile organic compound (VOC) emissions at the top of the borehole.
- Effectiveness decreased in coarse or loose sediments without the use of casing (which generally slows the process).
- Difficult to control air losses (lost circulation) downhole in fractured rock zones or highly permeable sediments without using casing.

4.5.3 Procedure

- The air compressor on the rig is equipped with filters to eliminate the introduction of oil from the compressor. Be sure the filter has been recently replaced to avoid contamination of the air supply and the downhole environment with hydrocarbon lubricants.
- Check all casing to be advanced into the hole for cleanliness. Cutting fluid residues (high in solvents), road dust, and manufacturing oils are all common on these casings and need to be removed per the decontamination **SOP G-6.** Any surface coating (paint or lacquers) must be removed by the subcontractor (by sandblasting, if necessary).
- Potable water may be required during bedrock drilling to cool the bit and swivel and control dust.
- Take samples of cuttings continuously with a strainer or sieve over 5-foot intervals, or more frequently if a change in lithology is suspected.
- Note changes in drilling speed that may be indicative of lithologic breaks. Similarly, quick downward movements of the drill string with corresponding loss of fluid usually indicates the presence of a fracture or void. An increase of water at this point suggests that the fracture is water-bearing.
- Listen for water cascading down the side of the hole or use a mirror to reflect a light source (e.g., the sun) down the hole to check for water entry zones. A weighed, decontaminated tape can be moved down the borehole to determine these entry zone depths.
- When possible, estimate water entry flow rates. Check water levels when there is a lull or break in drilling. Recovery rates can be established over prolonged periods.

- Look for and document physical evidence of fractures. These include iron stained surfaces, slickensides, and calcium fill on cuttings.
- Always have a bucket of bentonite pellets ready to plug a borehole in the event that confining or retarding unit is penetrated.

5. WELL CONSTRUCTION

5.1 MATERIALS

5.1.1 Casing/Screen

Polyvinyl chloride (PVC) used for screens, casings, and fittings will conform to the National Sanitation Foundation (NSF) Standard 14 for potable water usage or ASTM Standard F480, and bear the appropriate rating logo. The screens and casing will need to have their rating verified if the manufacturers or suppliers remove or do not apply this logo. All materials will be as chemically inert as technically practical with respect to the site environment. All well screens will be commercially fabricated, machine-slotted, and have an inside diameter equal to or greater than the inside diameter of the well casing. No fitting will restrict the inside diameter of the joined casing and/or screen. All screens, casings, and fittings will be new. Screens will have the largest open area per unit length that is practical for the adjacent aquifer and available filter. Couplings within the casing and between the casing and screen will be compatibly threaded. Thermal or solvent welded couplings on plastic pipe will not be used. This also applies to threaded or slip-joint couplings thermally welded to the casing by the manufacturer or in the field.

Each cap will be constructed to preclude binding to the well casing due to tightness of fit, unclean surface, or frost, and secure enough to preclude debris and insects from entering the well. Caps and risers may be threaded; however, sufficient annular space will be allowed between the well and protective casing to enable one to thaw any frosted shut caps. Preferably, unfiltered vents will not be placed in these caps or in the well riser/stickup. Unfiltered vents may compromise water sample integrity by allowing foreign materials to enter the well between sampling events. Caps will be loose enough to allow equilibration between hydrostatic and atmospheric pressures or have filtered vents. Special cap (and riser) designs will be provided for wells in floodplains and those instances where the top of the well may be below grade, e.g., in roadways and parking lots.

The use of well centralizers will be considered for wells deeper than 20 feet. When used, they will be of PVC, PTFE, or stainless steel and attached to the casing at regular intervals by means of stainless steel fasteners or strapping. Centralizers will not be attached to the well screen or to that part of the well casing exposed to the granular filter or bentonite seal. Centralizers will be oriented to allow for the unrestricted passage of the tremie pipe(s) used for filter pack and grout placement. Additional guidance on centralizers can be found in ASTM D5092.

5.1.2 Filter Pack

Selection of the filter pack grain size will be based on the grain size of the formation screened; composite filter packs may be used in cases where the filter pack screens formations of different grain size (refer to ASTM D5092 for specific requirements). If the actual gradation is to be determined during drilling, then more than one filter pack gradation will be available so that well installation will not be unnecessarily delayed.

Granular filter packs will be visually free of material that would pass through a No. 200 [75-micrometer (µm)] sieve, inert, siliceous, composed of rounded grains, and of appropriate size for the well screen and host environment. The filter material will be packaged in bags by the supplier and therein delivered to the site.

The filter pack material will be placed in the borehole annulus at a slow, uniform rate, in a manner to prevent bridging. As filter pack material is added to the annulus, the drill string will be removed slowly, allowing the filter pack material to settle into place while preventing collapse of the borehole. A measuring device will be used to sound the filter pack level in the borehole annulus during placement to detect and prevent bridging.

5.1.3 Bentonite Seal

Bentonite is the only material that is allowed for sealing or as drilling mud under normal circumstances. This includes any form of bentonite (powders, granules, or pellets) intended for drilling mud, grout, or seals. Chips or pellets of an appropriate size depending on the annular space available will be used to form the well seal. If chips are used, they should be sieved to remove fine-grained material.

Organic additives will not be used in drilling mud. An exception might be made for some high-yield bentonites, to which the manufacturer has added a small quantity of polymer. Bentonite will be used only if absolutely necessary to ensure that the borehole will not collapse or to improve cuttings removal.

If the seals on the monitoring wells are installed above the saturated zone, the bentonite must be poured in as slurry using the tremie pipe method. If the well seals are installed below the saturated zone, the bentonite must be poured in as pellets. The depth to the seal materials must be verified periodically throughout the placement of the seal to ensure proper and uniform installation of these materials (ANG, 2009).

5.1.4 Grout

Grout, when used in monitoring well construction or borehole/well abandonment, will be composed of Portland cement, bentonite (0 to 10% dry bentonite per 94-pound sack of dry cement), and a maximum 6 to 7 gallons of approved water per sack of cement. The amount of water per sack of cement required for a pumpable mix will vary with the amount of bentonite used. The amount of water used will be kept to a minimum. Neither additives nor borehole cuttings will be mixed with the grout.

All grout materials will be combined in an aboveground rigid container or mixer, and mechanically (not manually) blended on-site to produce a thick, lump-free mixture throughout the mixing vessel. The mixed grout will be recirculated through the grout pump prior to placement. Grout will be placed using a grout pump and pipe/tremie. The grout pipe will be of rigid construction for vertical control of pipe placement. Drill rods, rigid PVC, or metal pipes are suggested stock for tremie pipes. If hoses or flexible plastics must be used, they may have to be fitted with a length of steel pipe at the downhole end to keep the flexible material from curling and embedding itself into the borehole wall. This is especially true in cold weather when the coiled material resists straightening. Grout pipes will have side discharge. The side discharge will help to maintain the integrity of the underlying material (especially the bentonite seal). The grout materials within the annular space seal will be allowed to settle, and will be topped off to ground surface within 24 hours of the initial grout placement. Prior to exposing any portion of the borehole above the seal by removal of the drill casing, the annulus between the drill casing and the well casing should be filled with sufficient bentonite-cement grout using a tremie pipe to allow for planned drill casing removal. The grout will be pumped into the annular space under pressure using a tremie pipe placed at the top of the bentonite seal to ensure a continuous seal. The grout should not penetrate any portion of the well screen or granular filter pack. Disturbance of the bentonite seal should be minimal.

5.2 WATER SOURCE

To the extent practical, the use of drilling water will be held to a minimum. When water usage is deemed necessary, the source of any water used in drilling, grouting, sealing, filter placement, well installation, well decommissioning/abandonment, or equipment washing will be approved prior to arrival of the drilling equipment on-site and specified in the work plans. Desirable characteristics for the source include:

- An uncontaminated aquifer origin.
- Wellhead upgradient of potential contaminant sources.
- Water that is untreated and unfiltered.
- A tap having accessibility and capacity (greater than 10 gpm) compatible with project schedules and equipment.
- Only one designated tap for access.
- Surface water bodies will not be used, if at all practical.

If a suitable source exists on-site, that source will be used. The drilling subcontractor will have the responsibility to procure, transport, and store the water required for project needs in a manner that avoids the chemical contamination or degradation of the water once obtained. The drilling subcontractor will also be responsible for any heating, thermal insulation, or agitation of the water to maintain the water as a fluid for its intended uses.

5.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

Materials will be delivered to the site and stored in a secure area. Subcontractors are generally responsible for scheduling delivery and ordering those supplies pertaining to the installation of wells. An inventory will be kept to track the materials. Perishable materials will be covered with tarps and secured to prevent water damage. All materials will be handled in a safe manner and in accordance with health and safety protocols.

6. WELL INSTALLATION

6.1 PREPARATION

Every morning before entering the field, the field team and drilling subcontractor will meet to discuss the location and construction criteria for the day's activities. The field geologist will also ensure that the drilling subcontractor obtains all necessary supplies for the day's work (e.g., bentonite, Portland cement, and screen and riser), and has decontaminated all equipment and manmade construction materials to be used downhole (e.g., augers and PVC screen and riser). All available areal data (e.g., borehole logs) should be reviewed to determine expected formation depths prior to the day's drilling.

6.2 DOCUMENTATION

During any activities pertaining to well construction, abandonment, or development, the field geologist will note in the field logbook the following information:

- Length of time required to perform all drill rig activities (e.g., overdrilling, well construction, abandonment/grouting, development times, and pumping rates).
- All well construction/abandonment supplies used (e.g., bentonite, Portland cement, filter sand, and screen/riser footage).
- Any difficulties in well construction, development, or abandonment. This information may be used to substantiate a change of scope or explain anomalous sampling data.
- Exact measurements (using a tape measure) of screen, end cap trap, and riser lengths.
- A completed well construction diagram.

At the end of the day or the following morning, before commencing with daily activities, the field geologist should go over the day's billing (time and materials). The driller's signature should be obtained acknowledging the accuracy of the figures reported. This is the only information available to verify subcontractor invoices.

- Get a copy of Driller's Log of Activities for the same period.
- Submit Well Completion Form.
- Submit Borehole Completion Form.

The following procedure will be used to drill wells and piezometers:

- Mobilize to decontamination area.
- Decontaminate all equipment according to **SOP G-6**.
- Inspect the rig for any leaks (e.g., oil or hydraulic fluid) and the equipment for cleanliness (i.e., lack of dirt and grease). The only lubricant that may be used on equipment that enters a borehole is Teflon tape (with the exception of Numa Lube, which may be used in a downhole hammer).
- Mobilize to the site.
- Survey the well location for utilities, access, and work areas.
- Set up exclusion zone and work areas.
- Set up sampling and monitoring equipment, including a sample description table covered with Visqueen, if appropriate.
- Lithologic samples will normally be collected, field screened with a PID or FID, and described for every 5-foot interval (minimum), or more often if a change in lithology is observed or is required. Augered intervals between split-spoon samples will be described from cuttings when practical.
- Record all observations in the field logbook. It is critical to note any change in lithology, texture, color, moisture content, and bedding.
- Complete borehole and record completion information in the field logbook.
- Mark boring by appropriate method.
- Clean up area (i.e., leave the site as close to its original condition as possible):
    - Drum or spread any cuttings.

- Line up, properly seal, and label all drums, noting the type of material in the drum and field instrument readings (see **SOP G-2**).
- Remove all trash.

Borehole completion may take one of two forms:

- Piezometer construction.
- Monitor well construction.

Completion procedures for each borehole type are described in the following subsections.

6.3 PIEZOMETERS

Piezometers are installed where additional information is needed to more accurately evaluate the groundwater flow direction in a given aquifer. Piezometers can also be used to collect groundwater samples for analytical screening purposes.

6.3.1 Construction

The following piezometer construction procedures will be followed:

- Piezometers must be installed in areas that are free from contamination. Soil samples from borings to be used for piezometer installation must be collected, lithologically logged, and field-screened using a PID or FID. If soil contamination is encountered, the borehole must be properly abandoned and the piezometer must be installed at another location away from the contaminated area.

- Piezometers will generally be constructed in boreholes advanced with 4.25-inch inside diameter, hollow-stem augers.

- Piezometers will be constructed within the augers as the augers are pulled back and will typically be constructed using either 1- or 2-inch-diameter PVC with a 5 to 10-foot screen length and a threaded bottom cap with a drain hole drilled in the bottom cap to allow drainage if the water table drops below the total depth of the piezometer. The well screen will be machine-slotted with No. 10 slots (0.010 inch). The screened section will be threaded to attach to the PVC riser pipe. PVC cement will never be used to joint sections.

- Place decontaminated PVC screen and riser into the auger.

- Use Morie No. 1 or finer sand to create a filter pack that will extend from total depth to approximately 1 to 2 feet above the top of the screen as the augers are withdrawn from the borehole.

- Place a minimum 3-foot-thick bentonite pellet seal above the filter pack. Add pellets slowly to minimize the risk of bridging that could result in inadequate sealing properties. Allow pellets to hydrate for 10 to 15 minutes. If the seal is located above the water table (dry), use a pure bentonite slurry or pour potable water on the pellets to cause them to hydrate. Depending on the hydrogeologic conditions encountered in the borehole and/or intended use, actual screen and filter pack lengths may vary (e.g., 1- or 2-foot screens may be used).

- Tremie grout a cement/bentonite grout slurry from the top of the seal to 4 ft bgs. The grout slurry will consist of the following ratio of components:

  - 94 pounds of Type I Portland cement.
  - 4 pounds of pure sodium bentonite powder.
  - No more than 6.5 gallons of potable water.

- Proper grouting techniques are required to prevent cross-contamination. Thus, it is imperative that the field team closely supervise all grouting operations.

- Two piezometers may be installed in the same borehole if logistics warrant this type of procedure (i.e., difficult access or thick concrete at the ground surface). Nested piezometer installation will be conducted as described previously, except that a bentonite seal will be installed as an impermeable layer between the screened intervals. Specifically, the lower screen's bentonite seal will extend to 1 foot below the proposed depth of the upper screen. A minimum 1-foot-thick filter pack base (normally 2 feet thick) will be added to avoid possible contact of the upper screen with the bentonite seal.

- Complete the piezometer as directed in Section 7.

6.4 OVERBURDEN MONITORING WELLS

6.4.1 Specifications

Overburden monitoring wells generally will be constructed in a borehole advanced by hollow-stem augers and without the use of drilling fluids, where possible; however, in areas of running sands or difficult drilling, case-and-wash techniques, using 8-inch interior diameter, hardened-steel casing with a drive shoe and a tricone roller technique will be used. Lithology will be described following the Unified Soil Classification System (USCS). All water used for drilling operations and well development will be obtained from documented supply wells.

The overburden wells generally will monitor 5- to 10-foot intervals, or as specified in the work plan; however, screen length may be modified by the field geologist to accommodate specific data needs. Proposed screened intervals may be changed based on the results of soil screening with a PID or FID, or when highly permeable zones are encountered. Wells installed to monitor the water table will be screened from approximately 3 feet above the existing water level in the borehole to approximately 7 feet below this level to allow for seasonal groundwater table fluctuations. Where floating product is suspected to exist, screens will be installed to extend 5 feet above the water table.

After completion of the borehole, the monitoring well will be constructed using Schedule 40 PVC riser and well screen. The PVC well screen will be machine-slotted and will be No. 10 (0.010-inch). Filter pack and well slot size was selected based on the mean grain size of the majority of the finely grained geologic deposits in the screened interval, and was designed to retain most of the formation.

Morie or equivalent sand, used for the sand pack, should not extend less than 2 feet above the top of the screen. The mean grain size of the filter pack should be twice the mean grain size of the formation material based on lithologic information. A seal consisting of pure sodium bentonite pellets or chips, approximately 3 feet thick, will be placed above the filter pack. A minimum of 3 to 4 hours for hydration of the bentonite pellets or tabs is required when cement grout is used above the seal. If bentonite chips are used, the minimum hydration time could be twice as long. If the seal is above the water table, the pellets will be hydrated with potable water. Bentonite chips should not be placed in the vadose zone. Cement/bentonite grout will be tremied into place from the top of the bentonite seal to the ground surface. The protective casing will then be installed, and grout will be added to the annulus between the borehole and the exterior wall of the protective casing. To prevent frost heaving, a pure bentonite slurry will be added to the annulus between the well casing and the interior of the protective casing. Each batch of grout will be mixed to consist of 94 pounds of Type I Portland cement or equivalent, 4 pounds of pure sodium bentonite powder, and not more than 6.5 gallons of potable water. The bentonite pellets and grout seal should be a minimum of 5 feet thick (2 feet of pellets and at least 3 feet of cement/bentonite grout).

All well casing will be decontaminated as described in **SOP G-6**. The PVC casing and screen will be joined with flush-threaded joints. Glue is not permitted to join casing or screen. If a slip cap is used for a bottom cap, it should be affixed to the well screen using stainless steel screws. All PVC will conform to the ASTM Standard F480 or NSF Standard 14 (plastic pipe system).

6.4.2 Construction

The following construction details will be followed when installing single-cased overburden wells:

- Discuss construction details (screen and filter pack size).
- Lower screen and riser into the augers or temporary casing to the bottom of the well. If the well exceeds 50 feet in depth, two centralizers will be used.
- Add the appropriate grade of Morie or equivalent sand to the annulus around the screen to 2 feet above the screen as the augers are pulled back. If case-and-wash methods are used, the sand will be added while the temporary casing is pulled back.
- Add a 3-foot-thick seal consisting of pure sodium bentonite pellets or chips. If the seal will be above the water table, potable water will be poured on the pellets to cause them to hydrate.
- Pellets will be tamped down to the top of the sand pack and allowed to hydrate for 3 to 4 hours before the rest of the annulus is grouted.
- Tremie grout (above the bentonite seal).
- Complete well as directed in Section 7.
- **Note:** The bentonite and grout seal should be a minimum of 5 feet thick (2 feet of pellets or bentonite slurry and at least 3 feet of cement/bentonite grout). Deviations from these procedures are sometimes necessary because of field conditions, but must be approved.

7. WELL COMPLETION

7.1 BACKGROUND

Elements of well protection are intended to protect the monitoring well from physical damage, to prevent erosion and/or ponding in the immediate vicinity of the monitoring well, and to enhance the validity of the water samples.

The potential for physical damage is lessened by the installation of padlocked, protective iron/steel casing over the monitoring well and iron/steel posts around the well (when needed for protection). The casing and posts will be new. The protective casing diameter or minimum dimension will be 2 inches greater than the nominal diameter of the monitoring well, and the nominal length will be 5 feet. The protective casing will be vented to the atmosphere via a hinged locking cap that will prevent entry of water, but will not be airtight. The concrete/cement filled posts will be at least 3 inches in diameter and the top modified to preclude the entry of water. The nominal length of the posts will be 6 feet. Special circumstances necessitating different materials will be addressed in the work plan. The protective casing and posts for the aboveground finished monitoring wells will be painted yellow for corrosion protection and visibility.

Erosion and/or ponding in the immediate vicinity of the monitoring well may be prevented by assuring that the ground surface slopes away from the monitoring well protective casing by the installation of a 3-ft by 3-ft coarse gravel blanket or cement pad around the well.

Wells will contain a locking cover on the protective casing. The cover will be hinged or telescoped, but not threaded. All locks on these covers should be opened by a single key, if possible.

7.2 ABOVEGROUND WELL COMPLETION

Aboveground wells will be completed as follows:

- Extend the well casing 2 to 3 feet above ground surface.
- Provide an end plug or casing cap for each well. Use a filtered vented cap or drill a small (0.125-inch) hole into the PVC riser just below the PVC cap or into the PVC cap to allow air circulation in the well.
- Shield the extended well casing with a carbon steel protective casing that is set over the well casing and cap and extends to a depth of 3 ft bgs.
- Grout the annular space between the borehole and the protective casing with cement/bentonite grout to a depth of 4 ft bgs.
- Fill the annular space between the well casing and the protective casing with pure sodium bentonite slurry to protect the well casing from frost heave.
- A ground surface seal will be constructed using a minimum of 6 inches of concrete below the land surface and sloped away from the protective casing. The ground surface seal will be installed around the protective cover and may not be placed between the protective cover pipe and the well casing. The top of the anchor pad at the outer edge will be at the level of the surrounding ground surface and slope upward toward the casing at 1/4 inch per foot.

- Drill a small diameter hole (0.25- to 0.375-inch) in the protective casing (weep hole) near the top of the cement pad to allow for drainage, and mark a survey location on the inner casing (mark with an indelible marker or cut a small notch in the PVC on the side toward the hinge).

- Install a lockable cap or lid on the protective casing.

- Mark the well number clearly on the protective casing cap using impact lettering.

- Install three 3-inch diameter, concrete-filled steel guard posts (bollards) around the well, if directed to do so by the on-site geologist.

- The bollards will be 6 feet in total length and installed radially from each well head.

- Recess the guard posts approximately 2 feet into the ground outside of the cement pad and set in concrete approximately 3 to 5 feet from the protective casing.

- Fill each guard post with concrete.

- All wells will be secured as soon as possible after drilling. Corrosion-resistant locks will be used for both flush and aboveground well assemblies. The locks must have extended shanks.

7.3 FLUSH-MOUNTED WELL COMPLETION

Where well stickup is of concern, the well will be completed as a flush mount, level with the ground surface. Base-specific personnel (i.e. environmental managers) should be consulted if a flush mount set up is considered as there could be base-specific requirements for surface completion.

Flush-mounted wells will be completed as follows:

- Cut the casing 2 to 3 inches bgs, and install a protective locking lid consisting of a cast-iron valve box assembly or manhole cover. The flush-mounted protective cover pipe may not extend beyond the annular space seal.

- Center the lid assembly in a 3-foot-diameter concrete pad sloped away from the valve box. The concrete anchor pad surrounding the flush-mounted protective cover pipe will be placed to a minimum depth of 6 inches bgs to prevent frost heaving. The top of the anchor pad at the outer edge will be at the level of the surrounding ground surface and slope upward toward the casing at 1/4 inch per foot.

- Provide a compressive cap with a filtered vent for equilibrium and to prevent infiltration of surface water.

- There may be no more than 12 inches between the top of the monitoring well casing and the top of the flush-mounted cover pipe after installation.

- Clearly mark the well number on the valve box lid and well casing using an impact-labeling method or equivalent, and mark a surveying point on the inner casing.

8. MAINTENANCE

Wells need to be examined periodically (normally during sampling) to determine if they have been damaged, vandalized, or otherwise compromised, and also to check for evidence of disintegration such as cracked casing, pads, or surface seals, and to check the security of the well (locked cap).

9. PRECAUTIONS

- Refer to the APP for discussions of hazards and preventive measures.
- Make sure all utility clearances have been obtained.
- Be especially observant of overhead hazards (e.g., electric, trees).
- Stop drilling if unexpected refusal is encountered within 10 feet of grade and evaluate cuttings. It may be an unmarked utility or other hazard.

10. BIBLIOGRAPHY

ANG (Air National Guard). 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

ASTM Standard D5787. 2009. "Standard Practice for Monitoring Well Protection." ASTM International, West Conshohocken, PA. 2009, DOI: 10.1520/D5787-95R09. www.astm.org.

ASTM Standard D5092. 2004. "Standard Practice for Design and Installation of Ground Water Monitoring Wells." ASTM International, West Conshohocken, PA. 2004, DOI: 10.1520/D5092-04E01. www.astm.org.

ASTM Standard D5784. 2006. "Standard Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices." ASTM International, West Conshohocken, PA. 2006, DOI: 10.1520/D5784-95R06. www.astm.org.

ASTM Standard F480. 2006. "Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80." ASTM International, West Conshohocken, PA. 2006, DOI: 10.1520/F0480-06B. www.astm.org.

STANDARD OPERATING PROCEDURE W-2

WELL DEVELOPMENT

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

Well development is the process by which foreign materials and solids are removed from the screen filter pack or open hole, allowing water to flow freely into the well or piezometer. This process is accomplished by moving water through the well screen or borehole into and out of the surrounding material. Well development serves four principal purposes:

- Removes materials that have built up in the openings of the screen or borehole during the well drilling and installation process.
- Removes fine materials from the side of the borehole that result from the drilling procedures (e.g., drilling mud).
- Increases hydraulic conductivity of the filter pack and adjacent geologic materials by removing fine materials.
- Stabilizes the fine materials that remain in the vicinity of the well, thereby retarding their entry into the well.

The benefits are increased yield and reduced suspended solids, which result in better sample representativeness.

The well will be developed using mechanical surging or equivalent and overpumping. In this method (surge blocking), a surge block is pushed in and pulled out of the well in a plunger-like fashion. As fines are flushed into the well, they are pumped out or bailed out. This method is the most effective method of development, but is used only to develop screened wells because it may cause collapse in an open borehole.

All materials placed in the wells must be decontaminated prior to their use. The tubing will be dedicated to each individual well and will be disposed of after use. All pumps must be equipped with clean wiring (no electrical or duct tape), and have either polyvinyl chloride (PVC) or polyethylene tubing. If well yields cannot sustain the flow rate of the submersible pump, a dedicated or disposable bailer will be used to evacuate the well. Water will not be added to the well to aid in development, nor will any type of air-lift technique be used.

2. EQUIPMENT

Well development forms and pens
Deionized water and decontamination supplies
Stopwatch/wristwatch
Electronic water level measurement device
Surge block
Submersible pump
Generator (or battery source)
Polyethylene tubing
Closed-bottom bailer (as required)
Flow rate/volume measurement devices
Turbidity meter
Thermometer
pH meter
Electrical conductivity meter
Organic vapor detector (photoionization detector [PID] or flame ionization detector [FID])
Dissolved oxygen meter (optional)
Eh meter (optional)

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-6	Decontamination
SOP G-7	Management of Investigation Derived Waste

4. WELL DEVELOPMENT PROCEDURES

Wells are developed as follows:

- Development should not be performed until that the grout has had ample time to cure, unless grout is above the depth of the water table.

- Well development will be performed using surge block or similar techniques. Depending on well construction design, the surging will either be performed manually using a surge block connected to a tremie pipe (or equivalent) or operated mechanically from the drilling rig. The entire length of the saturated well screen will be surged. Surging will alternate with pumping for a minimum of 1 hour or up to 4 hours, until sediment production nearly ceases.

- The wells will then be pumped (if yields are high enough: >0.5 gallons per minute [gpm]) using a decontaminated submersible pump (low-yielding wells should be pumped with a 2-inch outer diameter adjustable rate pump or manually bailed). All pumps will be equipped with clean wiring and PVC or polyethylene tubing. The submersible pumps should be capable of operating at a range of pumping rates [generally from 1 to 10 gpm], either by use of different pumps or throttling back on pump flow to meet well yield conditions.

- At regular intervals (such as every 15 minutes during development), purge rate; depth to water; and groundwater pH, temperature, electrical conductivity, PID/FID readings, turbidity, incremental, and total volume purged will be recorded. Well development will proceed until the following conditions are met:

  - Clear, sediment-free formation water is produced from the wells.

  - Stabilization of water quality parameters. Stabilization will be defined by the following variances between three successive readings: pH within ± 0.1 units; conductivity within ± 10%; oxidation-reduction potential (ORP) within ± 10 millivolts (mV), DO within ± 10%; and turbidity within ± 10% and < 50 Nephelometric turbidity units (NTU); and temperature within ± 1°C (ANG, 2009).

  - At least three well volumes (including the saturated filter material in the annulus) plus the volume of water added during the drilling process (if any) have been removed from the well.

- All purge water will be containerized in containers (i.e., 30 or 55-gallon drums with bolt-tightened lids). All containers will be labeled with an indelible paint pen (drum surface) and an adhesive drum label attached to the drum with the following information:

  1. Drum number

2. Contract and delivery order number;
3. Contents (development water and well identifiers);
4. Dates of development activities; and
5. Site Environmental Manager name and phone number.

- After 4 hours, if a turbidity of 5 NTU cannot be achieved, well development will discontinue, and the final turbidity will be noted in the log.

- Because one of the objectives during well development is the determination of well yield in gpm, the depth to water will be measured at the same time as the other parameters, and the flow of the submersible pump (if used) will be adjusted so that the water level stabilizes. At that point, flow rate should be approximately equal to well yield. The submersible pump intake will be placed below the water level and lowered as the water level drops. If the well goes dry during development, water levels should be recorded during a 10-minute recovery test that will be run to determine the rate at which groundwater is entering the well. Water levels are taken at intervals of 0 seconds, 15 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, and 10 minutes. At the end of development, an estimation of yield will be recorded on the Well Development Form (see UFP-QAPP Appendix D “Field Forms”).

5. BIBLIOGRAPHY

ANG (Air National Guard), 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

STANDARD OPERATING PROCEDURE W-3

WATER LEVEL AND WELL DEPTH MEASUREMENTS

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

This SOP delineates the protocols for measuring water level and well depth. This procedure is applicable to the sampling of monitoring wells and must be performed prior to any activities that may disturb the water level, such as purging or aquifer testing.

These measurements will be taken at least 24 hours after development or immediately before sampling. If the measurements are to be used for contouring groundwater data, every attempt should be made to collect the water levels within a 24-hour period. Measurement will be made using an electronic water level meter. The depth to groundwater will be measured and reported to the nearest 0.01 foot. Measurement will be made from the highest point on the rim of the well casing or riser (not protective casing). This same point on the well casing will be surveyed for vertical control and marked accordingly. Surface water levels will be measured at least to the nearest 0.1 foot using an adjacent temporary or permanent survey marker as a datum for current and future reference. For those projects involving the installation of monitoring wells, at least one set of static water level measurements should be made over a single, consecutive 10-to-12-hour period for all project-related wells; both newly installed and specified existing wells.

2. EQUIPMENT

Electronic water level indicator with cable measured at 0.01-foot increments
Tape for total depth measurement (optional)
Transducer and datalogger (optional for continuous monitoring)
Oil-water interface probe (optional)
Plastic sheeting
Photoionization detector (PID) or intrinsically safe flame ionization detector (FID)

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-6	Decontamination

4. PROCEDURE

4.1 PRELIMINARY STEPS

- Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well or protective casing. Note any damage or missing locks.

- Open the well cap high enough to sample the air in the well head for gross organic vapors with an organic vapor monitor (PID or FID). This will indicate the level of gross volatile contaminants as well as the potential for sampler exposure.

- Locate the permanent reference mark at the top of the casing. The reference point will be scribed, notched, or otherwise noted on the top of the casing. If no such marks are present, measure from the highest point of the well casing, and note this in the field notebook.

- Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.

- Keep all equipment and supplies protected from gross contamination. Keep the water level indicator probe in its protective compartment when not in use.

4.2 OPERATION

- Always perform non-aqueous phase liquid (NAPL) checks in wells with suspected NAPL contamination, and in wells where headspace tests reveal the presence of volatiles. Always perform a NAPL check the first time a well is sampled.

- Remove cap. Allow well to vent for at least 90 seconds.

4.2.1 NAPL Present

If NAPL contamination is suspected, use an oil-water interface probe and the following procedure to determine the existence and thickness of NAPLs:

- Open the probe housing, turn the probe on, and test the alarm. Slowly lower the probe into the well until the alarm sounds. A continuous alarm indicates a NAPL, while an intermittent alarm indicates water. If a NAPL is detected, record the initial level (first alarm). Mark the spot by grasping the cable with the thumb and forefinger at the top of the casing. If a mark is present on the casing, use the mark as the reference point. If no mark is present, use the highest point on the casing as the reference point. Record the depth.

- Continue to slowly lower the probe until it passes into the water phase. Record the water level and the thickness of NAPL (NAPL – water depths).

- Continue to slowly lower the probe through the water column to check for the presence of dense non-aqueous phase liquid (DNAPL).

- Measure depths to DNAPL and the bottom of the well, and record the thickness of any DNAPL layer.

- Fully decontaminate the probe (see **SOP G-6**).

4.2.2 No NAPL Present

If no NAPL is present, use an electronic water level detector as follows:

- The water level meter will be removed from the case, the sounder will be turned on, and the battery and sensitivity scale will be test checked by pushing the red button. Adjust the sensitivity scale (volume) until the buzzer is heard.

- Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzer is heard. The probe will be very slowly raised and lowered until the point is reached where the meter just begins to buzz. Marking the spot by grasping the cable with the thumb and forefingers at the top of the casing measuring point, the cable will be withdrawn and the depth will be recorded. If no mark is present, use the highest point on the casing as the reference point. Record the depth.

- To measure the well depth, the probe sounder will be turned off and the water level meter cable will be lowered until slack is noted in the cable. The cable will be very slowly raised and lowered until the exact bottom of the well is determined. The depth will be measured and recorded. The well depth and the time will be recorded in a field logbook. Note: if the electric water level indicator is used to determine the depth of the well, the offset distance from the tip to the electrode must be added to the depth.

- Withdraw the tape and probe, and wipe with paper towels, clean with phosphate-free detergent (e.g., Liquinox®), and rinse with deionized water, cloth-wipe, and allow to air dry between consecutive water level measurements.

- Generally proceed from clean to “dirty” wells to minimize the possibility of cross contamination.

5. CALIBRATION

No field calibration is necessary.

6. PRECAUTIONS

- Check instrument batteries prior to each use.
- Fully decontaminate probe and tape if exposed to NAPL.
- Make sure that the cable is not twisted and that the cable is intact and the lengths are correct (cables are sometimes spliced and may be shortened in the process).

7. BIBLIOGRAPHY

ANG (Air National Guard). 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

STANDARD OPERATING PROCEDURE W-4

LOW STRESS (LOW FLOW) GROUNDWATER PURGING AND SAMPLING

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) is in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

This SOP provides a general framework for collecting groundwater samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). This SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually between 100 and 500 milliliters/minute [mL/min]) in order to collect samples with minimal alterations to water chemistry. The use of low-flow methods is specifically required by ANG in the following situations:

- Sampling formations which exhibit a slow recharge;
- Sampling formations primarily composed of fine-grain sediments such that standard methods generate groundwater samples with unacceptably high turbidity; and/or
- Confirmation sampling at sites with excessive concentrations of metals (ANG, 2009).

This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation); however, this procedure is flexible and can be used in a variety of well construction and groundwater yield situations. Samples thus obtained are suitable for analyses of groundwater contaminants or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs).

The screen, or open interval of the monitoring well, should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Proper well construction and development cannot be overemphasized, because the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that, as part of development or redevelopment, the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in the shortest amount of time. With this information, field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake; however, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permeability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help ensure that the low stress procedure will not underestimate contaminant concentrations.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Stabilization is defined as follows:

- Temperature ± 1 degree Celsius (°C);
- pH ± 0.1 units;
- Electrical conductivity ± 10 percent (%);
- Turbidity ± 10% and < 50 nephelometric turbidity units (NTUs);
- Dissolved oxygen (DO) ± 10%; and
- Oxidation/Reduction potential (ORP) ± 10 millivolts (mV).

Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: (1) continue purging until stabilization is achieved; (2) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization); and (3) discontinue purging, collect samples, and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives). Option 3 is the normally selected option.

2. EQUIPMENT

All reusable sampling equipment must be properly decontaminated before any groundwater samples are collected and between each location (ANG, 2009). Monitoring instruments must be calibrated according to the manufacturer's specifications. It may be appropriate to use dedicated sampling systems for long-term monitoring and remediation projects which undergo routine sampling over time.

2.1 EXTRACTION DEVICE

Adjustable rate, submersible pumps are preferred (for example, Redi-flo 2 or bladder pump constructed of stainless steel or Teflon), but passive samplers are considered acceptable as long as they follow industry-accepted sampling methods (ANG, 2009).

Adjustable rate, peristaltic pumps (suction) may be used with caution, and are typically inappropriate where the depth to groundwater is greater than 20 feet.

2.2 TUBING

Teflon or Teflon-lined polyethylene tubing is preferred when sampling is to include VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and inorganics.

PVC, polypropylene, or polyethylene tubing may be used when collecting samples for inorganics analyses; however, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs; however, it should be used with caution when sampling for metals.

The use of ¼-inch or ⅜-inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump to minimize gaseous diffusion.

2.3 SUPPLIES

- Water level measuring device(s) capable of measuring to 0.01-foot accuracy (electronic "tape," pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each record.

- Flow measurement supplies (e.g., graduated cylinder and stop watch).

- Interface probe, if needed.

- Power source (e.g., generator, nitrogen tank).

    - If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.

- Indicator field parameter monitoring instruments such as the YSI model 556 MPS for pH, oxidation/reduction potential [ORP (add 200 to ORP value for correction factor to Eh)], DO, turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments and analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For ORP measurements, follow manufacturer's instructions.

- Decontamination supplies (for example, non-phosphate detergent, distilled/de-ionized water, isopropanol, nitric acid) (see **SOP G-6**).

- Logbook(s) and other forms (for example, well purging forms).

- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Well construction data, location map, field data from last sampling event.
- Well keys.
- Work Plan.
- Photoionization detector (PID) or flame ionization detector (FID) instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

3. RELATED PROCEDURES

SOP G-1	Field Documentation
SOP G-2	Calibration and Use of Field Instruments
SOP G-3	Sample Chain-of-Custody
SOP G-4	Sample Packing and Shipping
SOP G-6	Decontamination
SOP G-7	Management of Investigation Derived Waste
SOP G-9	Field Filtration
SOP W-3	Water Level and Well Depth Measurements

4. PROCEDURE

4.1 PRELIMINARY SITE ACTIVITIES

- Check well for security damage or evidence of tampering; record pertinent observations.
- Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument, and record the reading in the field logbook.
- If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one on the highest point of the inner well casing. Describe its location and record the date of the mark in the logbook.
- A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended

that water level depth (to 0.01 foot) and total well depth (to 0.1 foot) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. The depth to water and well depth and the time of measurement will be recorded. The reference point for these depths will be the measuring point identified on the top of the well casing. Care should be taken to minimize water column disturbance.

- The depth to water and total depth measurements will then be used to calculate the casing volume by subtracting the depth to water from the total depth of the well and multiplying by a conversion factor that is based on the diameter of the well casing (0.163 gallons per foot for a 2-inch inner diameter [ID] casing).

- The water level cable will be decontaminated, removed from the well, and stored until the submersible pump has been inserted into the well. At this time, the cable will be reinserted and a reading obtained to the top of groundwater with the materials in place. Groundwater level readings are included in each round of low-flow readings. After sampling is complete, the cable will be removed and decontaminated before its next use.

- The pump and associated tubing will be slowly and carefully lowered into the well, minimizing the re-suspension of solids that may have collected at the bottom of the well. If the entire screened interval is saturated, the pump will be placed in the center of the saturated zone; otherwise, the pump will be placed in the center of the saturated screen interval (but no less than 2 feet above the bottom of the well to avoid entrainment of sediment). The desired pump intake placement depth will be measured and recorded. Any solids that are re-suspended during pump installation will be allowed to resettle for 5 minutes before purging and sampling.

- Consistent with low-flow (micropurge) protocols, the wells will be purged and sampled at a rate that does not lower the water surface in the well. Purging will be performed at a rate no greater than 0.5 liter/minute.

- Water levels will be checked periodically to monitor drawdown as a guide to flow rate adjustment. A stabilized drawdown of no more than 0.20 foot should be maintained during purging. The pumping rate required adjustments will be based on site-specific conditions.

- A field-calibrated water quality meter and in-line multiprobe flow-through cell will be used to monitor the water quality parameters the sample is not exposed to the atmosphere prior to measurement of the parameters.

- An initial reading of parameters will be recorded at the start of purging and again at regular intervals during purging. Results will be recorded in the site logbook.

- Water quality parameters will be tested and recorded about every 5 minutes during purging until they are stabilized. A minimum of five sets of water quality indicator parameters should be recorded. The water quality parameters include pH, conductivity, temperature, turbidity, DO, and ORP.

- Purging may be terminated after 3 successive measurements indicate that water quality parameters have stabilized or when a minimum of one well volume has been purged (ANG, 2009).

- The pump will not be turned off between purging and sampling. Prior to beginning sampling, the flow-through cell will be removed and the total amount of water purged will be recorded.

- If existing site information has shown the groundwater to be non-hazardous, the purge water from monitoring wells will be discharged into the ground next to the well to allow infiltration.

- After collection and transfer to the appropriate sample container, the samples will be secured in a cooler at 4 ºC and made ready for shipment to the laboratory.

4.2 PURGING AND SAMPLING PROCEDURE

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

4.2.1 Install Pump

Lower pump, safety cable, tubing, and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. If possible, keep the pump intake at least 2 feet above the bottom of the well to minimize mobilization of particulates present in the bottom of the well. Collection of turbid-free water samples may be especially difficult if there are 2 feet or less of standing water in the well.

4.2.2 Measure Water Level

Before starting pump, measure water level. If recording pressure transducer is used, initialize starting condition.

4.2.3 Purge Well

4.2.3.1 Initial Sampling (Well Not Previously Sampled)

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 foot). If the minimal drawdown that can be achieved exceeds 0.3 foot but remains stable, continue purging until indicator field parameters stabilize. Drawdowns in excess of 10% of the initial length of the water column are to be avoided.

Monitor and record water level and pumping rate every 3 to 5 minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 100 to 500 mL/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first 15 minutes of pumping in order to help minimize purging time. During pump startup, drawdown may exceed the 0.3-foot target and then “recover” as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps (bladder pumps) capable of attaining very low pumping rates (below 100 mL/min), and/or the use of dedicated equipment. If the recharge rate of the well is lower than the extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently (typically 75%) to collect the appropriate volume needed for all anticipated samples (ideally, the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

4.2.3.2 Subsequent Sampling

After the synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

4.2.4 Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) every 3 to 5 minutes (or less frequently, if appropriate). Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at 3- to 5-minute intervals, are within the following limits:

- Turbidity (± 10% and < 50 NTU).
- DO (± 10%).
- Specific conductance (± 10%).
- Temperature (± 1 ^{o}C).
- pH (± 0.1 unit).
- ORP/Eh (± 10 mV).

All measurements, except turbidity, must be obtained using a flow-through cell. Transparent flow-through cells are preferred, because they allow field personnel to watch for particulate buildup within the cell. This buildup may affect indicator field parameter values measured within the cell, and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect the cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through cells are used in series, the one containing the DO probe should come first (this parameter is most susceptible to error if air leaks into the system).

4.2.5 Collect Water Samples

Water samples for laboratory analyses must be collected before water has passed through the flow-through cell (use a by-pass assembly or disconnect the cell to obtain the sample).

The sample collection order would be the following: VOCs, total petroleum hydrocarbons (TPH), SVOCs, metals/inorganics. VOC samples should be collected directly into pre-preserved sample containers. Filtered samples should be collected last, with the exception of wells with known high turbidity. In these cases, metals samples should be collected first and preferably during purging (ANG, 2009). All sample containers should be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that ¼-inch or ⅜-inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict the sampling end of the tubing; (2) insert small-diameter Teflon tubing into water-filled portion of the pump tubing, allowing the end to protrude beyond the end of the pump tubing, collect the sample from small diameter tubing; (3) collect non-VOC samples first, then increase the flow rate slightly until the water completely fills the tubing, collect the sample, and record the new drawdown, flow rate, and new indicator field parameter values.

Preservative should be added, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. The pH should be checked for all samples requiring pH adjustment to ensure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered PCBs or metal concentrations is a sampling objective, filtered water samples should be collected using the same low flow procedures. The use of an in-line filter is required, and the filter size (0.45 micrometers [µm] is commonly used) should be based on the sampling objective. The filter should be pre-rinsed with approximately 25 to 50 milliliters (mL) of groundwater prior to sample collection. The filtered water sample should be preserved immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health risk calculations.

Each sample should be labeled as collected. Samples requiring cooling (e.g., volatile organics, cyanide) should be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples do not need to be cooled after acidification to a pH less than 2.

4.2.6 Post-Sampling Activities

If recording pressure transducer is used, the water level should be remeasured with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, the well depth (to 0.1 ft) should be measured and recorded, if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event; however, it is recommended if the well has a “silting” problem or if confirmation of well identity is needed.

The well should be secured.

5. DECONTAMINATION

The non-dedicated sampling equipment will be decontaminated prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires that are in contact with the well) will be decontaminated by one of the procedures listed below.

5.1 PROCEDURE 1

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump, or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropanol be used sparingly in the decontamination process, and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

1. Flush the equipment/pump with potable water.
2. Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.
3. Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.
4. Flush with isopropanol (pesticide grade). If the equipment blank data from the previous sampling event show that the level of contaminants is insignificant, this step may be skipped.
5. Flush with distilled/deionized water. The final water rinse must not be recycled.

5.2 PROCEDURE 2

1. Steam clean the outside of the submersible pump.
2. Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a 3- or 4-inch-diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe, and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.
3. Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.
4. Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.
5. Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

6. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared in the same manner as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples may be collected as required by the UFP-QAPP.

- Field duplicate.
- Matrix spike.
- Matrix spike duplicate.
- Equipment blank.
- Trip blank (VOCs only).
- Temperature blank (one per sample cooler).

Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler. The equipment blank will include the pump and the pump's tubing. If the tubing is dedicated to the well, the equipment blank will include only the pump in subsequent sampling rounds.

Samples should be collected in order from wells with the lowest contaminant concentration to wells with the highest concentration. Equipment blanks will be collected after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine the precision of sampling procedure. For this procedure, a duplicate for each analyte group should be collected in consecutive order (e.g., VOC original, VOC duplicate, SVOC original, SVOC duplicate).

All monitoring instrumentation will be operated in accordance with the manufacturer's operating instructions (see **SOP G-2**). Instruments will be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be recalibrated so that all measurements fall within the calibration range. At the end of each day, calibration should be checked to verify that instruments remained in calibration. Temperature measuring equipment, thermometers, and thermistors need not be calibrated to the above frequency; they should be checked for accuracy prior to field use according to the manufacturer's instructions.

7. FIELD LOGBOOK

A field log will be kept to document all groundwater field monitoring activities and to record all of the following information:

- Well identification.

- Well depth and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid (NAPL) layers and detection method.
- Pumping rate, drawdown, indicator parameter values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.
- Well sampling sequence and time of each sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations during sampling event.
- Name of sample collector(s).
- Weather conditions.
- Quality assurance/quality control data for field instruments.
- Any problems encountered should be highlighted.
- Description of all sampling equipment used, including trade names, model number, diameters, material composition.

8. BIBLIOGRAPHY

ANG (Air National Guard). 2009. *Environmental Restoration Program Investigation Guide*. September 2009.

STANDARD OPERATING PROCEDURE W-5

BOREHOLE/WELL ABANDONMENT

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared in accordance with the Air National Guard (ANG) *Environmental Restoration Program Investigation Guidance*, dated September 2009 (ANG, 2009).

This Standard Operating Procedure (SOP) details the procedure for abandoning a borehole, temporary piezometer, or a monitoring well. Proper grouting techniques are critical for preventing the creation of a preferential flow pathway that could promote groundwater contamination and for preventing the creation of a trip or falling hazard caused by an open hole. Thus, it is imperative that the field team closely observe all grouting operations.

2. EQUIPMENT

Portland cement
Pure sodium bentonite powder
Potable water
Calculator

3. RELATED PROCEDURES

SOP G-1	Field Documentation

4. PROCEDURE

4.1 BOREHOLE ABANDONMENT

Borehole abandonment is conducted for one or more of the following reasons:

- Completion of a soil boring.
- Insufficient yield that precludes well installation.

- Excessive difficulties incurred during drilling.
- Requirements of a regulatory agency.

The following borehole abandonment procedure will be practiced:

- Calculate the volume of grout needed to completely fill the borehole. Prepare an additional 10% of expected volume to compensate for settlement during grouting.

- Tremie pump cement/bentonite grout slurry into the borehole, with the pump outlet placed at the bottom of the borehole. The cement/bentonite grout slurry will displace any borehole water upward, and pumping should continue until the slurry reaches the ground surface.

- The grout slurry will consist of the following ratio of components:

  - 94 pounds of Portland cement.
  - 4 pounds of pure sodium bentonite powder.
  - No more than 6.5 gallons of potable water.

- All grouted boreholes should be checked on the day after grouting to determine whether further settlement has occurred. Boreholes greater than 50 feet deep should be checked 2-3 days after the abandonment. Additional cement/bentonite grout should be added to the borehole to bring the closure to the ground surface – typically, this can be accomplished by adding cement/bentonite grout from the top of the borehole, unless a substantial amount of water has accumulated in the remaining borehole.

The procedure may be modified in order to follow existing federal and/or state regulations regarding soil boring abandonment.

4.2 MONITORING WELL/PIEZOMETER ABANDONMENT

Monitoring wells or temporary piezometers may be abandoned based on the following criteria:

- Location is no longer needed for investigation purposes (e.g., site has reached ‘No Further Action’ or ‘Response Complete’).

- Results of a survey of the condition of the monitoring well (e.g., well construction and damage).

- Difficulties encountered during drilling (e.g., prolonged loss of circulation and borehole collapse).

- To make way for construction activities.

- Requirements of a regulatory agency.

The field team will document these or other difficulties in the field logbook, and relay this information to the supervisor. One or more of these individuals will determine whether abandonment is necessary.

The following well abandonment procedures will be followed:

- Break up cement pad, remove demolition debris, pull outer steel protective casing with drilling rig (if possible), and remove polyvinyl chloride (PVC) inner casing (if possible) or cut to a workable level.
- Overdrill to the total depth of the well using hollow-stem augers large enough to encompass the diameter of the original borehole.
- Remove remaining PVC casing and screen.
- Tremie pump cement/bentonite grout slurry into the hollow-stem augers, with the pump outlet placed at the bottom of the augers. The cement/bentonite grout slurry will displace any borehole water upward, and the augers should be withdrawn flight-by-flight, only after the cement/bentonite grout slurry has filled the augers above the flight to be removed, maintaining a constant cement/bentonite grout slurry head. Pumping should continue until all auger flights are removed and the slurry reaches the ground surface.
- An alternative option is to abandon the well in place by tremie pumping cement/bentonite grout slurry into the well casing without removing the well casing. This procedure, however, must be approved before abandonment of the well, as it leaves the sand filter pack in place, which may create a preferential flow pathway that could promote groundwater contamination.

The procedure may be modified in order to follow existing federal and/or state regulations regarding monitoring well or piezometer abandonment.

5. BIBLIOGRAPHY

ANG (Air National Guard). 2009. *Environmental Restoration Program Investigation Guidance.* September 2009.

STANDARD OPERATING PROCEDURE W-6

SLUG TEST AQUIFER TESTING

1. SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) defines the methods for collecting data to calculate in situ hydraulic conductivity by the use of the slug test method.

Slug tests are used to estimate the hydraulic conductivity (K), the transmissivity (T), and the storage coefficient (s) of a water-bearing zone. These parameters (K, T, and s) are used to determine the rates of groundwater flow and contaminant transport.

Three types of tests are commonly used to characterize aquifer properties:

- **Laboratory Tests** - Provide point estimates of the one-dimensional vertical hydraulic conductivity while ignoring all but small-scale heterogeneities.
- **Slug Tests** - Provide in situ estimates of the two-dimensional horizontal hydraulic conductivity (and sometimes T and s) for a localized zone around a borehole.
- **Pumping Tests** - Provide in situ estimates of three-dimensional flow parameters for a relatively large area around a pumping well.

Typically, all three types of tests will be used together to characterize a site. The usefulness of laboratory tests, however, is limited because: (1) they do not effectively test macro-scale hydrologic features, such as fractures; and (2) they can test flow only in one dimension (usually vertical flow) and are not useful for evaluating two-dimensional horizontal flow. The use of pumping tests is limited by the expense of the tests and the need to dispose of large volumes of contaminated groundwater.

Slug tests involve displacing a known volume of water in a well instantaneously and measuring changes in the water level over time as the water level in the well returns to equilibrium. Displacing the water in the well is accomplished by lowering or raising a slug. A slug is a solid cylinder (or hollow, weighted, and capped cylinder) of polyvinyl chloride (PVC), Teflon, or stainless steel with an attachment point for a hauling line. Other variations of the test include the instantaneous addition or removal of a known volume of water to or from the well. Tests performed by lowering the slug into the well and raising the water level are called falling-head slug tests. Tests performed by raising the slug out of the well and lowering the water level are called rising-head slug tests. Data from both types of tests are comparable so long as the screened and filter pack section of the well is fully saturated (falling-head slug tests will produce erroneous results if the well screen or filter pack is partially saturated). Typically, falling-head tests and rising-head tests are conducted in pairs (when appropriate) as a quality control check to measure the consistency of test results.

Slug tests have several advantages over other types of aquifer tests in that they:

- Can evaluate the hydraulic conductivity of small portions of a water-bearing zone to assess aquifer heterogeneity.
- Are technically simple to conduct in the field.
- Are relatively inexpensive to complete, even in large numbers.
- Can be completed in a relatively short time.
- Pose fewer risks to the health and safety of field personnel.
- Pose little or no problems with the disposal of contaminated water.

Slug test data are usually analyzed using the methods proposed by Hvorslev (1951), Cooper et al. (1967), and Bouwer and Rice (1976). Hvorslev's method can be applied to a variety of different well and aquifer geometries, but has been used most commonly for unconfined systems. The Bouwer and Rice method is also designed for unconfined systems, and has been used more commonly than Hvorslev's method because it is somewhat easier to calculate. The Cooper Bredehoeft Papadopulos (CBP) method is the most commonly used method for analyzing slug tests in confined aquifers. The CBP method is the only one of the three that uses type-curve matching instead of straight-line fitting to analyze the water level change data.

2. EQUIPMENT

Water pressure transducers
Electronic data logger

Electric water level indicator

Stainless steel, Teflon™, or PVC slug of a known volume

Watch or stopwatch with second hand

Duct tape

Appropriate references and calculator

Slug Test Information Forms

Non water-soluble black ink marking pens

Rope (1/8 to 3/16 inch in diameter)

Portable personal computer

Portable field printer and accessories (optional)

Field notebook

Clean cloth and plastic sheeting

Photoionization detector (PID) or flame ionization detector (FID)

3. RELATED PROCEDURES

SOP G-2	Use and Calibration of Field Instruments
SOP G-6	Decontamination
SOP W-3	Water Level and Well Depth Measurements

4. PROCEDURE

Most field efforts, work projects, and sampling events require participants to have a thorough understanding of multiple operating practices. Field personnel performing aquifer slug tests, at a minimum, need to be familiar with the following associated procedures:

- ASTM D4043 Standard Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques
- ASTM D4044 Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers
- ASTM D4104 Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests)

4.1 PREPARATION

Field Team Leaders and other key project members (including a state-licensed professional geologist or engineer with experience conducting the slug tests) are required to meet with the Project Manager to discuss contractual requirements for surface aquifer slug tests. At a minimum, the following activities should be conducted:

- Discuss the extent and methods of the slug tests to be performed. Review available background information (i.e., topographic maps, aquifer data, geologic survey maps, well records, other site reports).
- Review associated operating practices for information on the performance of all relevant field activities that will be required to complete slug tests.
- Obtain appropriate permission for property access and off-site testing.
- Determine necessary testing and monitoring equipment. Decontaminate or pre-clean equipment. Inspect and test, if possible, all equipment to determine the operating condition of equipment to be used prior to performance of field activities.
- Obtain the appropriate field data collection forms.
- Obtain a logbook for documentation of equipment checks and other miscellaneous activities not documented in field data collection forms.
- Contact the delivery service to confirm the ability to ship equipment and samples to and from the site. Determine if shipping restrictions exist, and confirm regulations and specifications.
- Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.

4.2 FIELD PREPARATION

- Confirm that all equipment has been decontaminated or pre-cleaned before testing.
- Conduct a site survey prior to site entry in accordance with the Accident Prevention Plan (APP).
- Locate the monitor wells to be tested, and check for proper labeling and signs of vandalism.
- Open the well lock and protective casing, remove the well cap, and monitor the well head with an organic vapor detector (PID or FID) or as specified in the Site APP. The

resultant readings will determine the protective level required when working around the well head.

- Record in the logbook the appearance and physical condition of the monitoring well, the depth to water, the stickup, and the depth of the well. Calculate the volume of standing water in the well.
- Calibrate the transducer.

4.3 AQUIFER SLUG TEST OPERATION

The following are general procedures for performing slug tests. The procedures required for a particular slug test may vary slightly from those described, depending on site-specific conditions.

- Take precautions to minimize the potential for cross-contamination between wells. Slugs and measuring devices that contact aquifer water must be properly decontaminated prior to initiating each test.
- If tests are performed on more than one monitoring well, begin testing at the least contaminated well [usually the upgradient well(s)] and work downgradient in order of the least to most contaminated wells.
- Conduct the slug tests on undisturbed wells. If a test is conducted on a well that has recently been pumped for water sampling purposes, the measured water level must be within 0.1 ft of the static water level before sampling, or the slug test must not be conducted within 24 hours of sampling, whichever occurs first.
- When the slug test is performed with an electronic data logger and pressure transducer, store all data internally on the logger.
- Download the data to a computer as soon as possible after the test to ensure that the data were collected properly.
- Maintain a hard copy printout of the data in the files as backup to electronic data loss or failure.

The time required for a slug test is a function of the volume of the slug, the hydraulic conductivity of the formation, and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions, yet not so large that water flow is impeded or suction is caused on slug withdrawal. The length of the test may range from seconds to several hours, but is typically in the range of minutes.

4.4 AQUIFER SLUG TEST PROCEDURE

To complete a slug test in the field, the following steps will be performed:

- Determine whether the screened section of the well and the filter pack is fully saturated. Note in the logbook if the screen or the filter pack is not saturated.

- Unpack the data logging equipment. Examine it for visible damage. Check the operation of the data logging equipment. Record the results of the equipment check in the logbook.

- Pad the edges of both the inner and outer well casings with several layers of duct tape to protect transducer cables from sharp edges. Connect the transducer to the data logger.

- Measure a length of transducer cable sufficient to lower a transducer to a point approximately 10 feet below the water level measured in the well. The transducer should not be lowered to a depth greater than 1 foot above the measured bottom of the well to avoid being clogged with sediment.

- Securely tape the transducer cable with duct tape to the outside of the well's protective casing.

- Enter the required information into the electronic data logger. The type of information required by the logger may vary depending on the model used. Consult the data logger manual for the proper data entry sequence to be used. Typically, the following items must be entered:

  - Station ID or well numbers.
  - Test and step numbers.
  - Date and time.
  - Scale factor and offset for each transducer.
  - Initial water level.
  - Sampling rate.

- Attach a disposable rope to a slug of known volume. Measure and mark a length of rope sufficient to lower the top of the slug below the initially measured depth to water. Mark a point on the rope corresponding to where the bottom of the slug will be suspended just above the initial (top of) water level. Tie an attachment loop in the end of the rope.

- Lower the slug into the well to the marked point where the bottom of the slug is suspended just above the initial water level.

- Begin taking data on the electronic logger and lower the slug quickly and smoothly to displace and raise the water level to conduct a falling-head slug test. It is important to remove or add the slug as quickly and smoothly as possible because the accurate analysis depends on an instantaneous change in water volume in the well.

- Continue measuring and recording depth-time measurements until the water level returns to a minimum 90% of pretest equilibrium conditions, or if a sufficient number of water level measurements have been made to clearly show a trend on a plot of the data showing recovery versus the logarithm of time. Generally, 10 to 30 minutes is adequate.
- Reset (step) the data logger data collection schedule, and quickly and smoothly remove the slug from the water until it is at a point where the slug bottom is just above the initially measured water level (i.e., lower marked point on the rope) to conduct a rising-head slug test. Secure the rope to the outer casing and repeat preceding step.
- Stop the data logger operation and remove all equipment from the well.
- Secure the well.
- Download the data at the earliest opportunity, but before the capacity of the logger is exceeded.
- Review the recorded data (if possible) to determine whether additional testing is required. If adequate information has been recorded, remove the transducer and slug from the well.
- Decontaminate the slug, the transducer cable, and any other equipment used in the well for the test. Do not reuse rope between wells.

4.5 DOCUMENTATION

- Ensure that all equipment is accounted for, decontaminated, and ready for shipment.
- Make sure all slug test well locations are properly identified and readily visible.
- Deliver the original field data collection forms and field notebook to the Project Manager (or designee). The original field documents should be copied and filed.
- Follow the quality assurance/quality control (QA/QC) regimen established for the data. This should include documentation of all corrections or changes to the field forms. The field personnel should review these changes for accuracy at appropriate times during the QA/QC process.
- Have a state-licensed professional geologist or engineer with experience in conducting slug tests analyze, interpret, and report the test data using appropriate software packages or graphical solution methods. Acceptable standard methods include the following:

- For unconfined aquifers:
    - Bouwer and Rice method (1976 and 1989)
    - Hvorslev method (1951)
- For confined aquifers:
    - Cooper, et al (1967)
    - Papadopulos, et al (1973)
    - Nguyen and Pinder (1984)
    - Bouwer and Rice (1976 and 1989)
- If the well screen was not fully saturated, do not analyze the falling head test unless the aquifer conductivity is very low.

5. BIBLIOGRAPHY

ASTM Standard D4043. 2004. “Standard Guide for Selection of Aquifer Test Method in Determining Hydraulic Properties by Well Techniques.” ASTM International, West Conshohocken, PA. 2004, DOI: 10.1520/D4043-96R04. www.astm.org.

ASTM Standard D4104. 2004. “Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests).” ASTM International, West Conshohocken, PA. 2004, DOI: 10.1520/D4104-96R04. www.astm.org.

ASTM Standard D4044. 2008. “Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers.” ASTM International, West Conshohocken, PA. 2008, DOI: 10.1520/D4044-96R02. www.astm.org.

Bouwer, H. and R.C. Rice. 1976. "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells." *WRR*, Vol. 12, No. 3, p. 423-428.

Bouwer, H. 1989. *The Bouwer and Rice Slug Test – An Update.* Ground Water, Vol. 27, No. 3.

Cooper, Jr., H.H., J.D. Bredehoeft, and S.S. Papadopulos. 1967. "Response of a Finite-Diameter Well to an Instantaneous Charge of Water." *WRR*, Vol. 13, No. 1, p. 263-269.

Hvorslev, M.J. 1951. "Time Lag and Soil Permeability in Ground-Water Observations." 50. U.S. Army Corps of Engineers, Bulletin No. 36. Washington, DC.

Nyugen, V., and G.P. Pinder, 1984. *Direct Calculation of Aquifer Parameters in Slug Test Analyses, Groundwater Hydraulics.* American Geophysical Union Water Resources Monograph 9.

Papadopulos, I.S., H.H. Cooper, and J.D. Bredehoeft, 1973. *On the Analysis of Slug Test Data.* Water Resources Research, Vol. 9, pp. 1087 – 1089.

APPENDIX D
FIELD FORMS

Field Forms
Tailgate Safety Meeting Report
Employee/Visitor Daily Roster
Daily Work Summary Report
Equipment Calibration Log
Soil Sample Collection Field Sheet
GEOPROBE Soil Boring Log
SPLIT SPOON Soil Boring Log
Borehole Abandonment Log
Well Construction Log
Well Purging Form
Static Groundwater Level Measurement Form
Low Flow Groundwater Sampling Record
Well Development Information
Waste Inventory Tracking Log

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TAILGATE SAFETY MEETING REPORT

A tailgate safety meeting should be held before each unique activity, for each new crew and daily thereafter.

Site Name: **Date:**

Contract No.: **Delivery Order No.:**

HEALTH & SAFETY PLAN REVIEW

☐ H & S objectives	☐ Site emergency procedures	☐ Chem. hazards. contaminants	☐ Physical hazards
☐ Site history	☐ Air-horn signals, if any	☐ Exposure pathways	☐ Well drilling oper.
☐ Gen. site hazard assess.	☐ Hospital location	☐ Exposure monitoring program	☐ Noise monitoring
☐ Chain of command	☐ Telephone location	☐ Acute symptoms, if distinct	☐ Heat stress
☐ Visitor policy	☐ Response to media inquiries	☐ Decontamination procedures	

FIELD ACTIVITY

Safety Topics and Suggestions

Personal Protective Equipment (PPE)

Emergency Information and Procedures

Injuries and Accidents Since Previous Meeting

Additional comments

TAILGATE SAFETY MEETING ATTENDEES	DATE	
NAME	COMPANY	SIGNATURE

Meeting conducted by ______________________ Title ______________________

Signature ______________________ Date/Time ______________________

EMPLOYEE/VISITOR DAILY ROSTER

This roster is required for emergency response planning. All personnel arriving to and from the site must sign this roster. This log does not replace the H&S Orientation

Site Name:	**Contract No.:**
Date:	**Delivery Order No.**
Project Manager:	

DATE	NAME	COMPANY	TIME ONSITE	TIME OFF-SITE

DAILY WORK SUMMARY REPORT

Project Title & Location: ______________________________________

Contract No.: ________________________ **Date:** _________ **Rpt. No.:** ___

Weather: ☐ Clear ☐ Partly Cloudy ☐ Cloudy ☐ Rainfall (% of workday)

Temperature during workday: High °F. Low °F.

WORK PERSONNEL

Name	Company	Title/Job Role	Description of Work

OPERATING EQUIPMENT DATA (NOT HAND TOOLS)

Equipment	User	Hours Used	Hours Idle

WORK PERFORMED TODAY (Indicate location and description of work performed by prime and/or subcontractors):

DAILY WORK SUMMARY REPORT

DATE:__________

WORK PERFORMED TODAY cont. (Indicate location and description of work performed by prime and/or subcontractors):

DAILY HEALTH AND SAFETY ISSUES (Include highlights from daily health and safety meetings):

WORK DELAYS (Include a description and time frame of any work periods of delays due to ramp freezes, health and safety, equipment issues, and any lessons learned from the delays):

DAILY WORK SUMMARY REPORT

DATE:__________

REMARKS/NOTES (Include conversations with or instructions from the Client representatives; deviations from work plan; comments on change orders; environmental considerations; etc.):

Equipment Calibration Log

Page: _______ of _______

Project:
Project #:

Equipment Name	Equipment Number	Date & Time	Standards Used	Equipment Reading	Comments	Performed By

SOIL SAMPLE COLLECTION FIELD SHEET

GENERAL INFORMATION

SITE NAME: ____________________ PROJECT NO. ____________________

SAMPLE NO. ____________________ BORING NO. ____________________

DATE/TIME COLLECTED: ____________________ PERSONNEL: ____________________

SAMPLE METHOD / DEPTH: ____________________ ____________________

SAMPLE MEDIA:	SOIL	SEDIMENT	SLUDGE
SAMPLE QA SPLIT:	YES	NO	SPLIT SAMPLE NO. ____________________
SAMPLE QC DUPLICATE:	YES	NO	DUPLICATE SAMPLE NO. ____________________
MS/MSD REQUESTED:	YES	NO	

SAMPLE CONTAINERS, PRESERVATIVES, ANALYSIS

Sample Container	Preservative	Analysis Requested

OVA MEASUREMENTS

Background ____________________

Breathing zone ____________________

Boring ____________________

Headspace ____________________

SAMPLE DESCRIPTION

DEPTH:	DESCRIPTION:

GENERAL COMMENTS

____

____

____

GEOPROBE Soil Boring Log

Job Name

Job No.

Boring No.

Page ____ of ____

Logged By

Date Drilled

Drilling Co.

Drill Foreman

Boring Method/ Sample Method Geoprobe / Macrocore 4-ft 5-ft

Completion Depth

Location

Depth (Feet)	Recovery (% or inches)	PID every 6"	Visual Description	Sample No.	Comments

Depth to Groundwater: ____________

Backfill Type: Cuttings Cuttings/Bentonite Bentonite Asphalt / Concrete

Monitoring Well Installed? YES NO

Monitoring Well ID: ____________

Location surveyed? Yes No GPS Surveyor Other

Soil Logging Visual Descriptors

FORMAT: Moisture - Color - Soil Type (gradation) - Compactness/Consistency - Observations

EXAMPLE: Saturated brown medium SAND, little coarse gravel, trace silt, dense, odor.

Soil Type

clay		
silt		
sand		
	fine	
	medium	
	coarse	
gravel		> 0.19"
	fine	
	coarse	
cobbles		3-12"
boulders		> 12"

Gradation

	%
"and"	35-50
"some"	20-35
"little"	10-20
"trace"	0-10

Observations

- staining
- sheen
- smearing
- odor
- product (residual or free)
- other

Moisture

Descriptor
dry
moist
wet
saturated

Color

- light brown
- brown
- dark brown
- red
- red-brown
- tan
- dark grey
- light grey
- olive grey
- white
- orange
- yellow
- green
- black

Compactness (coarse-grained, non-plastic)

Descriptor	Blow Counts
loose	< 11
medium dense	11-30
dense	31-50
very dense	> 50

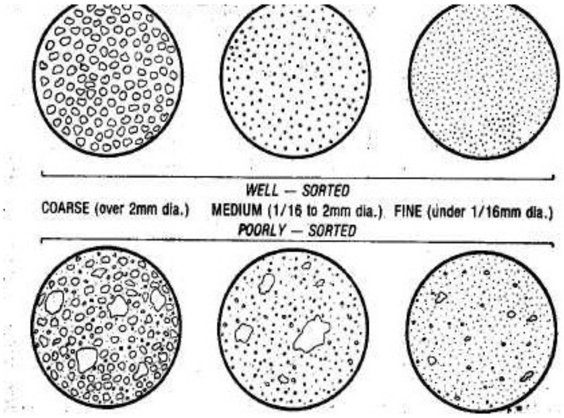
Consistency (fine-grained, some plasticity)

Descriptor	Blow Counts	
very soft	< 3	
soft	3-5	thumbtip indent- easy
medium	6-15	thumbtip indent- hard
stiff	16-25	thumbnail indent- easy
hard	> 25	thumbnail indent- hard

Sorting (Native materials/native sands only)

Well-sorted = uniform grain size
Poorly sorted = mix of grain sizes

Upward-fining = coarse grains at bottom of unit
Upward-coarsening = fine grains at bottom of unit



SPLIT SPOON Soil Boring Log

Job Name	**Boring No.**	**Logged By**
Job No.	**Page ____ of ____**	

Date Drilled:
Drilling Co.:
Driller:

Boring Method Mud rotary Air rotary ODEX Hollow-stem auger
Sample Method **Spoon diameter** **2"** **3"** **other _____**
Completion Depth **Boring diameter** **(fill in) __________**

Depth (Feet)	**Recovery**	**PID every 6"**	**Blow Counts for each 6"**		**Visual Description**	**Sample No.**	**Comments**

Depth to Groundwater: __________

Backfill Type: Cuttings Cuttings/Bentonite Bentonite Asphalt / Concrete

Monitoring Well Installed? YES NO

Monitoring Well ID: __________

Location surveyed? Yes No **GPS** **Surveyor** **Other**

Soil Logging Visual Descriptors

FORMAT: Moisture - Color - Soil Type (gradation) - Compactness/Consistency - Observations

EXAMPLE: Saturated brown medium SAND, little coarse gravel, trace silt, dense, odor.

Soil Type

clay		
silt		
sand		
	fine	
	medium	
	coarse	
gravel		> 0.19"
	fine	
	coarse	
cobbles		3-12"
boulders		> 12"

Gradation

	%
"and"	35-50
"some"	20-35
"little"	10-20
"trace"	0-10

Observations

staining
sheen
smearing
odor
product (residual or free)
other

Moisture

Descriptor
dry
moist
wet
saturated

Color

light brown
brown
dark brown
red
red-brown
tan
dark grey
light grey
olive grey
white
orange
yellow
green
black

Compactness (coarse-grained, non-plastic)

Descriptor	Blow Counts
loose	< 11
medium dense	11-30
dense	31-50
very dense	> 50

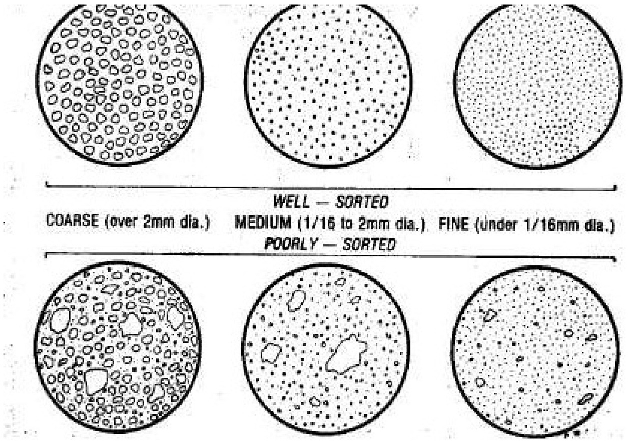
Consistency (fine-grained, some plasticity)

Descriptor	Blow Counts	
very soft	< 3	
soft	3-5	thumbtip indent- easy
medium	6-15	thumbtip indent- hard
stiff	16-25	thumbnail indent- easy
hard	> 25	thumbnail indent- hard

Sorting (Native materials/native sands only)

Well-sorted = uniform grain size
Poorly sorted = mix of grain sizes

Upward-fining = coarse grains at bottom of unit
Upward-coarsening = fine grains at bottom of unit



Borehole Abandonment Log

Location Identifier	Direct Push (DP) or Auger (A)	Date	Total Depth (ft)	Diameter (in)	Backfill Material	Surface Completion

Notes:

HBP - Hydrated bentonite pellets
BHS- Bore hole soil
AS- Asphalt
CEM- Neat Cement
SO- Soil

WELL CONSTRUCTION LOG	Sheet 1 of	**Well ID:**
Project:	Drilling Method:	
Client:	Total Well Depth:	
Date(s) Drilled:	Ground Elevation:	
Drilling Contractor:	Overburden Thickness:	
Drill Rig:	Well Construction:	
Drill Foreman:	Static Water Depth:	
Logged by:	Depth to Groundwater:	

Depth (ft bgs)	Graphic Log			Features	Descriptive Log	Remarks
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						

Legend: F-Fracture, C-Contact, M-Mineralized Zone, WX-Weathered Zone

B:\5.0-PROJECT PLANS\02 FIELD FORMS\Form_Well Construction Log.xlsx 12/3/2015

WELL CONSTRUCTION LOG	Sheet 2 of	**Well ID.:**
Project:	Drilling Method:	
Client:	Total Well Depth:	
Date(s) Drilled:	Logged by:	

Depth (ft bgs)	Graphic Log			Core Time (min/ft)	Descriptive Log	Remarks
55						
60						
65						
70						
75						
80						
85						
90						
95						
100						
105						

Legend: F-Fracture, C-Contact, M-Mineralized Zone, WX-Weathered Zone

WELL CONSTRUCTION LOG	Sheet 3 of	**Well ID.:**
Project:	Drilling Method:	
Client:	Total Well Depth:	
Date(s) Drilled:	Logged by:	

Depth (ft bgs)	Graphic Log	Core Time (min/ft)	Descriptive Log	Remarks
110				
115				
120				
125				
130				
135				
140				
145				
150				
155				
160				

Legend: F-Fracture, C-Contact, M-Mineralized Zone, WX-Weathered Zone

WELL CONSTRUCTION LOG	Sheet 4 of	**Well ID.:**
Project:	Drilling Method:	
Client:	Total Well Depth:	
Date(s) Drilled:	Logged by:	

Depth (ft bgs)	Graphic Log			Core Time (min/ft)	Descriptive Log	Remarks
165 170 175						
180 185 190 195 200						
205 210 215						

Legend: F-Fracture, C-Contact, M-Mineralized Zone, WX-Weathered Zone

WELL CONSTRUCTION LOG	Sheet of	**Well ID:**
Project:	Drilling Method:	
Client:	Total Well Depth:	
Date(s) Drilled:	Ground Elevation:	
Drilling Contractor:	Overburden Thickness:	
Drill Rig:	Well Construction:	
Drill Foreman:	Static Water Depth:	
Logged by:	Depth to Groundwater:	

Depth (ft bgs)	Graphic Log	Features	Descriptive Log	Remarks

Legend: F-Fracture, C-Contact, M-Mineralized Zone, WX-Weathered Zone

Well Purging Form

Company:
Client
Project:
Site/Area:

Location ID:
Date:
Sampler:
Signature:

Well Observations

Well Diameter:
Measuring Point:
Checked for NAPL:

Casing/Lid Condition:
Vapor Readings:
Observed NAPL:

Locked: Key:
Units: cm; ft; inches; meters
Sheen

Purge Calculations

(A) Depth to Well Bottom: (ft)
(B) Depth to Water: (ft)
(C) Sand Pack Length: (ft)
(D) Water Column Height (A-B): (ft)
(E) Casing Volume Factor: (GPF)
(F) Sand Pack Volume Factor: (GPF)
(G) Casing Volume (D x E): (Gal)
(H) Sand Pack Volume (C X F): (Gal)

Casing Factor (GPF for inches) = 0.041 (Well Diameter)^2
2” = 0.16; 4” = 0.65; 6” = 1.47; 8” = 2.61 GPF

Sand Pack Factor (GPF for inches)
= [0.041 (Hole Diameter)^2 – 0.041(Well Diameter)^2] 0.45

(I) Total Well Volume (G + H): (Gal)
(J) Volumes to be Purged:
(K) Total Purge Volume (I X J):

Purging Information

Purging Endpoint:
Purging Method:
Device Description:
Pump/Bailer Intake:
Purge Water:
Stored In: Tanks – Drums –

Criteria:
Cascading Water:
Field Measurements In:

Time	Depth to Water (ft BMP)	Purge Rate or Volume (GPM-Gal)	Turbidity (NTU)	Field Measurements and Units						Comments
				Temperature	pH	Specific. Conductance	Dissolved Oxygen	EH	PID	
				°C		µg/cm	%	ORP		

Total Purge Time: Total Purge Volume: Recovery:

Field Measurements

Manganese:: Ferrous Iron:

Static Groundwater Level Measurement Form

Project Location:

Well Identifier	Date	Time	Well Depth (FTOC)	Screen Length (ft)	Measuring Point (GL or TOC)	Depth to Water (FTOC)	PID Reading (Above Bkgrd) (ppm)

Notes: Well depth to be measured at time of sampling

LOW FLOW GROUNDWATER SAMPLING RECORD

PROJECT NAME ______________________ PROJECT # ______________ WELL ID __________

LOCATION ______________________

SAMPLING CREW ______________________ DATE: ______________ SAMPLE TIME: __________

PURGING DATA

REFERENCE POINT (CIRCLE): PVC Steel Casing TIC TOC

PURGING DEVICE: ______________

WELL COMPLETION (CIRCLE): Flush Stick-up

INITIAL DEPTH TO WATER ______________ (FT)

WELL DEPTH ______________ (FT)

Well Diameter __________

CLOCK TIME (24 HR)	Water Depth Below MP (ft)	PURGE RATE (mL/min)	CUM. VOLUME PURGED (L)	TEMP (°C) **(+/-1°C)**	SP COND (uS/cm^c)^1 **(+/-10%)**	pH (s.u) **(+/-0.1)**	ORP/Eh^2 (MV) **(+/-10)**	DO (mg/L) **(+/-10%)**	Turb (NTU) **(+/-10%)**	COMMENTS

1. uSiemens per cm (same as umhos/cm) at 25C
2. Oxidation reduction potential (stand in for Eh)

FINAL FIELD DATA

TEMPERATURE: ______________ (°C)

SPECIFIC CONDUCTANCE: ______________ (uS/cm)

pH: ______________ (S.U.)

ORP: __________ (MV)

DO: __________ (mg/L)

TURBIDITIY: __________ (NTU)

COMMENTS: ______________________

ODOR AND PHYSICAL APPEARANCE OF SAMPLE: ______________________ TOTAL DEPTH OF WELL: ______________

WEATHER CONDITIONS: ______________________

LOW FLOW GROUNDWATER SAMPLING RECORD

PROJECT NAME ______________________ Date: ______________ WELL ID __________

WELL CONDITION DATA

Protective Casing Present:	Y	N	Concrete Pad Present:	Y	N	Cap on Riser:	Y	N
Protective Casing Locked:	Y	N	Standing Water:	Y	N	Visible Heaving:	Y	N
Physical Damage:	Y	N						

If yes, Describe: ______________________

Field Notes/Observations:

SAMPLER'S SIGNATURE: ______________________

Well Development Information

(Page 1 of 2)

WELL ID: ______________________________

Site Name: ____________________________

Date: _________________________________

Field Personnel: ________________________

Weather: ______________________________

Stickup or Flush Mount (circle one)

Measuring Point: _______________________

WELL TOTAL DEPTH: ___________________________

DEPTH TO WATER: _____________________________

WATER COLUMN: ______________________________

WELL DIAMETER FACTOR: ______________________

(1.5”=0.1, 2”=0.16, 4”=0.65, 5.75”=1.35, 6”=1.47, 8”=2.51)

ONE WELL VOLUME: ___________________________

PURGE METHOD: ______________________________

ACTUAL VOLUME PURGED: ______________________

PURGE DATA

TIME	**Water Level** (ft bmp)	**Purge Rate** (lpm or gpm)	**Headspace** (ppm)	**Turbidity** (y/n)
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________
________	________	________	________	________

Well Development Information

(Page 2 of 2)

WELL ID: ______________________________

PURGE DATA (Continued)

TIME	**Water Level**	**Purge Rate**	**Headspace**	**Turbidity**
	(ft bmp)	(lpm or gpm)	(ppm)	(y/n)

Notes:

Waste Inventory Tracking Log

Drum Identifier	Contents (Site, Matrix, Sample Locations, Level of contamination)	Date Filled	Storage Location	Analytical Results (Y/N)	Properly Disposed (Y/N and Subcontractor)	Manifest and Custody completed and returned (Y/N)

Notes:

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APPENDIX E
LABORATORY STANDARD OPERATING PROCEDURES

LABORATORY SOPS

LABORATORY ACCREDITATION

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TestAmerica Denver
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Phone: 303-736-0100
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Title: Acid Digestion of Aqueous Samples for Metals Analysis by ICP

Approvals (Signature/Date):

Doug Gomer	6/26/15	Adam W Alban	26 June 15
Doug Gomer Technical Specialist	Date	Adam Alban Health & Safety Manager / Coordinator	Date
Margaret S. Sleevi	6/29/15		6/26/15
Margaret S. Sleevi Quality Assurance Manager	Date	William S. Cicero Laboratory Director	Date

Facility Distribution No. ____________ **Distributed To:** ________________________

1.0 Scope and Application

1.1 This standard operating procedure (SOP) describes the acid digestion of aqueous samples by EPA Method 200.7, SW-846 Method 3005A or SW-846 Method 3010A prior to the determination of the concentration of individual metallic elements by inductively coupled plasma atomic emission spectroscopy (ICP). These methods include digestions for total, total recoverable, dissolved, and potentially dissolved analytes (see definitions in Section 3).

1.2 This SOP is applicable to ground water, surface water, domestic and industrial wastewater, TCLP leachates, and other aqueous media. This SOP is not applicable to oils or other liquids that are not miscible with water.

NOTE: Samples that are found to be immiscible with water, e.g., contain oil or other immiscible organic solvents, are subcontracted to other labs that are capable of handling such samples. If during the preparation process it is discovered that the sample is immiscible with water or is biphasic, the analyst notifies the Technical Specialist and Project Manager, who can subcontract the samples to a laboratory with the capability to handle the sample.

1.3 The following table summarizes the applicability of the various digestion methods referenced in this SOP. All sample digestates are analyzed by ICP in accordance with SOPs DV-MT-0012, DV-MT-0019 and DV-MT-0021.

Method	**Title**	**Summary**	**SOP Section**
3005A/200.7_Prep	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by ICP	Preparation of surface and ground water samples for total recoverable or dissolved metals for analysis by ICP.	10.5
3010A	Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis by ICP	Preparation of aqueous samples, EP and mobility procedure extracts, and wastes that contain suspended solids for total metals analysis by ICP.	10.7

1.4 Sample digestion requirements are established by the laboratory Project Manager before samples are received. TestAmerica LIMS (TALS) method codes are applied to samples at Login to indicate which digestion is to be used for each sample.

1.5 This procedure can be used for all of the elements listed in Table 1. Additional elements may be analyzed using the digestion methods in this SOP provided the method performance criteria specified in Section 12 and the Quality Control (QC) acceptance criteria specified in Section 9 of this SOP and the ICP determinative SOPs DV-MT-0012, DV-MT-0019 and DV-MT-0021 are met.

1.6 All samples require digestion prior to analysis, with the possible exception of "direct analysis" of dissolved metals in filtered and acidified aqueous samples. Although digestion is not specifically required by the method, some clients and regulators do require digestion of dissolved samples. This must be determined by the laboratory Project Manager before projects start, and is communicated to the analysts through Method Comments in TALS.

2.0 Summary of Method

2.1 Method 3005A/200.7_Prep, Total Recoverable, Dissolved Metals or Potentially Dissolved Metals

A representative portion of sample is heated with diluted nitric and hydrochloric acids until substantially reduced in volume. The digestate is filtered (if necessary) and diluted to volume.

2.2 Method 3010A Total Metals

A representative portion of sample is refluxed with nitric acid. This step is repeated until the digestate is light in color or until its color has stabilized. After the digestate has been reduced to a low volume, it is refluxed with hydrochloric acid, filtered (if necessary), and brought up to volume.

3.0 Definitions

3.1 Dissolved Analyte: The concentration of analyte in an aqueous sample that will pass through a 0.45-µm membrane filter prior to acidification (sample is acidified after filtration).

3.2 Potentially Dissolved Metals: The concentration of elements in solution after acidifying the sample with nitric acid to pH < 2, holding at room temperature for 8 to 96 hours, and then filtering through a 0.45-µm membrane filter. This definition is based on the Colorado surface water regulations.

3.3 Total Recoverable Analyte: The concentration of analyte determined by analysis of the solution extract of a solid sample or an unfiltered aqueous sample following digestion by refluxing with hot dilute mineral acid(s).

3.4 Total Metals: The concentration of elements in an unfiltered sample subject to a more rigorous nitric acid / hydrochloric acid digestion than is used for total recoverable metals.

3.5 General Analytical Terms: Refer to the Glossary of the TestAmerica Denver Quality Assurance Manual (QAM) and policy DV-QA-003P, “Quality Assurance Program,” for definitions of general analytical and QA/QC terms.

4.0 Interferences

4.1 Potential sources of trace metals contamination include metallic or metal-containing labware (e.g., talc powdered gloves which contain high levels of zinc), containers, impure reagents, dirty glassware, improper sample transfers, dirty work areas, and atmospheric inputs such as dirt and dust, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them.

4.2 Physical interference effects may contribute to inaccuracies in the determinations of trace elements. Oils, solvents, and other matrices may not be digested using these methods if they are not miscible with acids. If physical interferences are present, they should be documented in the final report case narrative.

4.3 Visual interferences or anomalies (such as foaming, emulsions, precipitates, etc.) must be documented in the final report case narrative.

4.4 Allowing samples to boil or go dry during digestion may result in the loss of volatile metals. If this occurs, the sample must be re-prepared. Antimony is easily lost by volatilization from hydrochloric acid media.

4.5 Precipitation of silver chloride (AgCl) may occur when chloride ions and high concentrations of silver (i.e., greater than 1 mg/L) are present in the sample. Method 3005 or 3010 samples containing more than 1 mg/L silver are redigested at a reduced sample volume and reanalyzed to produce more accurate results. Method 200.7 requires samples to be redigested if the silver is greater than 0.1 mg/L.

4.6 Specific analytical interferences are discussed in the ICP determinative methods. See SOPs DV-MT-0012, DV-MT-0019, and DV-MT-0021.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Safety Manual, Radiation Safety Manual and this document.

5.2 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.

5.3 Specific Safety Concerns or Requirements

5.3.1 Eye protection that satisfies ANSI Z87.1, laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated must be removed and discarded; non-disposable gloves must be cleaned immediately.

5.3.2 Samples that contain high concentrations of carbonates or organic material, or samples that are at elevated pH can react violently when acids are added.

5.3.3 Care must be taken when handling the digestion tubes. The tubes may become very hot during the digestion procedure. Allow the tubes to cool before attempting to touch the digested samples.

5.4 Primary Materials Used

5.4.1 The following is a list of the materials used in this method which have a serious or significant hazard rating.

5.4.2 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.

Material (1)	**Hazards**	**Exposure Limit(2)**	**Signs and Symptoms of Exposure**
Stock Standard Solutions	Oxidizer Corrosive Poison	5 mg/m^3 as HNO_3	Toxic. Causes irritation to the respiratory tract. Causes irritation. Symptoms include redness and pain. May cause burns. May cause sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. May affect the central nervous system. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage.
Nitric Acid (HNO_3)	Corrosive Oxidizer Poison	2 ppm (TWA) 4 ppm (STEL)	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Hydrochloric Acid (HCl)	Corrosive Poison	5 ppm (Ceiling)	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 EQUIPMENT AND SUPPLIES

6.1 Instrumentation

6.1.1 Digestion blocks, with adjustable heating, capable of maintaining a sample temperature of 90 - 95 °C.

6.1.2 Thermometer that covers a temperature range of at least 80 - 110 °C, in increments of 1 °C.

6.1.3 Liquid-filled thermometers must have a tag indicating that the accuracy was checked by the QA group within the last 12 months.

6.1.4 Digital thermometers must have a tag showing that they were checked within the last three months.

6.1.5 See SOP DV-QA-0001 for details of the thermometer calibration procedure.

6.1.6 Centrifuge (when the desired method of removing particulates is centrifugation).

6.1.7 Calibrated mechanical pipettes with disposable pipette tips. Pipette calibration is checked in accordance with SOP DV-QA-0008.

6.2 Supplies

6.2.1 Disposable digestion tubes, with volume accuracy verified to ± 3% gravimetrically prior to use. See SOP DV-QA-0008.

6.2.2 Watch glasses, ribbed or equivalent, or disposable digestion tube covers.

6.2.3 Whatman GD/XP - PVDF membrane, 0.45-micron syringe filters (No. 6973-2504), for trace metal analysis, or equivalent. When used to filter any sample in a preparation batch or analytical batch, filters of the same type are also used to filter the method blank and the LCS in the batch. Acceptable results for the QC samples demonstrate that the filters neither add nor subtract analytes.

6.2.4 Syringes or equivalent filtration apparatus.

6.2.5 Re-pipettors or suitable reagent dispensers.

6.2.6 Class A volumetric graduated cylinders.

6.2.7 pH indicator strips.

6.2.8 Plastic digestate storage bottles.

7.0 Standards and Reagents

7.1 Standards must be NIST traceable, where available. Multi-element standards are verified against a second-source standard before they are put into use (the only exception is standards purchased directly from NIST), which is described in SOP DV-QA-0015.

7.2 Stock standards are purchased as custom multi-element mixes or as single-element solutions. Standards are logged into the TALS Reagent Module and are assigned unique identification numbers that can be used to access traceability information.

7.3 All standards must be stored in FEP fluorocarbon or previously unused polyethylene or polypropylene bottles.

7.4 Stock standard solutions must be replaced prior to the expiration date provided by the manufacturer. If no expiration date is provided, the stock solutions may be used for up to one year and must be replaced sooner if verification from an independent source indicates a problem.

7.5 Standards containing silver must be protected from light using either a cardboard box or amber containers.

7.6 Shelf-Life

7.6.1 Stock standards, standards as received from the vendor, expire on the date assigned by the vendor. If no date is assigned by the vendor, then a one-year expiration will be assigned by the laboratory.

7.6.2 Intermediate concentration standards or working standards may be used for up to six months. The expiration date cannot be later than the date assigned to the stock standard.

7.6.3 Any suspect standards are re-verified, and replaced if re-verification fails.

7.7 Laboratory Control Sample (LCS) Spike Stock Standards

The LCS spike stock standards are custom-made standards purchased from Inorganic Ventures. The standards are designated ICP-SPK-3A (ICP-1) and ICP-SPK-2B (ICP-2) and contain the following elements at ready-to-use concentrations:

LCS Spike Stock Standards

Elements in LCS Spike	**Concentration in ppm (µg/mL)**
Ca, K, Mg, Na	5,000
P, Si	1,000
Al, Ba, Bi, Se, Tl, U, Sn, S	200
Fe, Sr, Li, B, Mo, Ti, As, Th	100
Co, Mn, Ni, Pb, V, Zn, Sb, Zr	50
Cu	25

Elements in LCS Spike	**Concentration in ppm (µg/mL)**
Cr	20
Cd	10
Ag, Be	5

7.8 TCLP Spike Stock Standard (TCLP Spike)

The TCLP spike stock standard is purchased from commercial sources. The stock is a custom-made standard purchased at ready-to-use concentrations and designated as TCLP Spike, as follows:

TCLP Spike Stock Standard

Elements in TCLP Spike	**Concentration in ppm (µg/mL)**
Ba	1,000
Cr, Pb	500
As	300
Cu, Zn	200
Ag, Cd, Se	100

7.9 TCLP Mercury Spike Solution

TCLP leachate matrix spike samples are spiked for both ICP elements and mercury at the time of sample preparation but before preservation. The mercury spike standard is prepared by the mercury analyst as the mercury daily spike solution (Hg Daily Spk) at a concentration of 100 µg/L (SOP DV-MT-0015).

7.10 Reagent Water

Reagent water must be produced by a Millipore de-ionized system or equivalent and must achieve the performance specifications for ASTM Type II water, i.e., conductivity < 1.0 µmhos/cm; resistivity > 1.0 megohms-cm; silica < 3.0 µg/L. In addition, the reagent water must be free of the analytes of interest as demonstrated through the analysis of method blanks as defined in the determinative SOPs DV-MT-0012, DV-MT-0019, and DV-MT-0021.

7.11 Nitric acid (HNO_3), concentrated, trace metal grade or better.

7.12 Hydrochloric acid (HCl), concentrated, trace metal grade or better.

8.0 Sample Collection, Preservation, Shipment and Storage

Preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Water	HDPE	500 mL	HNO_3, pH < 2	180 Days	40 CFR Part 136.3

[1] Inclusive of digestion and analysis.

9.0 Quality Control

9.1 The minimum required QC, acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the TALS Method Comments to determine which specific QC requirements apply to each job.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Control Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, QA/QC Requirements for Federal Programs.

9.1.3 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 Method Comments in TALS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. Ongoing proficiency must be demonstrated by each analyst on an annual basis. See Section 12 for more details on initial demonstrations of capability, analyst training and qualification.

9.3 Preparation Batch

A preparation batch is a group of up to 20 samples that are of the same matrix and are processed together using the same procedures and reagents. The preparation batch must contain a method blank, an LCS, a matrix spike (MS), and a matrix spike duplicate (MSD). In some cases, at client request, it may be appropriate to process a matrix spike and sample duplicate in place of the MS/MSD. If clients specify samples for the MS/MSD pair, then the batch may contain multiple MS/MSD pairs to accommodate client requests. Clients may also request a duplicate LCS (LCSD). In cases where the client has not provided sufficient sample to prepare an MS and MSD, an LCS and LCSD will be prepared instead.

9.4 Sample Count

Laboratory-generated QC samples (method blanks, LCSs) are not included in the sample count for determining the size of a preparation batch. The MS and MSD are not included in the sample count unless specifically requested by the client. The prep batch consist of the laboratory generated QC and no more than twenty field samples.

9.5 Method Blank (MB)

9.5.1 The method blank consists of reagent water containing all reagents specific to the method that is carried through the entire analytical procedure, including preparation and analysis. When samples are filtered in the laboratory for determination of dissolved metals, then the blank is filtered using a filter of the same type that was used for the samples.

9.5.2 TCLP method blanks are prepared by taking 50 mL of TCLP leachate fluid (see SOP DV-IP-0012) through the appropriate procedure as described in Section 10. TCLP method blanks are referred to as LB (extraction fluid 1) and LB2 (extraction fluid 2) in TALS and on the final reports.

9.5.3 One method blank must be processed with each preparation batch. The method blank is used to identify any system and process interferences or contamination of the analytical system that may lead to the reporting of elevated analyte concentrations or false-positive data. Method blank results are evaluated by the ICP analysts as described in SOPs DV-MT-0012, DV-MT-0019 and DV-MT-0021.

9.5.4 Acceptance Criteria

The method blank should not contain any analyte of interest at or above ½ the reporting limit (RL) or at or above 10% of the measured concentration of that analyte in associated samples, whichever is higher. In other words, the sample result must be a minimum of 10 times higher than the blank contamination level. Method blank results that are greater than ½ the RL may also be reported if the associated sample results fall below the RL and the client accepts the data.

9.5.5 Corrective Action

If the method blank does not meet the acceptance criteria, the blank and all associated samples in the batch must be re-digested and reanalyzed.

9.6 Laboratory Control Sample (LCS)

9.6.1 One aqueous LCS must be processed with each preparation batch. The LCS must contain all analytes of interest and must be carried through the entire analytical procedure. When samples are filtered in the laboratory for determination of dissolved metals, then the LCS is filtered using a filter of the same type that was used for the samples.

9.6.2 An LCS for a batch of aqueous samples is prepared by adding 0.5 mL of each of the LCS spike stock standards, ICP-1 and ICP-2 (Section 7.7), to 50 mL of reagent water. This produces the final concentrations shown in Table 1.

9.6.3 An LCS for a TCLP batch is prepared by adding 0.5 mL of each of the LCS spike stock standards, ICP-1 and ICP-2 (Section 7.7), plus 0.5 mL of the TCLP Spike stock standard (Section 7.8) to 50 mL of the TCLP leachate solution (see SOP DV-IP-0012). This produces the final concentrations shown in Table 2.

9.6.4 The LCS is used to monitor the accuracy of the analytical process. LCS results are evaluated by the ICP analyst as described in SOP DV-MT-0012. Ongoing monitoring of the LCS results provides evidence that the laboratory is performing the method within acceptable accuracy and precision guidelines.

9.6.5 Acceptance Criteria

LCS recovery control limits are set at ± 3 standard deviations about the historical mean. These limits must not be wider than 85 - 115 % recovery for Method 200.7 or 80 - 120 % for Method 6010. The control limits are maintained in the LIMS system.

9.6.6 Corrective Action

If the LCS percent recovery falls outside of the control limits for any analyte, that analyte is judged to be out of control. All associated samples must be reprocessed for analysis. One possible exception is a recovery for a given element above the upper control limit with no detection for the same element in the samples. This latter case must be documented in an NCM and explained in the case narrative.

9.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

9.7.1 A matrix spike (MS) is a field sample to which known concentrations of target analytes have been added. A matrix spike duplicate (MSD) is a second aliquot of the same sample (spiked identically as the MS) prepared and analyzed along with the sample and matrix spike. Normally, one MS/MSD pair is digested with each preparation batch. Samples identified as field blanks, equipment blanks, or rinse blanks are not appropriate for use as the batch MS/MSD.

9.7.2 Some programs (e.g., South Carolina and North Carolina) require that MS/MSD pairs are run at a 10% frequency. Also, some clients may require unspiked duplicate samples in place of or in addition to an MS/MSD pair. Check special project instructions attached as Method Comments in TALS and any project QASs before starting the batch.

NOTE: This method does not require a sample duplicate. Precision is measured using the MS/MSD. Use of the MS/MSD precision is preferred as not all samples will contain measurable concentrations of target analytes. Samples that have target analytes at low concentrations or non-detectable levels do not provide useful precision data. When an MS/MSD is not available, the LCS and LCSD are used to measure precision.

9.7.3 If insufficient sample is available to process an MS/MSD pair, then a duplicate LCS must be processed and an NCM generated. The LCS pair is then evaluated according to the MS/MSD criteria.

9.7.4 The purpose of analyzing matrix spike samples is to assess the effect of the sample matrix on the accuracy and precision of the analysis. MS/MSD results are evaluated by the ICP analysts as described in SOPs DV-MT-0012, DV-MT-0019 and DV-MT-0021. If the MS/MSD results fail to meet control limits while the LCS results are in control, then something about the sample matrix is interfering with the analysis.

9.7.5 Matrix spikes for aqueous sample batches are prepared by adding 0.5 mL of each of the LCS spike stock standards, ICP-1 and ICP-2 (Section 7.7), to a digestion tube containing 50 mL of the selected sample. The final spike concentrations are shown in Table 1.

9.7.6 Matrix spikes for TCLP batches are prepared by adding 0.5 mL of the TCLP Spike stock standard (Section 7.8) plus 0.5 mL of each of the LCS spike stock standards, ICP-1 and ICP-2 (Section 7.7), to 50 mL of the parent TCLP aliquot. A second aliquot is spiked for mercury analysis at by adding 1.5 mL of the 100 mg/L Hg standard (Hg Daily Spk) to 30ml of parent sample. The matrix spike samples are then preserved with HNO_3 to pH < 2. The final spike concentrations are shown in Table 2.

NOTE: The MS and MSD must be spiked prior to preservation of the leachate.

9.7.7 Acceptance Criteria

The recovery for each analyte must fall within established limits. The relative percent difference (RPD) between the MS and MSD must be less than or equal to the established RPD limit. If any analyte recovery or relative percent difference (RPD) between the MS and MSD falls outside the acceptance range, the recovery of that analyte must be in control for the LCS.

9.7.8 Corrective Action

If MS/MSD results fail to meet control limits, but the LCS results are within limits, then samples do not require re-preparation and reanalysis unless the results indicate that a spiking error may have occurred. If the recovery of the LCS also failed acceptance criteria, then corrective action must be taken. Corrective action will include re-preparation and reanalysis of the batch. One possible exception is an LCS recovery for a given element above the upper control limit with no detection for the same element in the samples. This latter case must be documented in an NCM and explained in the case narrative.

9.8 Continuing Calibration Verification Standard (CCV)

Continuing calibration verification standards (CCVs) are not digested but are instead created and evaluated by the ICP analysts as described in SOPs DV-MT-0012, DV-MT-0019 and DV-MT-0021.

9.9 Second-Source Initial Calibration Verification (ICV) Standard

Initial calibration verification standards (ICVs) are not digested but are instead created and evaluated by the ICP analysts as described in SOPs DV-MT-0012, DV-MT-0019 and DV-MT-0021.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 All data shall be recorded directly on the described forms, logbooks, electronic forms, or directly in TALS at the time of data generation. It is not acceptable to record data on loose papers, scraps of paper, gloves, sample vials, or "Post-It" notes. Data may be recorded on paper bench sheets if the sheets are subsequently scanned and saved in a designated folder on the company server.

10.4 Sample Preparation

10.4.1 Samples are typically logged in as either water or solid. Waste such as organic liquids or sludges and tissues (animal/vegetable) are usually logged in with solid test codes. When initiating sample preparation, examine the sample to see if the sample matches the matrix designation. If the sample is logged in as aqueous, but it appears to be a waste (biphasic, oil, sludge-like, organic liquid, lots of sediment, etc.), contact the project manager and the laboratory Technical Specialist for further instructions. It may be necessary to subcontract these samples to a laboratory with the capability to digest organic matrices.

NOTE: TestAmerica Denver has not implemented digestion methods for water-immiscible organic matrices, e.g., oils. Samples that are known to be incompatible with TestAmerica Denver digestion techniques are typically subcontracted to other laboratories.

10.4.2 All samples are to be electronically checked out of sample control using the TALS Internal Chain of Custody (ICOC) module.

10.4.3 Proper sample identification is extremely important in any preparation procedure. Labeling of beakers, digestion tubes, and bottles must be done in a manner to ensure connection with the proper sample.

10.4.4 If possible, prepare all the samples of a project at the same time to minimize the QC required and streamline the flow of the project through the lab, data review and reporting.

10.4.5 Guidelines are provided in Appendix 1 on procedures to minimize contamination of samples and standards.

10.5 Aqueous Sample Preparation Setup

The following setup procedure must be followed for all aqueous samples prior to performing the specific digestion procedure. The sample preparation procedures for Methods 3005A and 3010A detailed in the following sections are also summarized in work instruction WI-DV-016.

10.5.1 Verify sample pH

10.5.1.1 Measure the sample pH with pH paper using a separate aliquot of sample. This can be done using disposable plastic droppers or pouring the sample on to the pH paper. Do not put the pH paper directly into the bottle. Record the pH on a copy of the internal chain of custody (ICOC). When all of the samples have been tested, initial and date the copy of the ICOC, scan it, and save it to the Metals folder on the G: drive.

10.5.1.2 All water sample pH's must be verified and documented before digestion.

10.5.1.3 If the pH>2 for a sample requiring acidic preservation, record the job in the Sample Filtration and Preservation Logbook.

10.5.1.4 If laboratory preservation is required, add 1-2 mL of conc. HNO_3 to the sample. Replace the lid and mix the sample. If the pH is still >2 add another addition of HNO_3. Do not add more than 5 mL. If the pH is still >2 create an NCM saying the sample will not preserve.

10.5.1.5 Allow the sample to sit for 8-16 hours following acidification.

10.5.1.6 Recheck the pH of the sample. If the pH>2, repeat Section 10.5.1.4 until the pH holds at <2 or 5 mL of HNO_3 has been added. If the pH is still >2 after the addition of 5 mL of HNO_3 create an NCM saying the sample will not preserve.

10.5.1.7 Samples cannot be digested for 24 hours after preservation. Note the date/time of this pH recheck in the Metals Prep Log in the LIMS.

10.5.1.8 Leachates or portions of leachates for metallic analyte deteminations must be acidified with nitric acid to a pH <2 unless precipitation occurs. Test a small portion of sample to see if precipitation occurs. If a precipitate forms do not acidify the leachate and analyze as soon a possible. Leachates may be digested as soon as they are acidified.

10.5.2 Select the unfiltered fraction for a total or total recoverable analysis or the filtered fraction for a dissolved analysis. If requested by the client, select the filtered fraction for a total dissolved analysis. For TCLP and SPLP, select the proper sample leachates.

NOTE: Samples requiring dissolved metals determination are either filtered and preserved in the field or are filtered and preserved by the laboratory as soon as possible after receiving the samples. When filtered in the laboratory, the filtration and preservation are recorded in the Laboratory Sample Filtration and Preservation Logbook, including the preservative type and lot number. Filter acceptability is demonstrated by using filters of the same type to filter samples and batch QC samples when preparation batches include samples that were filtered in the laboratory. The results of the analysis of the batch QC samples are used to demonstrate that the filtration process neither adds nor subtracts target analytes from samples. The performance of the filtration process is recorded in TALS.

10.5.3 Mix the sample by shaking the container.

10.5.4 Measure and transfer 50 mL of the sample into a digestion tube (record the lot number of the digestion tubes used in the LIMS). When using calibrated digestion tubes, pour the sample into the tube to the 50 mL mark. For TCLP sample batches pour 10 mL of samples and bring to 50 mL with reagent water. Unless specifically required for a project, all samples are measured by volume and not by weight. Record the volume and units on the preparation bench sheet in TALS. If the digestion cup is filled beyond the required mark, the excess sample must not be poured back into the original container, but must be disposed of as waste.

10.5.5 Mix the sample by shaking the container and then measure two extra aliquots of the sample that is selected for the MS/MSD analysis. Spike each aliquot as described in Section 9.7. Refer to Section 9.7.6 for specific instructions for spiking the selected TCLP sample. Record the standards and pipette identifications in TALS.

10.5.6 Measure and transfer 50 mL of reagent water into a digestion tube for the method blank. If a determination of dissolved metals is requested (LIMS 3005A), use filtered reagent water for the method blank. For TCLP sample batches, measure 10 mL of the TCLP leachate solution and bring to 50 mL with reagent water for the blank. See Section 9.5 for a detailed description of the method blank.

10.5.7 Measure and transfer 50 mL of reagent water into a digestion tube for the LCS and add the spiking solutions as described in Section 9.6.2. For TCLP sample batches, use 10 mL of TCLP leachate fluid and bring to a final volume of 50ml with reagent water for preparing the LCS (Section 9.6.3). Record the standards and pipette identifications in TALS. If determination of dissolved metals is requested and one or more samples were filtered in the laboratory, then filter the LCS using a filter of the same type that was used to filter the sample(s).

10.5.8 If the analysis is for total recoverable, dissolved metals, or potentially dissolved metals, continue on with Section 10.5. If the analysis is for total metals, skip Section 10.6 and go to Section 10.7.

10.6 Total Recoverable, Dissolved, or Potentially Dissolved Digestion for Waters by 3005A and 200.7_Prep.

10.6.1 Add 1 mL of concentrated HNO_3 and 2.5 mL of concentrated HCl to the sample in the digestion tube.

10.6.2 Heat at 90-95 °C until the volume is reduced to between 15 and 20 mL. Record the start and stop times, digestion block temperature (observed and corrected) and the thermometer ID in TALS.

CAUTION: DO NOT ALLOW SAMPLE TO BOIL OR GO DRY. Doing so will result in the loss of analyte and the sample must be re-prepared.

10.6.3 Allow the digestion tube to cool in a fume hood.

10.6.4 Wash down the digestion tube walls with reagent water.

10.6.5 Add 1.5 mL of concentrated HNO_3 to the digestate.

10.6.6 Revolume to 50 mL with reagent water. Cap and shake to mix.

10.6.7 If insoluble materials are present, the sample will be filtered at the instrument by the analyst.

NOTES: If any samples in a preparation batch are filtered, the method blank and LCS associated with that batch must also be filtered.

Instead of filtering, the samples may be diluted and mixed and then centrifuged or allowed to settle overnight to remove insoluble material from the supernatant solution.

10.6.8 The sample is now ready for analysis.

10.7 Total Metals Digestion for Waters or TCLP Leachates by 3010A

10.7.1 Add 1.5 mL of concentrated HNO_3 to the sample in the digestion tube.

10.7.2 Heat at 90-95 °C until volume is reduced to 10 ± 5 mL. Record the start and stop times, digestion block temperature (observed and corrected) and the thermometer ID in TALS.

CAUTION: DO NOT ALLOW SAMPLE TO BOIL OR GO DRY. Doing so will result in the loss of analyte and the sample must be re-prepared.

10.7.3 Allow the digestion tube to cool in a fume hood.

10.7.4 Add another 1.5 mL portion of concentrated HNO_3 and cover the sample with a watchglass.

10.7.5 Continue refluxing until the digestion is complete.

NOTE: Digestion is complete when the digestate is light in color or does not change in appearance. For most samples the addition of two nitric acid aliquots is sufficient. Additional aliquots of nitric acid may be added if necessary.

10.7.6 Evaporate to a low volume of 5 to 10 mL. If the sample does go to dryness, the digestion must be started over using a fresh portion of sample.

10.7.7 Allow the digestion tube to cool in a fume hood.

10.7.8 Add 2.5 mL of concentrated HCl.

10.7.9 Cover and reflux for an additional 15 minutes to dissolve any precipitate or residue.

10.7.10 Wash down the digestion tube walls and watch glass (or digestion tube cover) with reagent water.

10.7.11 Adjust to 50 mL final volume with reagent water. This must be done volumetrically, and not using a balance.

10.7.12 If insoluble materials are present, the sample will be filtered at the instrument by the analyst.

NOTES: If any samples in a preparation batch are filtered, the method blank and LCS associated with that batch must also be filtered.

Instead of filtering, the samples may be diluted and mixed and then centrifuged or allowed to settle overnight to remove insoluble material from the supernatant solution.

10.7.13 The sample is now ready for analysis.

10.8 Calibration

10.8.1 The digestion block temperature must be maintained between 90 and 95 °C. The temperature must be monitored continuously while in use and must be recorded in TALS. The temperature must be monitored by measuring the temperature of reagent water contained in a capped digestion tube that is placed in each digestion block. The thermometer used and the start and end times for all temperature cycles are recorded in TALS.

10.8.2 The thermometer is calibrated in accordance with SOP DV-QA-0001, Thermometer Calibration Procedures.

11.0 Calculations / Data Reduction

11.1 This SOP does not produce any analytical data. See the determinative method SOPs DV-MT-0012, DV-MT-0019 or DV-MT-0021 for data analysis and applicable calculations.

11.2 Documentation

11.2.1 All of the preparation information is recorded and stored in TALS.

11.2.2 The preparation information includes:

11.2.2.1 Batch number, job and sample numbers, preparation date, and analyst name;

11.2.2.2 Matrix and prep type;

11.2.2.3 Initial sample pH, Initial sample volume and final volume;

11.2.2.4 Reagent manufacturer and lot number for each reagent used;

11.2.2.5 Digestion tube lot information;

11.2.2.6 Standard identification number for each standard used;

11.2.2.7 Start and stop times for digestions;

11.2.2.8 Observed and corrected temperature readings during digestion;

11.2.2.9 Identification numbers of calibrated measuring equipment used (thermometers, balances, pipettes, etc.).

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

12.1.1 An initial method detection limit study is performed for each analyte and each sample matrix type in accordance with Policy DV-QA-005P. An MDL verification is performed once a year to satisfy NELAC 2003/2009 requirements. For DoD, AFCEE and Texas TRRP projects, an MDL verification is performed quarterly. MDLs are stored in TALS.

12.1.2 The current MDL value is maintained in TALS.

12.2 Demonstration of Capabilities

An initial demonstration of capability for each method must be performed prior to analyzing samples.

12.2.1 For the standard analyte list, the initial demonstration consists of the preparation and analysis of a QC check sample containing all of the standard analytes for the method, as well as a method detection limit (MDL) study.

12.2.2 Four aliquots of the QC check sample are analyzed with the same procedures used to analyze samples, including sample preparation.

12.2.3 The mean recovery and standard deviation are calculated for each analyte of interest. These results are compared with the established or project-specific acceptance criteria. All four results must meet acceptance criteria before the method can be used to analyze samples.

12.2.4 For non-standard analytes, an MDL study must be performed and calibration curve generated before analyzing any samples, unless lesser requirements are previously agreed to with the client. In any event, the minimum initial demonstration required is successful analysis of an extracted standard at the reporting limit and a single point calibration.

12.3 Training Requirements

12.3.1 The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. See requirements for demonstration of analyst proficiency in SOP DV-QA-0024.

12.3.2 Each analyst performing the method must complete a demonstration of capability (DOC) by successfully preparing and/or analyzing four consecutive LCSs, or a blind performance evaluation (PE) sample, or other acceptable QC samples. The results of the DOC study are summarized in the NELAC format, as described in SOP DV-QA-0024. DOCs are approved by the Quality Assurance Manager and the Technical Director. DOC records are maintained by the QA staff in the central training files. Analysts who continue to perform the method must successfully complete a demonstration of capability annually.

13.0 Pollution Control

13.1 This method allows for the proportional reduction of sample and reagent volumes to decrease waste generation.

13.2 Standards and reagents should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in Section 13, *Waste Management and Pollution Prevention*, of the Environmental Health and Safety Manual, and DV-HS-001P, *Waste Management Plan*.

14.2 The following waste streams are produced when this method is carried out:

14.2.1 Expired Chemicals/Reagents/Standards: Contact Waste Coordinator

14.2.2 Acidic waste from sample digests: Waste Stream J.

NOTE: Radioactive, mixed waste and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Waste Coordinator for proper management of radioactive or potentially radioactive waste generated by this procedure

15.0 References / Cross-References

15.1 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition and all promulgated updates, EPA Office of Solid Waste, January 2005.

15.1.1 Method 3005A, Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, Revision 1, July 1992.

15.1.2 Method 3010A, Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy, Revision 1, July 1992.

15.2 Method 200.7, Determination of Metals And Trace Elements In Water And Wastes By Inductively Coupled Plasma-Atomic Emission Spectrometry, Revision 4.4, 1994.

16.0 Method Modifications

16.1 Modifications Specific to MCAWW Methods (200.7_Prep)

It was determined by technical review that several of the MCAWW methods were equivalent to the SW-846 methods and therefore were combined under the scope of this SOP as described in Section 10.0. The nature of the differences were deemed insignificant in regards to the amount of acid added and the evaporative volume based on the flexibility allowed by the methods (i.e., add additional acid as required) and the subjective wording of the methods (i.e., evaporate to near dryness versus an exact volume).

16.2 Chapter 1 of SW-846 states that the method blank should not contain any analyte of interest at or above the MDL. This SOP states that the method blank must not contain any analyte of interest at or above ½ the reporting limit. Common laboratory contaminants are allowed up to two times the reporting limit in the blank following consultation with the client.

16.3 The referenced methods use 100 mL of sample for digestion. This SOP uses a 50 mL aliquot, with a proportional reduction in digestion reagents. This change is made to allow better control of temperature and potential sample contamination with the use of the digestion block. It is also considered one of the laboratory's hazardous waste reduction initiatives.

16.4 The use of reduced sample volumes are supported in EPA's document "Response to Public Comments Background Document, Promulgation of the Second Update to SW-846, Third Edition" dated November 3, 1994. This document states "flexibility to alter digestion volumes is addressed and 'allowed' by the table (3-1) and is also inherently allowed by specific digestion methods. Table 3-1 is only to be used as guidance when collecting samples..." EMSL-Ci has also taken the stance that "reduction in sample size and appropriate corresponding reduction in sample volume is not considered a significant change in the methodology."

17.0 Attachments

Table 1. Matrix Spike and Aqueous Laboratory Control Sample Levels

Table 2. TCLP Reporting Limits, Regulatory Limits, and Matrix Spike Levels

Appendix 1. Contamination Control Guidelines

18.0 Revision History

- Revision 8 dated 30 June 2015
    - Updated Section 10.5.1.1 to include statement about not putting the pH paper into the bottle
    - Added language to Section 4.5 for clarification
    - Added new Section 10.3 reminding analysts to enter data directly at time of acquisition

- Revision 7 dated 31 October 2014
    - Annual technical review
    - Removed reference to SOP DV-IP-0017 for oils in section 1.2
    - Added maximum silver concentration to section 4.5 for method 200.7
    - Updated standard ID's for sections 7.7 and 7.8 and added Sulfur to the spike list
    - Corrected intermediate standard expirations from three months to six months
    - Removed duplicate analyte spike levels in ICP spike standards
    - Changed references from LIMS to TALS
    - Corrected concentration of Hg Daily spike standard
    - Removed Figures 1 and 2
    - Corrected various grammar and language errors
    - Corrected analyte spike levels in Table 1

- Revision 6 dated 08 October 2013
    - Updated sections 10.4.1.3, 10.4.1.4 and 10.4.1.6 about preservation procedure and removed the comment about recording the amount of acid added in the preservation logbook

- Revision 5, dated 15 July 2013
    - Annual review
    - Changed section 10.5.5, 7.3, 9.4, 9.5.2, 9.5.4, 10.3.1, 10.3.2, 10.4, 10.4.4, 10.5.2, 10.6.2, 11.2.2, 12.1.1 and 12.3 to reflect current practices
    - Corrected formatting and grammatical errors
    - Clarified sample matrices for this method in section 1.2
    - Corrected references in table associated with section 1.3
    - Added ICP determinative SOPs to sections 1.5, 4.6, 7.10, 9.5.3, 9.7.4
    - Added 200.7_Prep whenever 3005A was referenced
    - Edited section 3.5 to reflect current reference
    - Removed note associated with section 5.4.1
    - Added SOP reference to section 6.2.1
    - Removed references to Denver Standards Log and replaces those references with TALS reagent module

  - Correct standard names in section 7.7
  - Removed references to Supplemental Metals Prep Sheet
  - Updated sections 10.4.4, 10.4.6 and 10.4.7 for 10 mL TCLP sample aliquot
  - Added reference to 200.7 in Section 15

- Revision 4.7, dated 18 July 2012
  - Annual review
  - Updated Section 9.1, 10.1 and 10.2 to reflect current practice
  - Updated Section 9.7.6 on spiking TCLP aliquots
  - Added section 10.4.1.9 for TCLP preservation
  - Removed Appendix 2. Added reference to work instruction in Section 10.4
  - Updated Figures 1 and 2 to reflect current practice.
  - Formatting and editorial changes throughout

- Revision 4.6, dated 24 August 2011
  - Added recommendation to use disposable bulbs for pH checking in section 10.8.1.
  - Added requirement to store samples with a Rush form after preserving in section 10.8.1.2.

- Revision 4.5, dated 31 January 2011
  - Change note in section 10.8.1.8 to be 24 hours before preparation.

Earlier revision histories have been archived and are available upon request.

Table 1.

Matrix Spike and Aqueous Laboratory Control Sample Levels

Element	LCS Concentration (ug/L)	Matrix Spike Concentration (ug/L)
Aluminum	2,000	2,000
Antimony	500	500
Arsenic	1,000	1,000
Barium	2,000	2,000
Beryllium	50	50
Bismuth	2,000	2,000
Boron	1,000	1,000
Cadmium	100	100
Calcium	50,000	50,000
Chromium	200	200
Cobalt	500	500
Copper	250	250
Iron	1,000	1,000
Lead	500	500
Lithium	1,000	1,000
Magnesium	50,000	50,000
Manganese	500	500
Molybdenum	1,000	1,000
Nickel	500	500
Phosphorous	10,000	10,000
Potassium	50,000	50,000
Selenium	2,000	2,000
Silicon	10,000	10,000
Si (as SiO_2)	21,400	21,400
Silver	50	50
Sodium	50,000	50,000
Strontium	1,000	1,000
Thallium	2,000	2,000
Tin	2,000	2,000
Titanium	1,000	1,000
Uranium	2,000	2,000
Vanadium	500	500
Zinc	500	500
Zirconium	500	500

Table 2.

TCLP Reporting Limits, Regulatory Limits, and Matrix Spike Levels

Element	RL (mg/L)	Regulatory Limit (mg/L)	Spike Level (mg/L)
Arsenic	0.1	5,000	5.0
Barium	1.0	100,000	12.0
Cadmium	0.05	1,000	1.05
Chromium	1.0	5,000	5.2
Lead	0.03	5,000	5.5
Selenium	0.05	1,000	3.0
Silver	0.1	5,000	1.05

Appendix 1.

Contamination Control Guidelines

The following procedures are strongly recommended to prevent contamination:

- All work areas used to prepare standards and spikes should be cleaned before and after each use.
- All glassware should be washed with detergent and tap water and rinsed with 1:1 nitric acid followed by deionized water.
- Proper laboratory housekeeping is essential in the reduction of contamination in the metals laboratory. All work areas must be kept scrupulously clean.
- Powdered or latex gloves must not be used in the metals laboratory since the powder contains silica and zinc, as well as other metallic analytes. Only vinyl or nitrile gloves should be used in the metals laboratory.
- Glassware should be periodically checked for cracks and etches and discarded if found. Etched glassware can cause cross contamination of any metallic analytes.
- Autosampler trays should be covered to reduce the possibility of contamination. Trace levels of elements being analyzed in the samples can be easily contaminated by dust particles in the laboratory.

The following are helpful hints in the identification of the source of contaminants:

- Reagents or standards can contain contaminants or be contaminated with the improper use of a pipette.
- Improper cleaning of glassware can cause contamination.
- Separate glassware if an unusually high sample is analyzed and soak with sulfuric acid prior to routine cleaning.

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Title: Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) [Method No(s). SW846 1311 and 1312]

Approvals (Signature/Date):

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Facility Distribution No. __________

Distributed To: __________

1.0 Scope and Application

1.1 This SOP describes the application of the Toxicity Characteristic Leaching Procedure (TCLP), SW-846 Method 1311. The Toxicity Characteristic (TC) of a sample is established by determining the levels of 8 metals and 31 organic chemicals in the aqueous leachate of a sample. The TC is one of four criteria in 40 CFR Part 261 to determine whether a sample is classified as a hazardous waste. The other three are corrosivity, reactivity and ignitability. The TC Rule utilizes the TCLP method to generate the leachate under controlled conditions that were designed to simulate leaching through a landfill. EPA's "worst case" waste disposal model assumes mismanaged wastes will be exposed to leaching by the acidic fluids generated in municipal landfills. The EPA's model also assumes the landfill fluids will dominate the acid/base characteristics of the waste. The TCLP procedure directs the testing laboratory to use a more acidic leaching fluid if the sample is an alkaline waste, again in keeping with the model's assumption that the acid fluids will dominate leaching chemistry over time.

1.2 The specific list of TC analytes and regulatory limits may be found in Attachment 1.

NOTE: The list in Attachment 1 does not include the December 1994 EPA rule for Universal Treatment Standards for Land Disposal Restrictions. Those requirements include 216 specific metallic and organic compounds and, in some cases, lower detection limit requirements (see 40 CFR 268.40). TCLP leachates are part of the new Universal Treatment Standards, but the conventional analytical methods will not necessarily meet the new regulatory limits. Consult with the client and with TestAmerica Laboratories Technical Specialists before establishing the instrumental methods for these regulations.

1.3 This SOP also describes the application of the Synthetic Precipitation Leaching Procedure (SPLP) which was designed to simulate the leaching that would occur if a waste was disposed in a landfill and exposed only to percolating rain water. The procedure is based on SW-846 Method 1312. The list of analytes for SPLP may extend beyond the toxicity characteristic compounds shown in Attachment 1. With the exception of the use of a modified extraction fluid, the SPLP and TCLP protocols are essentially equivalent. Where slight differences may exist between the SPLP and TCLP they are distinguished within this SOP.

1.4 The procedure is applicable to liquid, solid, and multiphase wastes. Currently TestAmerica Denver does not have the capability to digest organic wastes for metals analysis. Therefore if the sample produces a leachate that includes an organic phase, and the client is asking for metals analysis, TestAmerica Denver cannot accept the sample.

1.5 The results obtained are highly dependent on the pH of the extracting solution, the length of time that the sample is exposed to the extracting solution, the temperature during extraction, and the particle size/surface area of the sample. These parameters must be carefully controlled.

1.6 The reporting limits are based on the individual samples as well as the individual analysis techniques. However, the sample is determined to be hazardous if it contains any analyte at levels greater than or equal to the regulatory limits.

1.7 If a total analysis of the waste demonstrates that individual analytes are not present in the waste or that they are present but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the procedure need not be run. If the total analysis results indicate that TCLP is not required, the decision to cease TCLP analysis should be remanded to the client.

1.8 If an analysis of any one of the liquid fractions of the leachate indicates that a regulated compound is present at such a high concentration that, even after accounting for dilution from the other fractions of the leachate, the concentration would be equal to or above the regulatory level for that compound, then the waste is hazardous and it may not be necessary to analyze the remaining fractions of the leachate. However, the remaining analyses should not be terminated without the approval of the client.

2.0 Summary of Method

2.1 For liquid samples that contain less than 0.5% dry solid material, the sample, after filtration through 0.6 to 0.8 µm glass fiber filter, is defined as the TCLP leachate and reagent water is used as the blank fluid.

2.2 For samples containing greater than or equal to 0.5% solids, the liquid, if any, is separated from the solids and stored for later analysis. The particle size of the remaining solid phase is reduced, if necessary. The solid phase is leached with an amount of leach fluid equal to 20 times the weight of the solid phase. For TCLP, the leach fluid employed for the leaching of non-volatile analytes is a function of the alkalinity of the solid phase of the sample. For SPLP, the leach fluid employed is a function of the region of the country where the sample site is located if the sample is a soil. Two leachates may be generated: a) one for analysis of non-volatile constituents (semi-volatile organics, pesticides, herbicides and metals and b) one from a Zero Headspace Extractor (ZHE) for analysis of volatile organic constituents. Following leaching, the liquid leachate is separated from the solid phase by filtration through a 0.6 to 0.8 µm fiber filter.

2.3 If the initial liquid phase of the sample (the filtrate) is miscible with the leachate, then they are combined, prepared, and analyzed together. If not miscible, the filtrate and leachate are analyzed separately and the results can be mathematically combined to yield a volume-weighted average concentration.

3.0 Definitions

3.1 Leachate: The TCLP solution generated after solids are tumbled with leaching fluid.

3.2 Filtrate: The liquid fraction of a sample that passes through a 0.6 to 0.8 µm fiber filter.

3.3 Final Leachate: The final solution generated from this procedure - either a leachate or a leachate combined with filtrate.

3.4 Leach Batch: A Leach Batch as a set of up to 20 field samples of similar matrix that behave similarly and are processed using the same leaching procedure, reagents, and blank fluid type within the same time period. One TCLP leach blank (LB) will be prepared with each TCLP leachate batch.

3.5 Percent Wet Solids: The fraction of a sample (as a percentage of the total sample) from which no liquid may be forced out by an applied pressure.

4.0 Interferences

4.1 Oily samples may present unusual filtration and drying problems. Oils may contaminate the ZHEs and filtration apparatus. Therefore it is important to use filter apparatus designated to oily samples and do extra cleaning after filtration.

4.1.1 For oily wastes that filter completely, the filtrate is the leachate and should be sent on for analysis. If the client is requesting metals analysis on these wastes, the sample cannot be analyzed at TestAmerica Denver. For filterable oily wastes requiring semi-volatile organic analysis, the sample should be logged into the LIMS as a waste matrix for method 1311_T with a waste dilution extraction method 3580. For filterable oily samples requiring volatile organic analysis, the sample should be logged into the LIMS as a waste matrix for method 1311_Z with a 5030B_H prep method.

4.1.2 For oily wastes that do not filter completely, any filtrate will have to be logged as a separate sample according to Section 4.1.1 above while the portion of the sample that does not filter will have to be leached. The results from the leachate and the filtrate will have to be reported separately and then mathematically re-combined in proportion to give a final result.

4.2 Solvents, reagents, glassware and other sample processing hardware may yield artifacts and/or interferences to sample analysis. All these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing leach blanks as described in the Section 9.4 and the individual determinative SOPs.

4.3 Glassware and equipment contamination may result in analyte degradation. Soap residue on glassware and equipment may contribute to this. All glassware and equipment should be rinsed very carefully to avoid this problem.

4.4 Phthalates may be eliminated by proper glassware cleanup and by avoiding plastics. Only glass, Teflon or Type 316 stainless steel tumblers may be used for leachates to be analyzed for organics. Plastic tumblers may be used for leachates to be analyzed for the metals.

4.5 Over exposure of the sample to the environment will result in the loss of volatile components. Samples that are being leached for volatiles should be kept cold. They should not be removed from cold storage until immediately before aliquotting, or alternatively can be kept in an ice bath in the TCLP lab.

4.6 Potential interferences that may be encountered during analysis are discussed in the individual analytical methods.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Environmental Health and Safety Manual (CW-E-M-001), Radiation Safety Manual 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.

5.2 Specific Safety Concerns or Requirements

5.2.1 Eye protection that satisfies ANSI Z87.1, laboratory coat, and nitrile or latex gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; non-disposable gloves must be cleaned immediately.

5.2.2 Gas pressurized equipment is employed in this procedure. Be sure all valves and gauges are operating properly and that none of the equipment, especially tubing, is over-pressurized.

CAUTION: Do not open equipment that has been pressurized until it has returned to ambient pressure.

5.2.3 A rotary agitation apparatus is used in this procedure. Certain samples may break the glass jars used in the procedure. For these samples, extra caution, including plastic or polyethylene over-wraps of the glass jar, may be necessary.

5.2.4 Secure tumbler and extraction apparatus before starting rotary agitation apparatus.

5.2.5 During sample rotation, pressure may build up inside the bottle. Periodic venting of the bottle will relieve pressure. This is more common with samples being leached with TCLP fluid 2. If necessary, secure the lid with duct tape to ensure the vessel stays sealed for the entire leaching period.

5.2.6 Due to the potential for ignition and/or flammability, do not attempt to dry non-aqueous liquid samples in an oven.

5.2.7 Do not attempt to manually stop a rotating piece of equipment. Keep all hanging objects, such as ties, hair, necklaces, etc., away from rotating equipment. Guards must be used when the apparatus is rotating to prevent loose clothing or limbs from getting caught.

5.2.8 Glass vials can break when the caps are being tightened. Cut resistant gloves should be worn whenever caps are being tightened.

5.2.9 When cleaning ZHE's a methanol rinse is used to remove any residual volatile compounds. After the rinse, the ZHE is put in an oven as a final cleaning procedure. It is very important that after the rinse the ZHE is allowed to dry for two hours in a fume hood before it is put in the oven. If this is not done then methanol vapor will acuminate in the oven resulting in a hazard. This hazard can cause a fire, explosion, or methanol exposure to the face and/or eyes when the door to the oven is opened.

5.2.10 After performing the procedure, the analyst must separate solid wastes from liquid wastes. This is done by filtering the waste through cloth. The corners and edges of the cloth are gathered together and the liquid is wrung out of the cloth into a drum. The cloth and the trapped solids are then immediately transferred to a waste container. No waste shall be left outside of a closed container.

5.3 Primary Materials Used

The following is a list of materials used in this method, which have a serious or significant hazard rating.

NOTE: This list does not contain all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.

A complete list of materials used in the method can be found in the reagent and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Hydrochloric Acid	Corrosive Poison	5 ppm (Ceiling)	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Nitric Acid, HNO_3	Corrosive Oxidizer Poison	2 ppm (TWA) 4 ppm (STEL)	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Material (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Sodium Hydroxide	Corrosive	2 mg/m3 (Ceiling)	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat, or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes and with greater exposures, it can cause burns that may result in permanent impairment of vision, even blindness.
Acetic Acid, Glacial	Corrosive Poison Flammable Liquid and Vapor	10 ppm (TWA)	Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur. Can cause serious damage to skin, including redness, pain, and burns. Contact with eyes may cause severe damage followed by loss of sight.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison Carcinogen	1 mg/m^3 (TWA)	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Methanol	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.
Methylene Chloride	Carcinogen Irritant	25 ppm (TWA) 125 ppm (STEL)	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, and headache. Causes irritation, redness, and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

(1) Always add acid to water to prevent violent reactions.
(2) Exposure limit refers to the OSHA regulatory exposure limit.

6.0 Equipment and Supplies

6.1 Leach Vessels

6.1.1 For volatile analytes - zero-headspace extraction (ZHE) vessel, gas-pressure actuated, Millipore YT3009OHW or equivalent (see Attachment 6). Cleaned by the following steps:

6.1.1.1 Remove the top and bottom flange from the barrel.

6.1.1.2 Remove support screens and o-rings from the top flange.

6.1.1.3 Remove the piston from the barrel and remove the o-rings and wiper seal from the piston.

6.1.1.4 Wash all parts in hot soapy water, rinse with hot tap water, and rinse with DI water.

6.1.1.5 Rinse top Flange, barrel, and piston with methanol, and allow to dry in a hood for at least 2 hours before placing in an oven heated to approximately 75ºC for at least 4 hours.

6.1.1.6 O-rings, wiper seals, and screens are placed in a disposable 2L HDPE bottle filled with methanol and tumbled 2-3 hours. They are then allowed to dry in a hood for at least 2 hours before placing in an oven heated to approximately 75ºC for at least 4 hours.

6.1.1.7 Disposable screens can be used instead of re-usable metal screens. Environmental Express part number F2090MM.

6.1.2 For metals - either disposable borosilicate glass jars (1 gallon, with Teflon lid inserts) or disposable 2 L HDPE (Nalgene® or equivalent) bottles may be used.

6.1.3 For non-volatile organics – disposable borosilicate glass jars must be used.

6.2 Vacuum Filtration Apparatus - Capable of 0 - 50 psi. For the filtering of leachates for metal analysis only as the apparatus is constructed of plastics. Cleaned by disassembling completely, washing with warm soapy water, rinsing with hot tap water, rinsing with DI water, and allowing to dry.

6.3 Stainless Steel Pressure Filtration Apparatus – 142 mm diameter. Capable of 0 - 50 psi. (See Attachment 7). For the filtering of leachates for semi-volatile organics and metals. For the percent wet solids determination. Cleaned by disassembling completely, washing with warm soapy water, rinsing with hot tap water, rinsing with DI water, rinsing with methanol, and allowing to dry.

6.4 Acid Washed, Low Metal, Borosilicate Glass Fiber Filters - 0.6 - 0.8 µm (Ahlstrom Grade 26). Certified for low metal content. 14.2 cm in diameter for pressure filter use. 4.7 cm in diameter for vacuum filter use. Glass fiber filters are fragile and should be handled with care.

6.5 Glass Fiber Filter Paper – 90 mm in diameter. For use in the ZHE.

6.6 Rotary Agitation Apparatus - Multiple-vessel, Associated Design and Manufacturing Company 3740-6 or equivalent (see Attachment 6). The apparatus must be capable of rotating the extraction vessel in an end-over-end fashion at 30 ± 2 rpm. The RPM is checked annually.

6.7 Gas-Tight Syringes - 100mL capacity, Luer Lock Hamilton 0158330 or equivalent

6.8 Top Loading Balance - Capable of 0g – 4000g ± 0.01g. The balance accuracy is verified each day of use in accordance with SOP DV-QA-0014.

6.9 pH Meter and Probe - Capable of reading to the nearest 0.01 unit, and with automatic temperature compensation. Calibrated daily. See Attachment 13 for detailed instructions.

6.9.1 Always use fresh aliquots of the pH buffers in fresh cups.

6.9.2 Always keep the probe immersed in pH electrode storage solution when not in use.

6.9.3 Calibrate the meter using buffers at pH 2, 4, 7, & 10.

6.10 Narrow Range pH Strips – Can be used to measure pH in place of the pH meter when dealing with especially oily samples that may damage the pH probe.

6.11 Magnetic Stirrer/Hotplate and Stirring Bars – For use in the leach fluid determination.

6.12 VOA Vials – 20 mL, with caps and septa. For the storage of leachates for volatile organic compounds analysis.

6.13 Glass Jars - 1/2 to 1 gallon, with Teflon lid-inserts. For the storage of leachates for sem-volatile organic compounds analysis.

6.14 Nalgene Plastic Bottles – 250mL to 1 L. For the storage of leachates for metals analysis.

6.15 Pipette - Calibration checked daily per SOP DV-QA-0008.

6.16 Bottle-top Pump – Calibration checked daily per SOP DV-QA-0008 to deliver 96.5mL of water.

6.17 Log Tag – An automated temperature data recorder used to monitor the temperature of the room during the 16-20 hour leach. See WI-DV-0067 for instructions on how to download the temperature readings.

6.18 Miscellaneous laboratory glassware and equipment.

6.19 Computer Software and Hardware

Please refer to the master list of documents and software located on R:\QA\Read\Master List of Documents\Master List of Documents and Software.xls for the current software to be used for data processing.

7.0 Reagents and Standards

7.1 Reagent Water **–** TestAmerica Denver has three ELGA Analytical water purification systems. The water coming from the ELGA system should be 18-18.2 Mohm-cm. The performance of the water polishing system is checked daily and recorded per SOP DV-QA-0026. Either water from the ELGA system or bottled HPLC grade water may be used in this procedure.

7.2 Hydrochloric Acid, 1 N "**1N HCl**" - For use in leach fluid determination. Add approximately 800mL of reagent water to a 1 liter Class A graduated cylinder. Using a 100mL Class A graduated cylinder, measure out 83mL of concentrated reagent grade HCl and carefully add the acid to the reagent water. Dilute to 1 liter with reagent water. Transfer to a 1 liter glass bottle, cap and shake to mix well.

7.3 69%-70% Trace Grade Nitric Acid - For the preservation of final leachates prior to metals analysis. Purchased ready to use.

7.4 Sodium Hydroxide, 10 N **"10N_NaOH"**- For use in TCLP Fluid #1. Purchased ready to use

7.5 Glacial Acetic Acid **"Acetic Acid"**– For use in TCLP Fluid #1 and #2. Concentrated, reagent grade liquid (HOAc).

7.6 pH Calibration Solutions - Buffered to a pH of 2, 4, 7, and 10. Commercially available. Fresh buffer solution must be used each day of analysis.

7.7 TCLP Leaching Fluids

The pH of both types of TCLP leaching fluids will be monitored and recorded daily before use by mixing fluid well and test with a calibrated pH meter.

The leaching fluids MUST be prepared correctly. If the desired pH range is not achieved and maintained, the TCLP may yield erroneous results due to improper leaching. If the pH is not within the specifications, the fluid must be discarded and fresh extraction fluid prepared.

7.7.1 TCLP Fluid #1: This reagent is prepared in a manner so that 5.7mL of glacial acetic acid and 64.3mL of 1 N NaOH is diluted to 1 liter in reagent water. When correctly prepared, the pH of this solution is 4.93 ± 0.05. The laboratory makes this reagent in large quantities by measuring 289mL of 10N NaOH and 256mL of glacial acetic acid and diluting up to 45L of reagent water. (Note that 289mL of 10N base is used instead of 2893mL of 1N base.) The reagent is mixed well as it is being prepared and the pH is checked. If the pH is not within the 4.93 ± 0.05 range, the fluid is not used.

7.7.2 TCLP Fluid #2: For every liter of fluid to be prepared, carefully add 5.7 mL glacial acetic acid and dilute up to volume with reagent water. When correctly prepared, the pH of this solution is 2.88 ± 0.05.

7.7.3 For water samples that are determined to be less than 0.5% solids, the leach fluid used to prepare the leach blanks is reagent water.

7.8 60/40 Sulfuric Acid / Nitric Acid - (60/40 weight percent mixture H2SO4/HNO3) For use in SPLP fluids. Cautiously mix 60 g of concentrated sulfuric acid with 40 g of concentrated nitric acid.

7.9 SPLP Leaching Fluids

SPLP solutions are un-buffered. The pH of SPLP fluids will be checked daily prior to use. Mix well and check with a calibrated pH meter. If not within specifications, the fluid may be discarded and fresh fluid prepared or the fluid must be adjusted using additional acid or reagent water to achieve proper pH.

7.9.1 SPLP Fluid #1: This fluid is used for soils from a site that is east of the Mississippi River. Add 60/40 weight percent mixture of sulfuric and nitric acids to approximately 20 liters of reagent water until the pH is 4.20 ± 0.05. Test with a calibrated pH meter. If the pH is above 4.25 add more acid until the pH is in range. If the pH is below 4.15 dilute by adding more reagent water. Use the spreadsheet described in Attachment 14 to determine how much water to add.

7.9.2 SPLP Fluid #2: This fluid is used for soils from a site that is west of the Mississippi River. Add 60/40 weight percent mixture of sulfuric and nitric acids to reagent water until the pH is 5.00 ± 0.05. Test with a calibrated pH meter. If the pH is above 5.05, add more acid until the pH is in range. If the pH is below 4.95 dilute by adding more reagent water. Use the spreadsheet described in Attachment 14 to determine how much water to add.

7.9.3 SPLP Fluid #3: This fluid is reagent water and is used for leaching of volatiles. Additionally, any cyanide-containing waste or soil is leached with fluid #3 because leaching of cyanide containing samples under acidic conditions may result in the formation of hydrogen cyanide gas. This fluid is also used as the blank fluid for SPLP water samples. If the samples are to be analyzed for common lab contaminates like acetone and methylene chloride by method 8260, the reagent water should first be boiled and purged per DV-MS-0010.

7.10 Metals Spike Standards

7.10.1 TCLP Spike – Purchased ready to use in 2% nitric acid at the concentrations listed in Attachment 2.

7.10.2 ICP SPK 2B – Purchased ready to use in 2% nitric acid at the concentrations listed in Attachment 3.

7.10.3 ICP SPK 3A – Purchased ready to use in 2% nitric acid at the concentrations listed in Attachment 4.

7.10.4 Hg Daily Spk – Prepared in 1% nitric acid at the concentration listed in Attachment 5.

7.11 Methanol – Used in cleaning ZHEs and steel pressure filters.

7.12 Methylene chloride - used to aid in cleaning oil contaminated equipment.

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 Samples being analyzed for non-volatile organic compounds should be collected and stored in glass containers with Teflon lid liners. Chemical preservatives shall NOT be added UNTIL AFTER leachate generation.

8.2 Samples being analyzed for metals only can be collected in either glass or polyethylene containers. Chemical preservatives shall NOT be added UNTIL AFTER leachate generation.

8.3 When the waste is to be evaluated for volatile analytes, care should be taken to minimize the loss of volatiles. Samples shall be collected and stored in a manner intended to prevent the loss of volatile analytes. Water samples should be collected in Teflon lined septum capped vials. Soil samples should be collected in Teflon line 4 oz jars. Both water and soils should be collected with minimal headspace and stored at 4 ± 2 ℃). Samples should be opened only immediately prior to leaching. A second container should be supplied for the percent solids determination.

8.4 Samples should be refrigerated to 4 ± 2℃ unless refrigeration results in irreversible physical changes to the waste. If precipitation occurs, the entire sample (including precipitate) should be extracted.

8.5 The physical state or states of the waste and the analytes of concern determine the minimum TCLP sample collection size. The amount of waste required varies with the percent solids. The lower the percent solids, the more waste will be required for preliminary and final testing.

8.5.1 For multi-phasic samples containing between 0.5% and 10% solids, several kilograms of sample are required to complete the analyses.

8.5.2 The general minimal requirements when the samples are 100% solids include: 1 - 32 oz jar for semi-volatile organic analysis and metals, and 1 - 4 oz jar for volatile organic analysis. Low-density sample materials, such as rags or vegetation, will require larger volumes of sample.

8.5.3 For liquid samples (less than 0.5% solids), minimum requirements are 2 - 32 oz jars for semi-volatile organic analysis and metals, and 2 - 8 oz jars for volatile organic analysis. If volatile organic analysis is the only requested parameter, 2 separate jars are required.

8.5.4 If matrix spike or duplicate control samples are requested, additional sample volume is required.

8.5.5 If sufficient sample volumes were not received, analyses cannot be started and the project manager should be notified as soon as possible.

8.6 Leachates or portions of leachates for metallic analyte determinations must be acidified with nitric acid to a pH less than 2, unless precipitation occurs. If precipitation occurs upon addition of nitric acid, then no more acid shall be added and the leachate shall be analyzed as soon as possible.

8.7 All leachates for semi-volatile organic analysis should be stored under refrigeration (4 ± 2 °C) until analyzed.

8.8 Leachates for volatile analysis must be stored under refrigeration (4 ± 2 °C) in VOA vials filled to eliminate all headspace.

8.9 Samples are subject to appropriate treatment within the following time periods:

HOLDING TIMES (DAYS)				
PARAMETER	**COLLECTION TO START OF LEACH**	**START OF TCLP TUMBLE TO PREPARATION**	**START OF TCLP LEACH OR SEMIVOLATILE PREP EXTRACTION TO ANALYSIS**	**TOTAL ELAPSED TIME**
Volatiles	14	N/A	14	28
Semi-Volatiles	14	7	40	61
Mercury	28	N/A	28	56
Other Metals	180	N/A	180	360

NOTE: The hold is the same for water and solids.

NOTE: The initial holding time is measured from date of collection to date TCLP leach started. (This should be the TCLP leach date in LIMS.) Semi-volatile method prep holding time is measured from the day leach was started to the start of method extraction. Subsequent analysis holding times are measured from the date extraction (TCLP or method prep) starts. If sample holding times are exceeded, the values obtained will be considered minimal concentrations. Exceeding holding times is not acceptable in establishing that a waste does not exceed the regulatory level. Exceeding the holding time will not invalidate characterization if the waste exceeds the regulatory limit. The Total Elapsed Time is to be used as guidance. If preps are initiated at the last possible moment of a holding time, the elapsed times may be exceeded.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Assurance Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs. This procedure meets all criteria of DoD QSM 5.0 unless otherwise stated.

9.1.3 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 Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Batching Samples - Samples that are less than 0.5% solids (i.e. liquid samples) are batched separately from samples that are greater than 0.5% (i.e. solid samples or multi-phasic samples.)

9.3 A Leach Batch is a set of up to 20 field samples of similar general matrix (i.e greater than 0.5% solids or less than 0.5% solids) that behave similarly and are processed using the same leaching procedure, reagents, and blank fluid type within the same time period. One TCLP leach blank (Method Blank) will be prepared with each TCLP leachate batch.

9.4 TCLP Leach Blanks - One blank (using the same extraction fluid as used for the samples) must be prepared and analyzed for every batch of samples leached that day in a particular vessel type. The leach blanks are generated in the same way as the samples (i.e., blanks will be tumbled and filtered with the samples). Leach fluid is tumbled with the samples in the same type of leach vessel (see Section 6.1) and filtered using the same filtration apparatus (see Section 6.2 and 6.3). Zero Headspace Extraction vessels are uniquely numbered. Each time a new batch is set up the blank should be rotated randomly to a different vessel to ensure all vessels are periodically checked. A vessel cannot be used in the leaching of more than 20 samples before it is used for the leaching of a blank. This is documented in the ZHE logbook.

9.5 Laboratory Control Sample (LCS) - A LCS is required with each batch of 20 or fewer samples. The LCS shall be created at the time of the preparative digestion or extraction by spiking an aliquot of the appropriate leach fluid used for that batch. Consult the individual analysis SOPs for additional LCS guidance (i.e., spike amounts, spike levels, recovery criteria, etc.).

9.6 Matrix Spike (MS/MSD) - Matrix spikes are used to monitor the performance of the analytical methods on the matrix and to assess the presence of interferences. An MS/MSD pair is required with each batch.

NOTE: Some clients interpret Section 8.2 of SW-846 1311 to mean that a matrix spike must be performed for each specific sample matrix. In other words, if the samples in the batch are visually distinct (clay, soil, sand, wood, plastic, metal) the lab must perform a MS/MSD on each distinct sample matrix type. If the client interprets the method in this way, this will be communicated through the Method Comment “MS per Specific Matrix”.

9.7 MS/MSD samples will be spiked after final leachate generation at the time of preparative digestion or extraction. Spikes are not to be added prior to the TCLP leaching. For metals, matrix spikes are to be added before preservation with nitric acid.

9.8 Consult the individual analysis SOPs for additional guidance on spike compounds and levels.

9.9 Consult the individual analysis SOPs for corrective action for blanks, LCSs, and MS/MSDs

10.0 Procedure

One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

Any deviations from this procedure identified after the work has been completed must also be documented in an NCM, with a cause and corrective action described.

NOTE: The worksheets referred to in this SOP can be found in G:\QA\Edit\FORMS\Organic Prep Forms\TCLP Worksheets Rev 9.

NOTE: See Attachment 12 for instructions on how to create batches in the LIMS system “TALS”.

10.1 WORKSHEET 1, SECTION A, SAMPLE DESCRIPTION – Enter data on Worksheet 1.

10.1.1 Preliminary TCLP evaluations (percent solids, particle size, selection of leach fluid, and fluid/leachate compatibility) are required to be done using a minimum of a 100 gram aliquot of sample. This aliquot may also undergo the actual TCLP or SPLP extraction for non-volatiles ONLY IF it has NOT been oven dried. If the solid portion is oven dried, a separate aliquot must be used for the actual leaching procedure.

10.1.2 Record the number of phases observed in the sample. It is common that when more than one container of multi-phasic materials is received from the field, each container will show different amounts of each phase.

10.1.3 If the sample has multiple phases and is received in more than one bottle, then the contents of each bottle should be combined in a single larger container prior to processing the sample further. However, the aliquot for volatile analysis should not be combined because that would expose the sample to headspace.

10.1.4 *LINE A.1* - Record the visible presence of a solid material heavier than water. If the sample contains more than one solid phase (e.g., wood and sediment mixed with water), describe the different phases in an NCM.

10.1.5 *LINE A.2* - Record the number of liquid phases observed in the sample according to apparent density. It may be impossible to distinguish apparent density if only one liquid phase is observed and there is no indication on the COC form. If this is the case, a small drop of the liquid can be added to a small amount of water to test the relative density.

NOTE: If the sample contains an oil layer, see Section 4.1 for guidance.

10.1.6 If the sample will obviously yield no free liquid when subjected to pressure filtration (i.e., it is 100% solid), then proceed to Section 10.3 (Leach Fluid Determination) for semi-volatile and metals analysis and proceed to Section 10.7 (ZHE Leaching Procedure) for volatile analysis. If only one jar was received, the ZHE procedure (Section 10.7) should be completed before proceeding to Section 10.3 for semi-volatile and metals analysis.

10.2 WORKSHEET 1, SECTION B – PERCENT SOLID PHASE

10.2.1 Percent Solids and ZHE Extractions - The ZHE filtration apparatus cannot accurately determine percent solids less than 5%. If an extraction is to be performed solely for volatile organic compounds and the percent solids concentration is apparently greater than 5%, proceed to Section 10.7 (ZHE Extraction Procedure). Otherwise continue with the steps in this section. The aliquot of sample used here cannot be used again for the ZHE extraction.

10.2.2 Determine Type of Filtration Apparatus Needed –

- If the sample is mostly a non-viscous liquid (water or non-viscous organic liquid) of low solids content (<10%) or a liquid containing highly granular solids, either vacuum filtration or pressure filtration may be used

- If the sample is viscous (sludge or has high solids content), use pressure filtration.

- If the sample is oily, a glass vacuum flask and Büchner funnel can be used to filter the sample.

10.2.3 *LINE B.1 - Weight of Filter.* Measure and record this value before loading the filter into the filter holder. Assemble the filtration apparatus. Use care when handling the 0.6 to 0.8 µm filter so as not to bend the filter or to contaminate it with trace amounts of oil from your hands.

10.2.4 *LINE B.3.b – Tare Weight of filtration collection bottle.* Select an appropriate container to collect the filtrate into. Record the weight of the empty container as the tare weight of the filtrate. A plastic bottle can be used if only metals analysis is requested, but a glass container should be used if any organic analyses are requested.

10.2.5 *LINES B.2.a, B.2.b, and B.2.c - Weight of Subsample for Percent Solids Determination*.

10.2.5.1 Weigh the full sample container and document this as the gross weight (Line B.2.a). Whenever possible, the entire contents of the sample container should be used in the percent solids determination.

If the entire contents of the sample container are used, then transfer the entire contents to the filtration apparatus. It might be more conducive to filtering if any liquid portion is poured into the filtration apparatus first as not to pre-maturely clog the filter. If necessary, centrifugation can be used as well.

If there is limited sample volume, and the entire contents of the sample container cannot be used in the percent solids determination, then care must be taken to create a representative sub sample by creating a well-mixed slurry before taking the sub-sample.

10.2.5.2 Weigh the empty sample container with any residual sample and document this as the tare weight (Line B.2.b). The worksheet will then calculate the net weight of the sample used for the percent solids determination in Line B.2.c. If net weight is less than 100 g, an NCM should be written as the percent solids determination should be performed on an aliquot of at least 100 g.

10.2.6 Slowly apply gentle pressure or vacuum of 10 psi to the filtration apparatus. Allow the sample to filter until no additional liquid has passed through the filter during a 2-minute period.

10.2.7 Increase the pressure in 10-psi increments until a maximum of 50 psi is reached. Stop the filtration when no additional filtrate is generated within a 2-minute period. This may require many hours to complete. The sample should not be filtered for more than 24 hours to avoid evaporation of the filtrate and thus miscalculation of the percent wet solids. If the sample filtration is not complete in 24 hours, then the client should be contacted.

NOTE: Some samples will contain liquid material that does not filter. Do not attempt to filter the sample again by exchanging filters. Viscous liquids or solids that do not pass through the filter are classified as a solid.

10.2.8 *LINE B.3.a – Gross Weight of Filtrate.* Remove the filtrate collection bottle, weigh and record the gross weight.

10.2.9 *LINE B.3.c – Net Weight of Filtrate.* The worksheet will calculate the net weight of the filtrate.

10.2.10 *LINE B.4 – Total Weight of Wet Solids.* The worksheet will calculate the total weight of wet solids by subtracting the net weight of the filtrate (Line B.3.c) from the net weight of the subsample (Line B.2.c)

10.2.11 *LINE B.5 – Weight Percent of Wet Solids*. The worksheet will calculate the percentage of wet solids in the sample based on weight by dividing the Total Weight of Wet Solids (Line B.4) by the Net Weight of the Subsample (Line B.2.c) and multiplying by 100.

10.2.12 *LINE B.3.d – Density of Filtrate.* If the percent solids determination result is greater than 0.5%, then determine the density of the aqueous phase of the filtrate using a calibrated pipette to measure the mass of 1 mL.

10.2.13 *LINE B.7* - The worksheet will then calculate the volume of the aqueous phase of the filtrate.

10.2.14 *LINE B.8* - If the filtrate is multi-phasic, pour the filtrate into a graduated cylinder. Measure and record the volume of the non-aqueous organic phase. If more than one organic phase is observed, enter “See Below” and provide a description at the bottom of Worksheet 1.

10.2.15 Retain the filtrate for use in Section 10.3.3. If the sample is logged for metals analysis only, the filtrate can be stored in a plastic container at room temperature. If the sample is logged for any organic analyses, then the filtrate must be stored refrigerated in a glass container. If the sample is logged for analysis of VOCs and a separate container was not received, then a small portion of this filtrate must be stored refrigerated in a VOA vial with no headspace and an NCM written.

10.2.16 If the Weight Percent of Wet Solids in Line B.5 is greater than 5.0%, and semi-volatile and metals analyses are required, proceed to section 10.3. If the Weight Percent of Wet Solids in Line B.5 is greater than 5.0% and volatile analysis is required, proceed to Section 10.7.3.

10.2.17 If the Weight Percent of Wet Solids in Line B.5 is less than 0.5%, discard the solid phase. No leaching will be necessary; the filtrate is equivalent to the final leachate. If the sample is logged for method 8260B, refer to Section 10.7.1 (ZHE leaching of 100% Liquid Samples) to generate leachate and blanks for volatile analysis. If the sample is logged for semi-volatiles and metals analysis, generate a leach blank by passing reagent water through a clean filtration apparatus similar to the apparatus used in the percent solids determination of the sample. Deliver the leachates and the associated blank to the appropriate departments along with all completed documentation.

10.2.18 If the Weight Percent of Wet Solids in Line B.5 is greater than or equal to 0.5% but less than 5.0% and it is noticed that a small amount of the aqueous filtrate is entrained in the wetting of the filter, proceed to Section 10.2.19 to complete the percent solids measurement on a dry-weight basis. If it is apparent to the analyst that the sample contains a significant amount of solids (>0.5%), the analyst can proceed to Section 10.2.19 to complete the percent solids measurement on a dry-weight basis to confirm this, or can proceed to Section 10.3 (Particle Size Reduction for Fluid Determination) for semi-volatile and metals analysis and Section 10.7.3 (ZHE Leaching of Samples Less than 100%, but greater than 0.5% Solids)

NOTE: If obviously oily (non-aqueous) material is entrained on the filter, do not dry the filter but instead proceed to Section 10.3 (Particle Size Reduction for Fluid Selection). Document in an NCM that the percent wet solids result is most likely biased high due to oily material trapped on the filter and that percent dry solids could not be performed.

10.2.19 *LINE B.6 – Weight Percent of Dry Solids*

NOTE: These steps are required only if it is noticed that a small amount of the filtrate is entrained in the wetting of the filter and the percent wet solids in Line B.5 is ≥ 0.5% and < 5.0 %.

- Remove the filter with the wet solids from the filtration apparatus. Take care to remove the entire filter. Often the filter will adhere to the apparatus.
- Dry the filter and solid phase at 100 ± 20 ° C. Record the observed temperature of the oven and the thermometer correction factor in Lines 6.d on Worksheet 1. Allow the filter to dry in the oven for at least 10 minutes.
- Remove the filter from the oven and allow to cool.
- Weigh and record the gross dry weight (Line B.6.a). The Worksheet will calculate the Weight Percent of Dry Solids in Line B.6.c using the equation in Section 11.5. If the Weight Percent of Dry Solids is less than 0.5%, then follow the guidelines in Section 10.2.17 for when percent wet solids is less than 0.5%. If the Weight Percent of Dry Solids is greater than 0.5%, repeat the drying step.
- Weigh and record the second gross dry weight (Line B.6.b). If the two weighings do not agree within 1%, perform additional drying and weighing until

successive weights agree within 1%. Record the last two successive weights as Weight 1 and Weight 2 on Lines B.6.1 and B.6.2

- If the Weight Percent of Dry Solids is ≥ 0.5% and the sample will be extracted for non-volatile constituents, proceed to Section 10.3 (Particle Size Reduction for Fluid Selection) using a fresh wet portion of sample.

- If the Weight Percent of Dry Solids result is ≥ 0.5% and the sample will be extracted for volatile constituents, proceed to Section 10.7.3 (ZHE Extraction Procedure).

- If the Weight Percent of Dry Solids result is less than 0.5%, discard the solid phase. No leaching will be necessary; the filtrate is the TCLP leachate. Follow the guidelines in Section 10.2.17 for when percent wet solids is less than 0.5%.

10.3 WORKSHEET 2, SECTION C and D – LEACH FLUID DETERMINATION

If the solid content is greater than or equal to 0.5% and if the sample is being analyzed for metals or non-volatile organic compounds, the type of leaching solution must be determined.

The sub-sample used for fluid selection is taken from the non-filterable solid portion of the sample, but the aliquot must not have been subjected to the oven drying in Section 10.2.19.

Follow times, temperature, and particle size specified in this section as closely as possible. If reaction time between the acid solution and solid waste is too short or too long, the procedure may produce false pH readings.

For SPLP, refer to Section 7.9 for fluid selection. The client must specify matrix type. Check special instructions, LIMS method, or the PM to determine if the sample is from east or west of the Mississippi River. Document on Line D.3, D.4, or D.5 the fluid type used and then proceed to Section 10.3.3 (Fluid Compatibility)

10.3.1 *LINE C.1 – Particle Size Reduction for Fluid Determination*

Reference WI-DV-0058. The sub-sample used for fluid determination must consist of particles less than 1 mm in diameter (versus the less than 1 cm requirement for the material used in the actual leach). The method requires smaller particle size to partially compensate for the shorter duration of contact time with the leachate solution as compared to the full leaching. Inappropriate use of coarser materials could result in the selection of the wrong fluid type.

Surface Area Exclusion – Size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram. Weigh the particle, and estimate the surface area based on three dimensions assuming a cuboid shape. If the surface area is less than or equal to 3.1 cm^2 per gram, enter “No” on Line C.1 and prepare an NCM documenting the surface area per gram of sample.

If the sample contains particles greater than 1 mm in diameter, crush, cut, or grind the solids to the required size. Enter “Yes” in Line C.1. Document in an NCM how the particle size reduction was performed.

Consult your supervisor and project manager when dealing with unusual sample matrices (e.g., wood, cloth, metal, brick)

10.3.2 Determination of Appropriate Leach Fluid

10.3.2.1 Calibrate the pH meter with fresh aliquots of buffer solution in accordance with the manual. See Section 6.9.

10.3.2.2 *LINE C.2* – Calibrate a balance per DV-QA-0014 and record the balance ID.

10.3.2.3 *LINE C.3* - Weigh out a 5.0g ± 0.1g sub sample (less than 1mm particle size) of the solid phase into a 150mL beaker. This sub sample cannot have been subjected to the oven drying in Section 10.2.19

10.3.2.4 *LINE C.4* – Using a Class A graduated cylinder, or a bottle top pump calibrated per DV-QA-0008, add 96.5mL of reagent water to the sub sample. Document on Line C.4.a the ID of the pipette or graduated cylinder.

10.3.2.5 *LINE C.5.a, Line C.5.b,* – Stir vigorously for 5 minutes on a stir plate. Document the time the stirring started on Line C.5.a. Document the time the stirring stopped on Line C.5.b.

10.3.2.6 *Line C.5.c* - Measure and record the sample pH. If the pH is less than or equal to 5.0, use TCLP Fluid #1. Place an “X” in LINE D.1 and proceed to Section 10.3.3 (Fluid Compatibility) If the sample matrix is especially oily, use narrow-range pH paper to measure the pH instead of the pH meter. This is done to protect the pH probe. Document the use of the narrow-range pH paper in an NCM.

10.3.2.7 *LINE C.6* - If the pH is greater than 5.0, add 3.5mL of 1 N HCl, using a calibrated pipette. Put a “X” on line C.6 and record the HCl Lot# and the Pipette ID in Lines C.6.a and C.6.b. Mix the sample briefly.

10.3.2.8 *LINE C.7.a thru C.7.f* – Cover the sample with a watch glass and place the sample on a heated hot plate and heat to 50ºC to 55ºC for 10 minutes. Do not stir the sample during this time. The heating cycle is a critical step. If the solid waste does not remain in contact with the acidic solution under specified time and temperature conditions, an erroneous pH may be measured. The temperature readings will be taken using a calibrated thermometer that is placed in a random sample on the hot plate. Record the observed temperature and the thermometer correction factor.

10.3.2.9 Measure the pH of the sample. During this pH measurement, do not stir the sample. Document the reading on line 7.f. If the sample matrix is especially oily, use narrow-range pH paper to measure the pH instead of the pH meter. This is done to protect the pH probe. Document the use of the narrow-range pH paper in an NCM.

10.3.2.10 *LINE D.1 and LINE D.2* – If the pH is less than or equal to 5.0, use Fluid #1 If the pH is greater than 5.0, use Fluid #2.

10.3.3 Determination of Filtrate/Leach Fluid Compatibility

Skip this Section if the sample did not yield an initial filtrate from Section 10.2

10.3.3.1 Place 5mL of the appropriate leaching fluid (determined in the previous step) into a 25mL vial. Add 5mL of the initial filtrate, cap and shake.

10.3.3.2 If the phases are miscible, the initial filtrate and solid phase leachate will be physically recombined upon completion of the leachate generation. Enter an “X” in LINE D.6 If the phases are not miscible, enter “NO”. The initial filtrate and the solid phase leachate will be prepared and analyzed separately and the results mathematically combined. See Section 11.12.

10.4 WORKSHEET 3, SECTION E– DETERMINATION OF SAMPLE SIZE FOR BOTTLE LEACH PROCEDURE

10.4.1 The aliquot used in the Percent Solids determination described in Section 10.2 may be used for this procedure ONLY if it was not oven dried. If the sample is 100% solid or the preliminary aliquot was not oven dried proceed directly to Section 10.4.2 (Particle Size Reduction for Leaching). If the aliquot from the Preliminary Evaluation was oven dried then, using a fresh aliquot of sample, filter the sample to obtain wet solids and filtrate as described in Sections 10.2.2 through Section 10.2.15. The percent wet solids calculations may need to be repeated in order to correct for sub-sampling error. Then using this new aliquot of wet solids, proceed to Section 10.4.2

10.4.2 *LINE E.1 – Particle Size Reduction for Leaching*

Reference WI-DV-0058. Evaluate the solid portion of the sample for particle size. If it contains particles greater than 1 cm in size, prepare the solid portion of the sample for leaching by crushing, cutting, or grinding such that all particles are less than 1 cm in size (i.e, capable of passing though a 9.5 mm, 0.375 inch standard sieve). Size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram. (See Section 10.3.1)

Consult your supervisor or manager when dealing with unusual sample matrices (e.g. wood, cloth, metal, brick). Scissors or tin snips may be used to cut cloth, plastic or sheet metal. Saws may be used for wood or solid metal. Bricks, rocks or other solids amenable to grinding can be reduced using a jaw crusher. Document in an NCM how unusual samples were handled. Note that size reduction to fine powder is not appropriate, and could invalidate results. If necessary, consult client for guidance.

10.4.3 *LINE E.2* -Calibration check a top-loading balance per DV-QA-0014. Document the Balance ID on Line E.2.

10.4.4 Determine the total volume of leachate (solid phase leachate + liquid filtrate) that needs to be generated for analysis according to Table 2 below. Note that the volumes listed in Table 2 are the minimum volume required for one extraction and analysis. If possible, extra volume should be prepared for re-extractions and re-analysis. Additional volume for MS/MSD analysis should be provided for at least one sample per leach batch for every requested analysis. The samples will be leached at a 20X dilution (i.e. 100g of solids will generate 2000mL of leachate).

Table 2. Minimum Required Leachate Volume

Analysis	Required Leachate Volume for TCLP (mL)	Required Leachate Volume for SPLP (mL)
Volatiles	20 (3 x 20mL vials are supplied to provide volume for screening and re-analysis)	40 (3 x 40mL vials are supplied to provide volume for screening and re-analysis)
Semivolatiles	200	1000
Pesticides	100	1000
Herbicides	100	1000
Metals	100	100

10.4.5 *LINE E.3* - Weigh at least 100g of the solid portion of the sample into an appropriate leach vessel. See Section 6.1 for appropriate leach vessels. Document the weight of the sample to the nearest 0.01g on Line E.3. A minimum sample size of 100g is required. If there is insufficient sample, a NCM is needed. If full suite TCLP is requested, use 150g to generate sufficient leachate.

10.5 WORKSHEET 3, SECTION F– DETERMINATION OF AMOUNT OF LEACH FLUID FOR BOTTLE LEACH PROCEDURE

10.5.1 *LINES F.1 through F.4 – Lot number of Leach fluid*. The worksheet will indicate the correct leach fluid to use as determined in Lines D.1 through D.5. Document the Lot number of the leach fluid used in Lines F.1 through F.4.

10.5.2 *LINE F.5 – pH of Leach Fluid*. Record the pH of the Leach fluid. Check to make sure the pH of the fluid is still within the specifications in Section 7.7 and Section 7.9. If the pH of the buffered TCLP fluids is not within specifications, ensure the pH meter is properly calibrated and re-check. If the re-check is also not within specifications, discard the fluid and make fresh fluid. If the pH of the un-buffered SPLP fluid is not within specifications, either discard the fluid or adjust the pH by adding more acid or more water. See Section 7.9.

10.5.3 *LINE F.6 – Volume of Leach Fluid.* The worksheet will calculate the volume of leach fluid to add to each sample based on the weight of the sample in Line E.3 using the formula in Section 11.7. Prepare method blanks by filling similar leach vessels with the same leach fluid used for the samples.

10.6 WORKSHEET 3, SECTION G– RECORD OF BOTTLE LEACH

10.6.1 LINE G.1 – Ensure any effervescence has stopped before capping the bottle tightly. Secure in a rotary agitator and turn on the rotator. The rotator speed must be checked under load every day of use. Count the number of rotations in 15 seconds and multiply by 4 to obtain the rotations per minute (RPM). If the RPM is between 28 and 32, then mark line G.1 “YES”. If the RPM is not between 28 and 32, then tag out the rotator until it can be repaired and move the samples to a rotator that does rotate at the correct speed.

10.6.2 *LINE G.2 and G.3* – Rotate the sample end-over-end for 16-20 hours. Record the leach start date and time on Line G.2. As agitation continues, pressure may build up within the bottle for some types of samples. To relieve excessive pressure, the bottle may be removed and opened periodically in a properly vented fume hood to relieve any built-up pressure. Due to the higher acidity of TCLP Leach Fluid #2, it is more common for these samples to generate excess pressure. Record the leach stop date and time on Line G.3.

10.6.3 *LINE G.4 – Temperature of Leach.* The temperature of the room should be 23 ± 2℃. A data-logging device (LogTag) records the room temperature. After the leach has been stopped, record the thermometer correction factor and the observed minimum temperature and in Line G.4.a and the observed maximum temperature in Line G.4.b. The worksheet will then calculate the actual minimum temp in Line 4.c and the actual maximum temp in Line 4.d.

Download LogTag data according to WI-DV-0067. Click on “Data” tab and print data to PDF. File should be stored with the EXCEL TCLP worksheet files. The LogTag PDF file will then be attached to each corresponding batch in the LIMS system “TALS” per instructions in Attachment 12, Line 13.

If the temperature of the room was not 23 ± 2℃, the solid fractions of the samples must be re-leached. If there is no volume to re-leach, the client must be contacted. The client must decide if the procedure should be canceled or if the laboratory should continue with a NCM.

10.6.4 Filter the leachate using vacuum or pressure filtration. This should be done the same day the 16-20 hour leaching was finished. For final filtration of the leachate, the glass fiber filter may be changed, if necessary to facilitate filtration. The entire leachate need not be filtered; however sufficient volume should be filtered to support the required analyses plus extra volume in case of re-extraction, re-digestion and MS/MSD. If needed, the leachate can be centrifuged to help facilitate filtration.

10.6.5 *LINE G.5 – pH of Leachate.* Record the pH of the leachate. If the leachate is especially oily, do not use the pH meter to measure the pH as this may damage the probe. Use narrow-range pH paper instead and write an NCM that the pH was measured using narrow-range pH paper instead of a pH meter.

10.6.6 If the sample contained no initial filtrate, (i.e the sample was 100% solids) the filtered leachate is defined as the final TCLP leachate. Proceed to Section 10.6.10

10.6.7 *LINE G.6 Volume of Leachate.* If the sample had an initial filtrate from Section 10.2, then measure the volume of leachate recovered so the leachate and the filtrate can be combined in the correct ratio. If the leachate contains an oil phase, it must be separated and its volume recorded on Line G.6.a. The oil and the filtered leachate must be analyzed separately. If requested, the results can be mathematically re-combined. See Section 11.11 and Section 11.12.

10.6.8 *LINE G.7 – Volume of initial filtrate for recombination*. The worksheet will use the equation in Section 11.8 to calculate how much of the initial filtrate should be combined with the volume of leachate in Line G.6. Consult Line D.6 to determine if the initial filtrate is compatible to the leachate. If they are compatible, they are to be combined in the correct proportions and mixed well. The combined solution is defined as the TCLP leachate. If the initial filtrate and the leachate are not compatible, they are to be prepared and analyzed separately and the results mathematically combined. See Section 11.11 and Section 11.12. The leachate and the filtrate will have to be logged as separate samples in LIMS.

10.6.9 *LINE G.8 – Volume of combined initial filtrate and leachate.* The worksheet will calculate the volume of the combined filtrate and leachate using the equation in Section 11.9.

10.6.10 Leachates for organic analyses should be stored in glass containers at 4℃ ± 2℃. Refer to Table 2 to determine how much leacha te is needed.

10.6.11 Leachates for metals analysis should be stored in poly bottles. A 250mL aliquot should be submitted for metals analysis.

10.6.12 Prepare a MS/MSD sub-sample for metals testing following the steps below.

10.6.12.1 Measure out 50mL of leachate into verified digestion tube. Add 0.5mL of the TCLP Spike described in Section 7.10.1. Add 0.5mL of the Prep Spike 2B described in Section 7.10.2. Add 0.5mL of the Prep Spike 3A described in Section 7.10.3. This 50mL aliquot will be split equally for the MS and the MSD after spiking.

10.6.12.2 If mercury is requested, measure out an additional 75mL aliquot. Pour two 30mL aliquots from the 75mL aliquot. Add 1.5mL of the mercury spike described in Section 7.10.4 to each of the 30mL aliquots. These two 30mL aliquots will now serve as the MS and the MSD.

10.6.13 Immediately preserve all leachates for metals by adding 1mL of nitric acid at a time until pH of 2 has been achieved. If after 5mL of acid has been added and the pH is still not 2, do not add more acid, but document final pH in an NCM. If a precipitate starts to form, immediately stop adding acid and document in an NCM.

10.7 WORKSHEET 4, ZHE PROCEDURE

Use the ZHE device to obtain a TCLP leachate for analysis of volatile compounds only. Leachate resulting from the use of the ZHE shall NOT be used to evaluate the mobility of non-volatile analytes (e.g. metals, pesticides, etc.).

Due to the shortcomings of the method, losses of volatile compounds may occur. Extra care should be observed during the ZHE procedure to ensure that such losses are minimized. Charge the ZHE with sample only once and do not open the device until the final leachate has been collected. Target compounds will volatilize very rapidly, therefore do not allow the waste, the initial liquid phase, or the leachate to be exposed to the atmosphere any longer than necessary. The sample should be kept cold and not allowed to come to room temperature until it is loaded into the ZHE and all headspace has been purged. Keep the sample in cold storage or in an ice bath.

The ZHE cannot accurately determine percent solids <5%. Go to Section 10.2 if it is apparent that the sample is less than 5% solids. If the sample is apparently greater than 5% solids, but less than 100% solids, go to Section 10.7.3. If the sample is 100% solids, go to Section 10.7.3. If the sample is 100% liquid, proceed to Section 10.7.1

10.7.1 ZHE Leaching of 100% Liquid Samples. – This procedure is to be used for samples determined to be 100% liquid per Section 10.2

10.7.1.1 Place o-rings and wiper seals on the ZHE piston. Moisten the o-rings with reagent water and place the piston in the ZHE body. Adjust the ZHE piston in the ZHE body to the appropriate height in order to contain the sample. At least 80mL of sample should be used. If the piston is 2cm below the top of the cylinder, this will be enough volume for 80mL. By seating the piston as high as possible, you will limit the headspace in the ZHE that will need to be purged later and the potential loss of volatiles.

10.7.1.2 Assemble the top flange and run water through the valve and work the o-ring back and forth until it loosens up. This will prevent the o-rings from tearing and will prevent the valve from leaking and reduce the frequency of o-ring replacement.

10.7.1.3 *LINE H.2.* - Place the sample in the ZHE body. Place the ZHE body on the ZHE base. Place the top flange on top of the ZHE body and secure tightly. Record the ZHE used on Line H.2

10.7.1.4 With the inlet/outlet valve closed, pressurize the ZHE until you hear the piston move upwards.

10.7.1.5 *LINE I.6* - Slowly open the inlet/outlet valve to release any headspace. Once liquid appears through the inlet/outlet valve, close the valve and attach a clean gas-tight syringe. Slowly open the valve and collect the filtrate. This filtrate is the final leachate. After all leachate has been collected, remove the syringe from the ZHE and document the filtration completion date and time on Line I.6

10.7.1.6 Transfer the leachate from the syringe to 20mL voa vials for TCLP leachates and 40mL voa vials for SPLP leachates. Care should be taken not to leave any headspace in the vials. The entire leachate need not be transferred, but three vials should be filled to allow for re-analysis and screening.

10.7.1.7 Generate a leach blank using reagent water in the same manner as above. Document in the ZHE logbook which ZHEs were used for samples and which ZHEs were used for method blanks. A ZHE cannot be used for a sample if it has not been used as a method blank in the past 20 uses.

10.7.2 ZHE Leaching of 100% Solid Samples

10.7.2.1 Consult Worksheet 1 and examine the sample. If the sample appears to be different from the preliminary information found on the worksheet, consult your supervisor. If the preliminary evaluations indicate the need for particle size reduction, crush, cut, or grind the sample so that all particles are less than 1 cm in size as measured with a ruler. (Do not sieve the sample). Size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram. Weigh the particle, and estimate the surface area based on three dimensions assuming a cuboid shape. If particle size reduction was necessary, document this on Worksheet 4 as an observation and write an NCM.

To minimize loss of volatiles, samples for volatiles that require particle size reduction should be kept in sample storage (at 4 ºC) until immediately before size reduction. Aggressive reduction which would generate heat should be avoided and exposure of the waste to the atmosphere should be avoided to the extent possible. Size reduction to a fine powder is not appropriate.

10.7.2.2 Assemble the top flange and run T1 fluid through the valve and work the o-ring back and forth until it loosens up. This will prevent the o-rings from tearing. It will also prevent the valve from leaking and reduce the frequency of o-ring replacement. Place the assembled top flange on top of the body, secure tightly. See Attachment 6.

10.7.2.3 Place o-rings and wiper seals on the ZHE piston. Moisten the o-rings with water and place the piston in the ZHE body. Adjust the ZHE piston in the ZHE body to the appropriate height in order to contain the required sample. At least 25 grams of sample will be needed. Normally the piston should be seated approximately 2cm below the top of the cylinder, but if the sample is bulky, the piston might have to be seated lower. By seating the piston as high as possible, you will limit the headspace in the ZHE that will need to be purged later and the potential loss of volatiles.

10.7.2.4 *LINE H.1* – Calibration check the balance per DV-QA-0014 and record the balance ID.

10.7.2.5 *LINE H.2* – Record the ID of the ZHE

NOTE: To reduce the time the sample is exposed to the air, the steps described in Section 10.7.2.6 through 10.7.2.9 should be done in quick sequence, working with one sample at a time.

10.7.2.6 *LINE H.3* – Place the ZHE cylinder on the balance and tare. Transfer 25 to 25.5g of the sample into the ZHE cylinder. Record the mass on Line H.3. If less than 25 g is used an NCM should be written to document the deviation from the procedure.

10.7.2.7 Place the ZHE body on the ZHE base and secure the top flange.

10.7.2.8 Close the liquid inlet/outlet valve on the top flange. Pressurize the ZHE until you hear the seals set.

10.7.2.9 Slowly open the liquid inlet/outlet valve to release all headspace. Then depressurize the ZHE using the pressure release valve.

10.7.2.10 *LINE H.7* – The worksheet will calculate the required volume of leach fluid to add to the ZHE in Line H.7, which is 20 times the mass of the wet solids in the ZHE body (e.g. If 25 g of wet solids were used, then 500 mL of fluid would be required). See the formula in Section 11.7.

Load a clean ZHE that has been specifically designated for blank fluid with the correct volume of TCLP Fluid #1 or SPLP Fluid #3 depending on the analysis requested. Measure the amount of fluid from Line H.7 using a clean 500 mL or 1000 mL graduated cylinder, and pour it into the ZHE with the piston moved all the way to the bottom.

Place the assembled top flange (screens and filter paper aren't necessary) on top of the body holding the blank fluid and secure tightly. Attach the connective tubing to the inlet/outlet valve and with pressure flowing, slowly open the valve, while holding the tubing straight up until all the air has been removed from the line. At the first sign of liquid, immediately close the inlet/outlet valve to prevent the loss of any blank fluid.

Attach the other end of the tubing to the sample ZHE, making sure the pressure relief valve on the bottom of the sample ZHE is left open. Slowly open the inlet/outlet valves on both ZHEs and turn on the pressure, which is attached to the ZHE containing the blank fluid, to allow the fluid to flow into the ZHE containing the sample. When it is determined that all the fluid has been transferred, close the inlet/outlet valve on both ZHEs and remove the transfer line. Observe the valve opening for any leaks. If it is leaking, the valve o-rings will need to be replaced.

Slowly open the liquid inlet/outlet valve to release any air that was introduced into the ZHE with the fluid. Close the valve as soon as liquid appears.

10.7.2.11 *LINES H.7a, H.7.b, and H.7.c* – Record the lot number and the pH of the fluid used.

10.7.2.12 *LINE I.1.a and LINE I.1.b* – Making sure the pressure relief valve at the bottom is closed, pressurize the ZHE to at least 15 psi. Record the on I.1.a. Let the ZHE sit for at least 15 minutes. Check to make sure the gauge indicates no loss of pressure. Record this check on Line I.1.b. Check the inlet/outlet valve for signs of leakage. If the ZHE shows signs of leakage or the pressure gauge indicates leakage, then the ZHE will be removed from service and repaired. Start the procedure over using either a new ZHE or the repaired ZHE and a fresh aliquot of sample. All repairs and maintenance performed on ZHEs are documented in the ZHE log book. If the ZHE has held pressure and there is no sign of leakage from the inlet/outlet valve then proceed on.

10.7.2.13 If the pressure gauge indicates a leak, place the ZHE in a bucket of water and watch for air bubbles. If bubbles are coming from the o-ring at the bottom of the cylinder, clean or replace the o-ring and wipe any contamination from the o-ring grooves. If bubbles are coming from the base pressure relief valve, try seating the valve with your finger or mark the base as having a leaky valve and set aside for repair.

10.7.2.14 Generate a leach blank by assembling and loading a ZHE with the same leach fluid used for the samples. Record in the ZHE logbook which ZHEs were used for the leaching of samples and which ZHEs were used for the leaching of blanks. A ZHE cannot be used for the leaching of a sample if it has not been used for the leaching of a blank in the past 20 leaches.

10.7.2.15 *LINE I.2 through LINE I.4-* Secure the ZHE in a rotatary agitator and rotate end-over-end at 28-32 rpm for 16-20 hours. Record the start time and the end time on Lines I.3 and I.4. The rotator speed must be checked every day of use under load. Count the number of rotations in 15 seconds and multiply by 4 to obtain the rotations per minute (RPM). If the RPM is between 28 and 32, then mark line I.2 “YES”. If the RPM is not between 28 and 32, then tag out the rotator until it can be repaired and move the samples to a rotator that does rotate at the correct speed.

10.7.2.16 *LINE I.5.a and LINE I.5.b* – A data-logging device (Log Tag) records the room temperature. The maximum and minimum temperature during the leach is recorded.

If the temperature of the room was not 23 ± 2℃, the solid fractions of the samples must be re-leached. If there is no volume to re-leach, the client must be contacted. The client must decide if the procedure should be canceled or if the laboratory should continue with a NCM.

Download LogTag data according to WI-DV-0067. Click on "Data" tab and print data to PDF. File should be stored with the EXCEL TCLP worksheet files. The LogTag PDF file will then be attached to each corresponding batch in the LIMS system "TALS" per instructions in Attachment 12, Line 14.

10.7.2.17 *LINE I.6* - Remove the ZHE from the rotary agitator and check that the ZHE is still under pressure. Do this by quickly opening and closing the pressure release valve and listening for the release of gas. If the ZHE is not under pressure, then the procedure must be repeated using a fresh aliquot of sample and the ZHE should be taken out of service for maintenance and repair.

10.7.2.18 *LINE I.7* – Attach a clean gas-tight syringe to the inlet/outlet valve. The plunger of the syringe should be completely compressed before being attached to the ZHE. Slowly open the inlet/outlet valve and allow the leachate to enter the syringe. If necessary the ZHE can be pressurized to facilitate the collection of the leachate, but care should be taken not to cause effervescence. After enough leachate has been collected to fill three 20 mL voa vials (about 75 mLs), remove the syringe from the ZHE. If the sample was multiphasic and the filtrate and leachate are to be recombined prior to analysis, the amount of leachate recovered needs to be entered in Line I.7. This step should be performed the same day the 16 to 20 hour leach is finished.

10.7.2.19 *LINE I.7.a* - If the leachate is bi-phasic record the volume of the non-aqueous phase on Line I.7.a. Document in an NCM. The oil phase may need to be analyzed separately and results mathematically re-combined.

10.7.2.20 Transfer the leachate from the syringe to three 20 mL voa vials for TCLP leachates or three 40 mL voa vials for SPLP leachates. Care should be taken not to leave any headspace in the vials. The entire leachate need not be transferred.

10.7.2.21 Label all leachates and deliver the leachates and associated blank to the GC/MS Volatiles department along with all completed documentation. The leachates should be stored at 4 ± 2 ℃.

10.7.3 ZHE Leaching of Samples Less than 100%, but greater then 0.5% Solids

10.7.3.1 Consult Worksheet 1 and examine the sample. If the sample appears to be different from the preliminary information found on the worksheet, consult your supervisor. If the preliminary evaluations indicate the need for particle size reduction, crush, cut, or grind the sample so that all particles are less than 1 cm in size as measured with a ruler. (Do not sieve the sample). Size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram. Weigh the particle, and estimate the surface area based on three dimensions assuming a cuboid shape. If particle size reduction was necessary, document this on Worksheet 4 as an observation.

NOTE: To minimize loss of volatiles, samples for volatiles that require particle size reduction should be kept in sample storage (at 4 ºC) until immediately before size reduction. Aggressive reduction which would generate heat should be avoided and exposure of the waste to the atmosphere should be avoided to the extent possible. Size reduction to a fine powder is not appropriate.

10.7.3.2 Assemble the top flange and run water through the valve and work the o-ring back and forth until it loosens up. This will prevent the o-rings from tearing. It will prevent the valve from leaking and reduce the frequency of o-ring replacement. Place the assembled top flange on top of the body, secure tightly. See Attachment 6.

10.7.3.3 *LINE H.4.b* - Weigh 1 to 2 empty gas-tight syringes. Record their combined weight as the tare weight on Line H.4.b. More syringes may be needed if the sample contains a low percent solids value. See Line B.5.

10.7.3.4 Place o-rings and wiper seals on the ZHE piston. Moisten the o-rings with water and place the piston in the ZHE body. Adjust the ZHE piston in the ZHE body to the appropriate height in order to contain the required sample. By seating the piston as high as possible, you will limit the headspace in the ZHE that will need to be purged later and the potential loss of volatiles.

10.7.3.5 *LINE H.1* – Calibration check the balance per DV-QA-0014 and record the balance ID.

10.7.3.6 *LINE H.2* – Record the ID of the ZHE

NOTE: To reduce the time the sample is exposed to the air, the steps described in Section 10.7.3.7 through Section 10.7.3.15 should be done in quick sequence, working with one sample at a time.

10.7.3.7 *LINE H.3* - Place the ZHE cylinder on the balance and tare. Use the equation in Section 11.10 to estimate how much sample to place into the ZHE in order to ensure 25g of wet solids is included in the aliquot. Transfer the sample into the ZHE cylinder. Record the mass on Line H.3.

10.7.3.8 Place the ZHE body on the ZHE base and secure the top flange.

10.7.3.9 Close the liquid inlet/outlet valve. Pressurize the ZHE until you hear the seals set.

10.7.3.10 Slowly open the liquid inlet/outlet valve to release all headspace. Once liquid starts to come out of the valve, immediately close the valve and attach one of the tared syringes.

10.7.3.11 Open the valve again and collect the filtrate. Once the syringe is filled, close the valve and attach an additional tared syringe and repeat until no more filtrate is collected. Increase the pressure of the ZHE 10 psi at a time up to 50 psi until no more filtrate emerges from the ZHE after 2 minutes.

10.7.3.12 *LINE H.4.a* - Weigh the full syringes and record their combined weight as the gross weight.

10.7.3.13 *LINE H.4.c* – The worksheet will then calculate the net weight of the filtrate using the equation in Section 11.2

10.7.3.14 *LINE H.5* – Record the volume of the filtrate by reading the graduations on the syringe(s).

10.7.3.15 Transfer the filtrate into vials with no headspace. Label and store the filtrate refrigerated 4 ± 2℃.

10.7.3.16 *LINE H.6* – The worksheet will then calculate the total grams of wet solids remaining in the ZHE using the formula in Section 11.3. If less than 25g of wet solids remains in the ZHE, an NCM should be written to document the deviation from the procedure.

NOTE: The ZHE has a maximum capacity of 500mL. Therefore you cannot load more than 25g of solids into the ZHE or else you will not be able to add the appropriate volume of leach fluid.

10.7.3.17 *LINE H.8*- The worksheet will then calculate the percent wet solids using the formula in Section 11.4

10.7.3.18 Follow steps in Section 10.7.2.10 through 10.7.2.21

10.7.3.19 If the initial filtrate from Section 10.7.3.15 is miscible with the leachate (as determined in Section 10.3.3), the leachate and the initial filtrate are directly recombined in the correct proportions.

For samples containing greater than 5% wet solids, the percent wet solids value from the ZHE filtration process should be used to determine the volume of filtrate to re-combine with the leachate. Therefore use the value in Line I.8.b. This approach is required since the percent solids value determined using the pressure filter may differ from the percent solids value determined using the ZHE due to sample variability or differences in the filtration apparatus.

For samples containing less than 5% wet solids, the percent wet solids value from the pressure or vacuum filtration process should be used to determine the volume of the filtrate to re-combine with the leachate. Therefore use the value in Line I.8.a. This approach is required because the ZHE is not appropriate to determine the percent solids of a sample if the percent solids are less than 5%.

Document the volume used in the comments section. For example, if the sample contained less than 5% wet solids and you are using the volume of initial filtrate calculated from Line I.8.a, Note “Sample “ABC” initial filtrate volume calculated from Line I.8.a”

10.7.3.20 If the individual phases are NOT compatible, they are to be collected, prepped and analyzed separately. If the individual phases are analyzed separately, the results can be mathematically recombined by using the recombination calculation in Section 11.12.

10.7.3.21 Label all leachates and deliver the leachates and associated blank to the GC/MS Volatiles department along with all completed documentation. The leachates should be stored at 4 ± 2 ℃.

10.8 Maintenance

10.8.1 The pH probe should be replaced when it is noticed that the readings drift or are inconsistent. This should be documented in the pH logbook.

10.8.2 ZHE valve o-rings need to be replaced when worn. Scientific Instrument Service part numbers V011 and V012. This should be documented in the ZHE logbook.

10.8.3 The ZHE inlet/outlet connector can become damaged and should be replaced with Millipore part number YT3009002. This should be documented in the ZHE logbook.

10.8.4 The pressure gauges and pressure release valves on the ZHE base need to be replaced when worn or broken. The pressure release valves can be purchased from Millipore under part number XX6700024.

10.8.5 The quick connect on the ZHE base will need to be replaced when worn. Swaglok part number SS-QC4-B-2PM.

10.8.6 When working with especially oily samples, disposable ZHE screens are preferred to help prevent cross-contamination.

10.9 Troubleshooting

10.9.1 When leaching samples with TCLP Fluid #2, applying duct tape to the lids can prevent the samples from leaking.

10.9.2 It is advisable to monitor and the temperature of the tumble room throughout the day before samples are set to tumble so that the heaters and air conditioners can be adjusted to keep the temperature in range. If four or more rotators are running at a time, this will generate heat in the room and the door might need to be propped open to keep the room in range. Normally heaters set at 75 °F and air conditioners set at 30°C keep the room in temperatu re range.

10.9.3 When working with a sample that appears to be 100% liquid, do not assume the sample is water miscible. Test the miscibility of the sample in water and methylene chloride.

10.9.4 When preparing the leach fluids, it is important to mix the fluids well. This is especially important when making large volumes of fluid.

10.9.5 When adjusting the pH of SPLP fluid, do not assume the pH of the reagent water is 7. Test the pH of the water and enter it into the adjustment spreadsheet. Also if only a very small amount of acid is needed to adjust the pH into range, the acid can be pre-diluted before adding it to the fluid to help in mixing and more accurate measurement.

11.0 Calculations and Data Reducation

11.1 Weight of Subsample (Line B.2.c)

(Net Weight, B.2.c) = (Gross Weight, B.2.a) – (Tare Weight, B.2.b)

11.2 Weight of Filtrate (Line B.3.c) or (Line H.4.c)

(Net Weight, B.3.c) = (Gross Weight, B.3.a) – (Tare Weight, B.3.b)

(Net Weight, H.4.c) = (Gross Weight, H.4.a) – (Tare Weight, H.4.b)

11.3 Total Weight of Wet Solids (Line B.4) or (Line H.6)

(Wet Solids, B.4) = (Weight of Subsample, B.2.c) – (Weight of Filtrate, B.3.c)

(Wet Solids, H.6) = (Weight of Subsample, H.3) – (Weight of Filtrate, H.4.c)

11.4 Weight Percent Wet Solids (Line B.5) or (Line H.8)

(% Wet Solids, B.5) = 100 x (Wet Solids, B.4) / (Weight of Subsample, B.2.c)

(% Wet Solids, H.8) = 100 x (Wet Solids, H.6) / (Weight of Subsample, H.3)

11.5 Weight Percent Dry Solids (Line B.6.c)

$$(\text{Weight percent dry solids, B.6.c}) = 100 \times \frac{(\text{Gross dry weight 2 or 1, B.6.b or B.6.a if B.6.a is blank}) - (\text{Weight of filter, B.1})}{(\text{Weight of subsample .B.2.c})}$$

11.6 Volume of Aqueous Filtrate (Line B.7)

(Vol. of Filtrate B.7) = (Weight of Filtrate, B.3.c) / (Density of Filtrate, B.3.d)

11.7 Volume of Fluid for Bottle Leach (Line F.6) or ZHE Leach (H.7)

(Vol. Fluid, F.6) = (Weight of Wet Solids, E.3) x 20

(Vol. Fluid, H.7) = (Weight of Wet Solids, H.6) x 20

11.8 Volume of Initial Filtrate to recombine with Leachate (Line G.7), (Line I.7.a) or (Line I.7.b)

$$(\text{Vol. of Inital Filtrate for Recombination, G.7}) = \frac{(\text{Solids Leachated, E.3})}{(\text{Tot. Wet Solids, B.4})} \times \frac{(\text{LeachateRecovered, G.6})}{(\text{FluidAdded, F.6})} \times (\text{InitialFiltrat, B.7})$$

$$(\text{Vol. of Inital Filtrate for Recombination, I.7.a}) = \frac{(\text{Wet Solids in ZHE, H.6})}{(\text{Tot. Wet Solids, B.4})} \times \frac{(\text{LeachateRecovered, I.6})}{(\text{FluidAdded, H.7})} \times (\text{InitialFiltrat, B.7})$$

$$(\text{Vol. of Inital Filtrate for Recombination, I.7.b}) = \frac{(\text{Weight of Filtrate, H.4.c})}{(\text{Fluid Added, H.7})} \times (\text{Volume of Leachate Recovered, I.6})$$

11.9 Combined initial filtrate and leachate (Line G.8)

(Combined Filtrate & Leachate, G.8) = (Vol of Leachate, G.6)+(Vol of Filtrate, G.7)

11.10 Weight of Sample to Charge to ZHE

(Weight of Sample) = 100 X [20g/ (%wet solids, B.5)]

11.11 Reporting Conventions for Multi-phase Leachates:

11.11.1 If both phases have positive results, use the values from each phase to calculate the recombined result. Use the reporting limit for each phase to calculate the recombined reporting limit.

11.11.2 If both phases are "ND," not detected, the recombined result is "ND," and the reporting limit is calculated from the reporting limit for each phase.

11.11.3 If one phase is "ND" and the other phase has a positive result, use the reporting limit for the "ND" phase and the positive value for the other phase to calculate the combined result. The combined reporting limit is based on the reporting limit for both phases. If the combined result is less than the combined reporting limit, then supply a footnote to indicate that "a positive result was detected below the calculated detection limit."

11.11.4 Units - regardless of the nature of the sample, all TCLP and SPLP results are reported in units of mg/L.

11.11.5 For limits and significant figures, consult the appropriate analytical methods

11.12 Mathematical recombination of analytical results:

$$\text{Final Analyte Concentration} = \frac{(V_1 \times C_1) + (V_2 \times C_2)}{V_1 + V_2}$$

V_1 = total volume of the initial filtrate phase (L).

C_1 = analyte concentration in initial filtrate phase (mg/L).

V_2 = volume of the theoretical solid phase leachate (L).

C_2 = analyte concentration in solid phase leachate (mg/L).

12.0 Training Requirements

12.1 The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. See requirements for demonstration of analyst proficiency in SOP DV-QA-0024.

13.0 Pollution Control

13.1 This method allows for the proportional reduction of sample and reagent volumes to decrease waste generation.

13.2 Standards and reagents should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in Section 13, "Waste Management and Pollution Prevention", of the Enviornmental Health and Safety Manual, and DV-HS-001P, "Waste Management Plan."

14.2 The following waste streams are produce when this method is carried out:

14.2.1 Expired Chemicals/Reagents/Standards – Contact Waste Coordinator

14.2.2 Solid waste (post extraction) – Excess Solid Samples - Waste Stream S See Note under Section 5.2.10

14.2.3 Aqueous waste (post extraction) - Aqueous Waste from TCLP - Waste Stream T

14.2.4 Buffer 4 - Aqueous Waste from TCLP - Waste Stream T

14.2.5 Buffers 7 and 10 - Aqueous Waste from TCLP - Waste Stream T

14.2.6 Methanol waste - Flammable Solvent - Waste Stream C

14.2.7 Methylene chloride waste - Waste Stream B

14.2.8 Radioactive, mixed waste and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of radioactive or potentially radioactive waste generated by this procedure.

15.0 References

15.1 Method 1311, Toxicity Characteristic Leaching Procedure, Revision 0, July 1992, SW-846 Final Update I.

15.2 Method 1312, Synthetic Precipitation Leaching Procedure, Revision 0, November 1992, SW-846 Proposed Update II.

15.3 Related Documents

15.3.1 Toxicity Characteristic: Corrections to Final Rule. Method 1311, Federal Register, Vol. 55, No. 126, Friday, June 29, 1990.

15.3.2 Toxicity Characteristic: Final Rule. Method 1311, Federal Register, Vol. 55, No. 61, Thursday, March 29, 1990.

15.4 Technical Background Document and Response to Comments, Method 1311, Toxicity Characteristic Leaching Procedure, USEPA/OSW, April, 1989.

16.0 Method Modifications

Item	Method	Modification
1	SW846 1311	Section 7.1 of the source method states that the sample aliquot used for the preliminary evaluation “...may not actually undergo TCLP extraction.” Section 7.1.5 of the source method indicates that the portion used for the preliminary evaluation may be used for either the ZHE or non-volatile extraction if the sample was 100% solid. Section 7.1.5 further indicates that if the sample was subjected to filtration (i.e., < 100% solid) that this aliquot may be used for the non-volatile extraction procedure only as long as sufficient sample is available (minimum 100 g). This SOP states that samples which have been subjected to the oven drying step may not be used for TCLP extraction because solid phase degradation may result upon heating.

Item	Method	Modification
3	SW846 1311	Percent Solids Determination. Section 7.1.2 of the source method indicates that "if the percent wet solids is ≥ 0.5% and it is noticed that a small amount of the filtrate is entrained in wetting of the filter" that the filter should be oven dried to determine percent dry solids ". Drying of oil or organic matrices can both be hazardous and inappropriate. Additionally, it may be impossible to achieve a constant weight when performing this step. Due to safety concerns, this SOP states that if obviously oily or heavy organic matrices are entrained on the filter, the filter is not oven dried.
4	SW846 1311	Section 7.2.13 of the source method provides no guidance as to how to determine filtrate and leach fluid compatibility. Therefore, this SOP has incorporated a miscibility test into the Preliminary Determinations section.
5	SW846 1311	Method 1311 does not address the appropriate approach to take if the pH equals 5.0. This SOP requires that Fluid #1 must be used if the pH is less than or equal to 5.0.
6	SW846 1311	Section 8.2 of the source method states "A matrix spike shall be performed for each waste type..." and "A minimum of one matrix spike must be analyzed for each analytical batch." Further, Section 8.2.3 of the source method also states "The purpose of the matrix spike is to monitor the performance of the analytical methods used, and to determine whether matrix interferences exist." The TestAmerica Laboratory Quality Manual is designed to address the performance monitoring of analytical methodology through the LCS program. A minimum of one MS and MSD will be prepared for each TCLP leachate batch. The MS/MSD results are used to determine the effect of a matrix on the precision and accuracy of the analytical process. Due to the potential variability of the matrix of each sample, the MS/MSD results have immediate bearing only on the specific sample spiked and not all samples inthe batch.
7	SW846 1311	Section 6.4 of the source method states samples "may" be refrigerated unless refrigeration results in irreversible physical change to the waste. This procedures states the samples "should" be refrigerated unless refrigeration results in irreversible physical change to the waste.

17.0 Attachments

Attachment 1: Toxicity Characteristic Analytes and Regulatory Levels (Final Rule)
Attachment 2: Metals TCLP Spike
Attachment 3: Metals ICP SPK 2A
Attachment 4: Metals ICP SPK 3A
Attachment 5: Metals Hg Daily Spk
Attachment 6: Rotary Agitation Apparatus and Zero Headspace Extraction Vessel (ZHE)
Attachment 7: Pressure Filtration Device
Attachment 8: TCLP Worksheet No. 1: Sample Description
Attachment 9: TCLP Worksheet No. 2: Selection of Leach Fluid
Attachment 10: TCLP/SPLP Worksheet No. 3: Bottle Leach Procedure
Attachment 11: TCLP Worksheet No. 4: ZHE Leach
Attachment 12: Instructions for Batching in LIMS
Attachment 13: Instruction Manual for pH meter.
Attachment 14: SPLP worksheet for correcting fluid pH.

18.0 Revision History

- Revision 9, dated 31, October 2015
    - Added detail to Section 4.5 and 10.7 stating that samples that are to be leached for volatiles should be kept cold until loaded into the ZHE and headspace is purged.
    - Revised Sections 10.6.1 and 10.7.2.15 to state that the rotation speed of the rotators must be checked under load each day of operation.
    - Revised Sections 10.6.4 and 10.7.2.18 to state that the leachate should be filtered the same day the 16-20 hour leach is completed.
    - Revised wording in Section 10.4.5 to match Section 10.4.2.
- Revision 8, dated 31, May 2015
    - Reformatted SOP.
    - Added comment to Section 1.4 to state that TestAmerica Denver cannot digest organic waste for metals analysis.
    - Section 4 was revised to discuss how organic waste samples will be treated. In the past organic liquids were assumed to be 100% liquid. The SOP was revised to state that organic liquids will be filtered to determine the percent solids.
    - Section 5.2.5 was revised to add details to the types of samples more likely to cause pressure to build up in the leach vessel.
    - Section 6 was revised to include the LogTag temperature recording device.
    - Section 9.2 was revised to clarify samples that are multi-phasic or solid per the procedure will be batched separately from samples that are liquid per the procedure.
    - Sections 3.4, 9.3 and 9.4 were revised to state that one leach blank will be prepared instead of “a minimum of one”.
    - Section 10.3 was revised to clarify that the steps to determine the leach fluid type are performed on the solid fraction of the sample.
    - Section 10.5.2 was revised to instruct the analyst on corrective action if the pH of the leach fluid is not within specifications.
    - Section 10.6.3 and Section 10.7.2.16 were revised to instruct the analyst on corrective action if the temperature of the room during the leach is outside of the control limits.
    - Sections 10.4.2 and 10.3.1 were revised to reference WI-DV-0058.
- Revision 7, dated 31, May 2014
    - Revised Section 6.9 to call for the pH meter to be calibrated at pH 2, pH 4, pH 7, and pH 10. Revised Attachment 13.
    - Added narrow range pH strips to Section 6 and revised Section 10 to allow their use as an alternative to the pH meter for oily samples.
    - Added the option to use disposable ZHE screens to Section 6.
    - The instructions in Section 7.7 on how to prepare TCLP fluids were revised to more closely match the source method.
    - Updated Section 7.10.2 for spike used to 2B
    - Attachment 14 was added to aid in the preparation of SPLP fluids. Section 7.9 was revised to instruct the analysts to use the spreadsheets when adjusting the pH of the SPLP fluid.
    - Section 9.1.2 was revised to state that this procedure meets all criteria for DoD QSM 5.0 unless otherwise stated.

  - Section 9.3 was revised to clarify how samples are batched by matrix. A note was added to Section 9.6 to clarify the required frequency of MS/MSD samples.
  - Revised Section 10.3.2 to remove the accuracy criteria for the bottle-top pump. Instead a reference was made to the SOP DV-QA-0008 which dictates the requirements for accuracy and precision of bottle-top pumps.
  - Revised Section 10.3.2 to instruct the analyst to cover the sample with a watch glass and to <u>not</u> stir the sample during the 10 minute heating process or during the pH measurement after the 10 minute heating process. This was done to more closely match the source method.
  - Revised Section 10.6.3.1 to instruct the analyst to attach the “Chart” data page from the temperature recording devise (LogTag) instead of the “Summary” data page.
  - Added a comment to Section 10.6.10 to direct the analyst to Table 2 to ensure enough leachate is delivered.
  - Updated Section 10.6.12 for Spike used to 2B
  - Added Troubleshooting and Maintenance sections to Section 10.
  - Updated Attachment 3 to include Sulfur and changed name to 2B
  - Revised Attachment 6 to show the Cylinder o-ring and the wiper seal on the ZHE.
  - Revised Attachment 7 to show the o-ring on the Pressure Filter.

- Revision 6, dated 31, May 2013
  - Section 5.2.10 was added and Section 14.2 were revised to address safety issues with waste handling.
  - Section 6.9 was revised and Attachment 13 was added because the lab acquired a new pH meter.
  - Section 8.9 was revised to show holding times are calculated from the beginning of the leaching procedure.
  - Section 9.1 and 10.0 were revised to reflect current practice.
  - Sections 10.2.19, 10.3.2, 10.6.3 and all Worksheets were revised to instruct the analysts to record the actual and observed temperatures and the thermometer correction factors.
  - Worksheet #3 was revised to indicate the correct leach fluid to use as determined in Lines D.1 through D.5. Section 10.5.1 was revised to reflect this change.
  - Section 10.7 was revised to instruct the analyst to be especially cautious to minimize the samples’ exposure to the atmosphere as much as possible to reduce the loss of volatiles.
  - Section 10.7.1.2, Section 10.7.2.3, and Section 10.7.3.4 were revised to instruct the analyst to seat the piston in the ZHE as high as possible when loading to limit the sample’s exposure to the atomosphere.
  - A note was added to Section 10.7.2.5 and Section 10.7.3.6 to instruct the analyst to work with one sample at a time to limit the samples’ exposure to the atmosphere.
  - Section 10.7.2.6 and Section 10.7.3.7 were revised to instruct the analyst to aliquot the sample directly into the ZHE instead of first aliquotting it into a weigh-boat and transferring it to the ZHE. This was done to limit the samples’ exposure to the atmosphere and is now possible because the laboratory utilizes a 3kg mass in the daily balance calibration.

- Revision 5, dated 11, May 2012
  - This procedure was revised to require the use of a 25g aliquot in the zero headspace extractor.

  - This procedure was revised to instruct analyst to measure the mass of sample used in the ZHE procedure on a balance using a weigh boat instead of taring the ZHE body on the balance. This was done because the total mass of the ZHE body and sample exceeds all standard masses available for daily balance calibration checks.
  - This procedure was revised to more accurately reflect how the laboratory is preparing the TCLP Fluid #1 in large quantities.
  - This procedure was revised to remove the requirement that blank fluid be prepared using nitrogen-purged water when volatiles are requested. Water from the laboratory's ELGA purification systems were tested for volatiles, and no volatiles were detected, therefore water from the ELGA systems will be used for the preparation of all leach fluids.
  - Revised section 10.6.12 to properly reflect current practices regarding the MS/MSD spiking procedure for metals analysis.

- Revision 4, dated 25 May, 2011
  - Revised Section 4.1 to change instructions on how oily samples should be logged in LIMS.
  - Added detail to Section 6.1.1 on how to clean the ZHE apparatus.
  - Added a bottle-top pump to the equipment list in Section 6.
  - Revised Section 7.1 to state that the water from the ELGA purification system should be 18 to 18.2 Mohm-cm.
  - Added additional clarification to Section 7.7 and Section 7.9 on how the TCLP blank fluids are prepared with nitrogen purged water when volatile analyses are requested.
  - Section 9.2 was revised to remove the requirement that samples have to be batched separately if the bulk matrix is visibly different. Samples are only batched separately based on % solids determination or per client request.
  - Added more detail to Section 10.2.5 on aliquoting samples for percent wet solids determination.
  - Revised Section 10.3.2 to require the documentation of exactly how much water was added to the sample, exactly what time the sample was placed on the stir plate, exactly what time the sample was removed from the stir-plate, exactly what temperature the sample was on the hot plate and the exact times the sample was on the hot plate.
  - Added Section 10.6.3.1 and Section 10.7.2.16.1 to describe LogTag download and file retention procedure.
  - Revised Section 10.6.11 and 10.6.12 to make changes to how the leachates are spiked and preserved for metals analysis.
  - Revised Section 10.7.1.3 to state "Nitrogen-purged water" as opposed to "DI water".
  - Revised Section 10.7.2.7 to state "T1 fluid prepared with nitrogen-purged water" as opposed to "DI water".
  - Revised Section 10.7.2.18 to remove duplicated verbiage.
  - Added Section 10.7.3.19.3 to instruct the need to document which calculated volume of initial filtrate was combined with the ZHE leachate.
  - Updated Attachments 8 thru 11 to include the revisions made above.

Earlier revision histories have been archived and are available upon request.

Attachment 1.
Toxicity Characteristic Analytes and Regulatory Levels (Final Rule)

Contaminant	mg/L
Arsenic	5.0
Barium	100.0
Benzene	0.5
Cadmium	1.0
Carbon tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Chromium	5.0
o-Cresols	200.0
m-Cresols	200.0
p-Cresols	200.0
Total Cresols (used if isomers not resolved)	200.0
2,4-D	10.0
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
2,4-Dinitrotoluene	0.13
1,1-Dichloroethylene	0.7
Endrin	0.02
Heptachlor (& epoxide)	0.008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10.0
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-TP (Silvex)	1.0
Vinyl chloride	0.2

Attachment 2
Metals TCLP Spike

Component	**Concentration (ug/mL)**
Silver	100
Arsenic	300
Barium	1000
Cadmium	100
Chromium	500
Copper	200
Lead	500
Selenium	100
Zinc	200

Attachment 3.
Metals ICP SPK 2B

Component	Concentration (ug/mL)
Boron	100
Molybdenum	100
Antimony	50
Silicon	1000
Tin	200
Titanium	100
Zirconium	50
Sulfur	20

Attachment 4.
Metals ICP SPK 3A

Component	Concentration (ug/mL)
Silver	5
Aluminum	200
Arsenic	100
Barium	200
Beryllium	5
Calcium	5000
Cadmium	10
Cobalt	50
Chromium	20
Copper	25
Iron	100
Potassium	5000
Lithium	100
Magnesium	5000
Manganese	50
Sodium	5000
Nickel	50
Phosphorus	1000
Lead	50
Selenium	200
Strontium	100
Thorium	100
Thallium	200
Uranium	200
Vanadium	50
Zinc	50
Bismuth	200

Attachment 5.

Metals Hg Daily Spk

Component	Concentration (mg/L)
Mercury	0.1

Attachment 6.
Rotary Agitation Apparatus and Zero Headspace Extraction Vessel (ZHE)

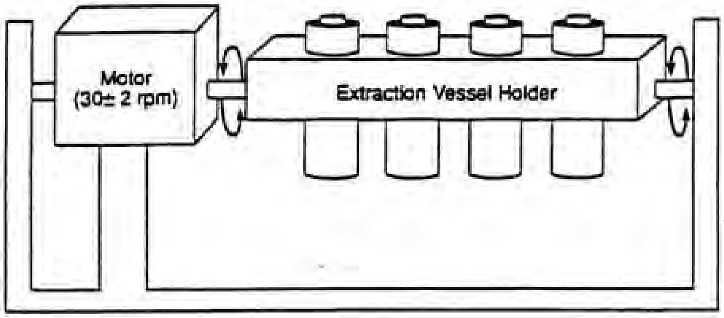
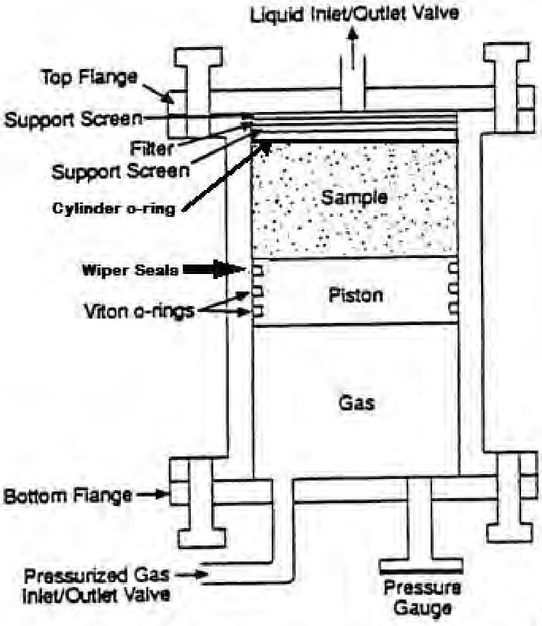
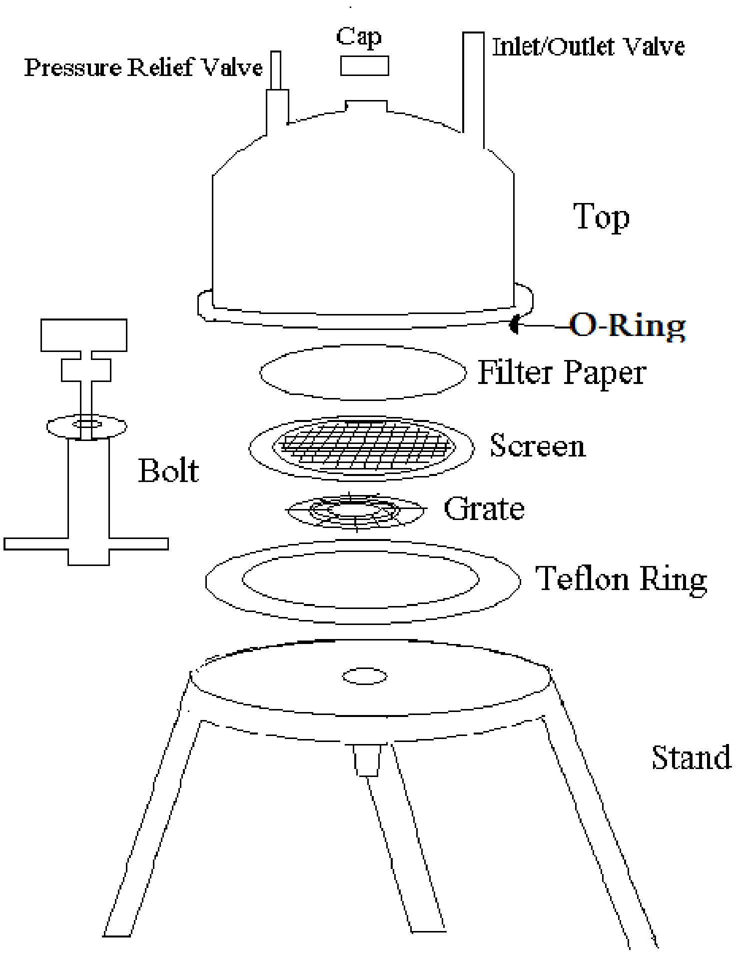


Figure 1. Rotary Agitation Apparatus



Attachment 7
Pressure Filtration Device



Attachment 8
Worksheet No. 1
TCLP

Analyst: ______

Date: ______

DV-IP-0012
TCLP/SPLP Worksheet No. 1
Sample Description

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Login No.										
Sample No.										
A. Sample Description										
Number of phases										
1. Solid										
2. Liquid										
a. lighter than water										
b. water										
c. heavier than water										
B. Percent Solid Phase										
Balance ID										
1. Weight of filter (g)										
2. Weight of subsample										
a. gross weight (g)										
b. tare weight (g)										
c. net weight (g)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Weight of filtrate										
a. gross weight (g)										
b. tare weight (g)										
c. net weight (g)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d. density of filtrate (g/mL)										
4. Total weight wet solids (g)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Weight percent solids (wet) (%)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6. Weight percent solids (dry)										
a. gross dry weight 1 (g)										
b. gross dry weight 2 (g)										
c. percent dry solids (%)										
d. Oven Temp (observed) (^{o}C)										
Thermometer Correction Factor										
Oven Temp Actual (^{o}C)	0	0	0	0	0	0	0	0	0	0
7. Vol. of initial aqueous filtrate (mL)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8. Vol. of initial organic filtrate (mL)										

Comments:

$$\left(\text{Weight percent dry solids, B.6.c}\right) = 100 \times \frac{\left(\text{Gross dry weight 2 or 1, B.6.b or B.6.a if B.6.a is blank}\right) - \left(\text{Weight of filter, B.1}\right)}{\left(\text{Weight of subsample .B.2.c}\right)}$$

(Net Weight of Subsample, B.2.c) = (gross weight, B.2.a) - (tare weight, B.2.b)

(Net Weight of Filtrate, B.3.c) = (gross weight, B.3.a) - (tare weight, B.3.b)

(Total weight wet solids, B.4) = (Weight subsample, B.2.c) - (Weight filtrate, B.3.c)

(Vol of initail filtrate, B.7) = (Weight of filtrate, B.3.c) / (Denisity of filtrate, B.3.d)

(Weight percent wet solids, B.5.) = 100 X (Total weight wet solids, B.4.) / (Weight of subsample, B.2.c.)

Attachment 9
TCLP Worksheet No. 2

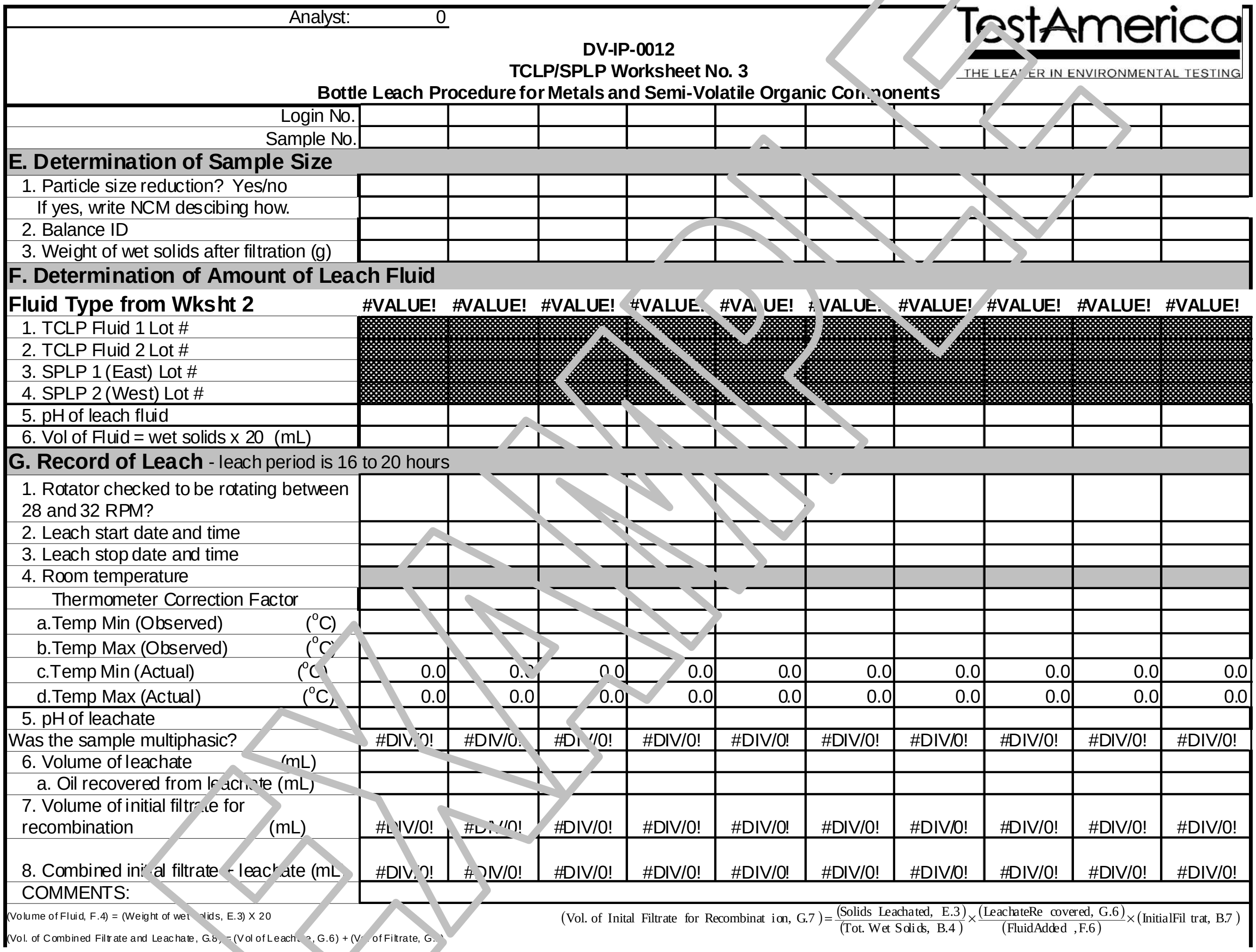
Analyst: 0

DV-IP-0012
TCLP Worksheet No. 2
Selection of Leach Fluid

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Login No.										
Sample No.										
C. Leach Fluid Determination- Does not apply to determination of volatile organic components or SPLP.										
1. Particle size reduction? (<1mm) Yes/No										
If yes, write NCM descibing how.										
2. Balance ID										
3. Sample weight, 5.0 +/- 0.1g										
4. Add 96.5 (+/- 2% or 94.57mL to 98.43mL)										
a. Pipette ID or Grad Cylinder ID										
5. Initial pH (after 5 min. mixing time)										
a. Start Time for Mixing										
b. Stop Time for Mixing										
c. pH reading after mixing										
6. If pH > 5.0, then add 3.5 mL 1N HCL & mark **"X"**										
a. HCL Lot# used										
b. Pipette ID										
7. Secondary pH (after 10min at 50C to 55C)										
a. Thermometer ID										
Termometer Correction Factor										
b. Start Time										
c. Start Temperature (Observed)										
Start Temperature (Actual)	0	0	0	0	0	0	0	0	0	0
d. Finish Time										
e. Finish Temperature (Observed)										
Finish Temperature (Actual)	0	0	0	0	0	0	0	0	0	0
f. pH reading after heating (temperature corrected)										
D. Selection of Leach Fluid										
1. If pH from C.5. or C.7.f. is <5.0 use Leach Fluid #1										
2. If pH from C.7.f is > 5.0, use Leach Fluid #2										
3. SPLP Fluid 1: Soils- East of the Mississippi River; Wastewates; or Wastewaters										
4. SPLP Fluid 2: Soils- West of Mississippi River										
5. SPLP Fluid 3: If VOCs or Cyanide containing wastes.										
6. **X** if filtrate and fluids are miscible										

Attachment 10
TCLP Worksheet No. 3



Analyst: 0

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

DV-IP-0012
TCLP/SPLP Worksheet No. 3
Bottle Leach Procedure for Metals and Semi-Volatile Organic Components

Login No.										
Sample No.										
E. Determination of Sample Size										
1. Particle size reduction? Yes/no										
If yes, write NCM descibing how.										
2. Balance ID										
3. Weight of wet solids after filtration (g)										
F. Determination of Amount of Leach Fluid										
Fluid Type from Wksht 2	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
1. TCLP Fluid 1 Lot #										
2. TCLP Fluid 2 Lot #										
3. SPLP 1 (East) Lot #										
4. SPLP 2 (West) Lot #										
5. pH of leach fluid										
6. Vol of Fluid = wet solids x 20 (mL)										
G. Record of Leach - leach period is 16 to 20 hours										
1. Rotator checked to be rotating between 28 and 32 RPM?										
2. Leach start date and time										
3. Leach stop date and time										
4. Room temperature										
Thermometer Correction Factor										
a.Temp Min (Observed) (^{o}C)										
b.Temp Max (Observed) (^{o}C)										
c.Temp Min (Actual) (^{o}C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d.Temp Max (Actual) (^{o}C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. pH of leachate										
Was the sample multiphasic?	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6. Volume of leachate (mL)										
a. Oil recovered from leachate (mL)										
7. Volume of initial filtrate for recombination (mL)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8. Combined initial filtrate + leachate (mL)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
COMMENTS:										

(Volume of Fluid, F.4) = (Weight of wet solids, E.3) X 20

(Vol. of Combined Filtrate and Leachate, G.8) = (Vol of Leachate, G.6) + (Vol of Filtrate, G.7)

$$(\text{Vol. of Inital Filtrate for Recombination, G.7}) = \frac{(\text{Solids Leachated, E.3})}{(\text{Tot. Wet Solids, B.4})} \times \frac{(\text{LeachateRecovered, G.6})}{(\text{FluidAdded, F.6})} \times (\text{InitialFiltrat, B.7})$$

Attachment 11
TCLP Worksheet No. 4

Analyst: 0

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DV-IP-0012
TCLP/SPLP Worksheet No. 4
ZHE Leach

Login No.										
Sample No.										
H.Determination of Amount of Leach Fluid										
1. Balance ID										
2. ZHE vessel number										
3. Weight of material added to ZHE (g)										
"X" if there was headspace in container.										
4. Weight of filtrate in syringe										
a. gross weight (g)										
b. tare weight (g)										
c. net weight (g)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Volume of filtrate in syringe (mL)										
6. Wet solids in ZHE (g)										
7. Weight of fluid to add (g)	0	0	0	0	0	0	0	0	0	0
a. TCLP Fluid 1 Lot #										
b. SPLP Fluid 3 Lot #										
c. pH of Blank Fluid										
8. Percent Wet Solids (%)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
I. Record of ZHE Leach - the Leach period is 16 to 20 hours.										
1. Leak Check										
a. Reading #1 (psi)										
b. Reading #2 (psi)										
2. Rotator checked to be rotating between 28 and 32 RPM?										
3. Leach start date & time										
4. Leach stop date & time										
5. Room temperature										
Thermometer Correction Factor										
a.Temp Min (Observed) (°C)										
b.Temp Max (Observed) (°C)										
c.Temp Min (Actual) (°C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d. Temp Max (Actual) (°C)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6. **X** if still under positive pressure after leaching										
7. Volume of leachate recovered (mL)										
a. Volume of oil recovered after leaching										
8. Vol. of initial aqueous filtrate for recombination										
a. Calculated from Worksheet 1 (mL)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
b. Calculated from Worksheet 4 (mL)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

(Net Weight of Filtrate, H.4.c) = (Gross weight, H.4.a.) - (Tare weight, H.4.b.)

(Percent Wet Solids, H.8.) = 100 X **[** (Wet Solids in ZHE, H.6) / (Weight of material added to ZHE, H.3) **]**

(Wet Solids in ZHE, H.6) = (Weight of material added to ZHE, H.3.) - (net weight of filtrate, H.4.c.)

(Vol of Filtrate for recombination, I.7.b) = (Vol of Leachate Recvd, I.6) X (Weight of Filtrate, H.4.c) / (Vol Fluid Added, H.7.)

(Weight of Fluid to add, H.7.) = (Wet Solids in ZHE, H.6) X 20

(Vol of Filtrate for recombination, I.7.a) = **[** (Wet Solids in ZHE, H.6.) / (Tot Wet Solids, B.4) **]** X **[** (Vol Leachate Recvd, I.6.) / (Vol Fluid Add, H.7.) **]** X (Vol Filtrate, B.7.)

COMMENTS:

Attachment 12

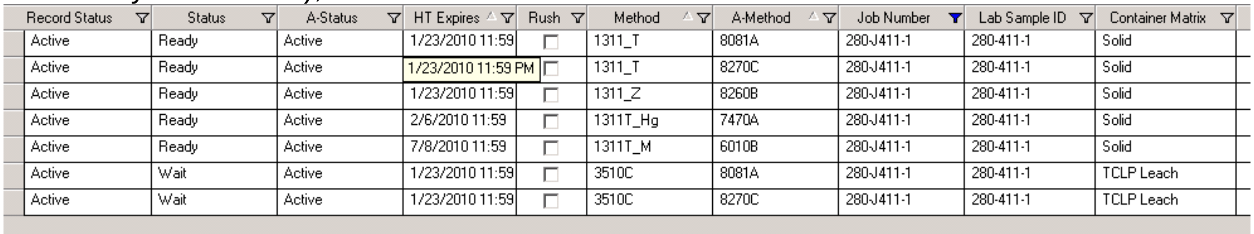
How to Batch TCLP and SPLP:

1311_T (Organics) **1311T_Hg** (Mercury) **1311T_M** (Metals)	**1312_E** (Organics) **1312_E_Hg** (Mercury) **1312_E_M** (Metals)	**1312_W** (Organic) **1312_W_Hg** (Mercury) **1312_W_M** (Metals)	**1311_Z** (ZHE)

Overview

The pre-prep methods listed above are specific to the analytes requested, but it is not necessary to batch them all separately. Above, the methods are placed in boxes to indicate which methods can be batched together, with one exception: *SPLP 8260s will be logged with 1312_E or 1312_W, which is the same leach method used for organic bottle preps so not all 1312_E can be batched together and not all 1312_W can be batched together*.

If one sample is logged in for TCLP 8270C, TCLP 8081B, TCLP 8260, TCLP 6010B, and TCLP 7470A, the sample will show up on the Organic Extractions backlog 5 times for TCLP, (once for each analytical method), and twice for 3510C.

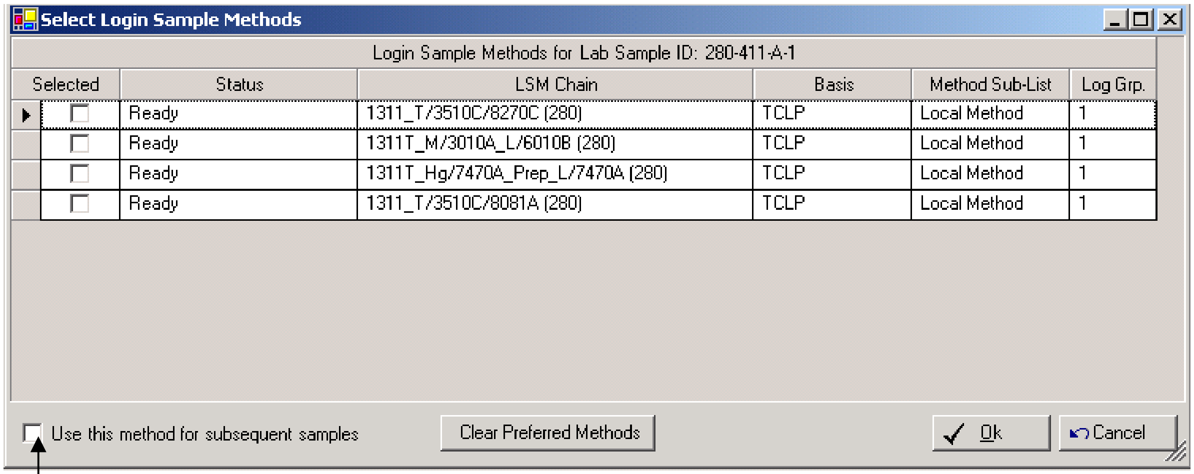


Record Status	Status	A-Status	HT Expires	Rush	Method	A-Method	Job Number	Lab Sample ID	Container Matrix
Active	Ready	Active	1/23/2010 11:59	☐	1311_T	8081A	280-J411-1	280-411-1	Solid
Active	Ready	Active	1/23/2010 11:59 PM	☐	1311_T	8270C	280-J411-1	280-411-1	Solid
Active	Ready	Active	1/23/2010 11:59	☐	1311_Z	8260B	280-J411-1	280-411-1	Solid
Active	Ready	Active	2/6/2010 11:59	☐	1311T_Hg	7470A	280-J411-1	280-411-1	Solid
Active	Ready	Active	7/8/2010 11:59	☐	1311T_M	6010B	280-J411-1	280-411-1	Solid
Active	Wait	Active	1/23/2010 11:59	☐	3510C	8081A	280-J411-1	280-411-1	TCLP Leach
Active	Wait	Active	1/23/2010 11:59	☐	3510C	8270C	280-J411-1	280-411-1	TCLP Leach

For the sample above, we would leach the sample in a glass bottle for the organics and metals and we would also do a ZHE leach. Therefore there will be 2 leach batches.

Simple Steps

1. Run the OP - TCLP backlog. This backlog is sorted by sample ID so samples logged for multiple extraction and analytical methods will be grouped by sample. Pull the samples from the walk-in cooler and take custody of the samples.
2. Use the TCLP spreadsheets in EXCEL to determine blank fluid for each sample. Once the leach fluid has been determined, you will know what samples can be batched together. You can not put samples with different leach fluids in the same batch.
3. Open Analyst Desktop and select Create Batch from Scratch
4. Your Batch Notes will appear, but we are not going to use the Batch Notes. Instead all of our data will be recorded in the TCLP spreadsheets in EXCEL.
5. Scan your samples into the batch. If your samples are logged in for more than one of the leach methods, a window will appear called “Select Login Sample Methods”.



Login Sample Methods for Lab Sample ID: 280-411-A-1

Selected	Status	LSM Chain	Basis	Method Sub-List	Log Grp.
☐	Ready	1311_T/3510C/8270C (280)	TCLP	Local Method	1
☐	Ready	1311T_M/3010A_L/6010B (280)	TCLP	Local Method	1
☐	Ready	1311T_Hg/7470A_Prep_L/7470A (280)	TCLP	Local Method	1
☐	Ready	1311_T/3510C/8081A (280)	TCLP	Local Method	1

☐ Use this method for subsequent samples

6. Select all LSM Chains that include the leach preps. If all of the samples that you want to batch together are logged in for the same methods, you can click the box in the lower left-hand corner that says "Use this method for subsequent samples". Then click "OK". **NOTE**: Be careful when clicking the "Use this method for subsequent samples" box. If you click this and the subsequent samples have more methods than the ones listed in the LSM box, they will not be included in the batch. You can check this in Step 10 below and fix it there if there is something wrong.
7. If your batch is for TCLP Fluid #1 or SPLP East Fluid, create a "LB" for the Leach Blank. If your batch is for TCLP Fluid #2 or SPLP_West Fluid, create a "LB2" for the Leach Blank. If your batch is for water TCLP samples, water SPLP samples, or SPLP ZHE samples, then you are using reagent water as your blank fluid and create a "LB3" for your Leach Blank There will be no other QC here at this point unless a client has requested MS/MSD on a sample. If that is the case, add the MS/MSD to the leach batch, but it does not get spiked before the leach.
8. Go to the Sample List tab. Here you will see that if the sample was logged in for more than one method chain, the sample will be listed here multiple times – one for each method chain. It is a good idea to check your backlog against the Sample List tab to make sure that all of your method chains that were listed on the backlog are in the batch. If they are not, right click on the sample and click on "Select LSM" to add the missing tests into the batch.
9. Go to the Worksheet tab. We won't be using the fields here to record our data because the calculations are not locked. We will use the TCLP spreadsheet instead. **But we will have to enter the Leach Fluid type or else our spreadsheets will not get into the raw data. Scroll all the way over to the right and enter "T1", "T2" "Milli-Q", "SE", "SW" or "S3".**
10. We will use a different status to indicate where the samples are.
    a. A status of "Batched" or "1st Level Review"means the blank fluid determination is done, samples are tumbling.
    b. A status of "2nd Level Review" means that the samples have completed the leachate and have been filtered.
11. Once all steps in the procedure are complete, save the TCLP worksheet in EXCEL. Then print it to pdf and save it in the same directory as the EXCEL file. **When you print it to pdf, be sure to select "Entire Workbook" so that all worksheets will be in the pdf.**
12. Go into the TALS batch and click on the documents button. Right click and from the menu select "Change Document Type", and then select "External Prep Worksheet". Attach the pdf of the EXCEL spreadsheet and the pdf of the LogTag Summary to the TALS batch.

pH Calibration

1. Prepare the electrode according to the electrode user guide.
2. In the setup mode, select the buffer set (USA or EUr-O) that will be used for the automatic buffer recognition feature.
3. In the measurement mode, press (☰) until the arrow icon points to the top line, press (△) until the **pH** icon is shown and press (∠) to begin the calibration.
4. Rinse the electrode, and ATC probe if being used, with distilled water and place into the buffer.
5. Wait for the **pH** icon to stop flashing.
   a. Automatic buffer recognition – When the **pH** icon stops flashing the meter will display the temperature-corrected pH value for the buffer.
   b. Manual calibration – When the **pH** icon stops flashing the meter will display the actual pH value read by the electrode. Press (▦) until the first digit to be changed is flashing, press (△) / (▽) to change the value of the flashing digit and continue to change the digits until the meter displays the temperature-corrected pH value of the buffer. Once the pH buffer value is set, press (▦) until the decimal point is in the correct location.
6. Press (∠) to proceed to the next calibration point and repeat steps 4 and 5 or press (🌡) to save and end the calibration.
7. The actual electrode slope, in percent, will be displayed in the main field and SLP will be displayed in the lower field.
   a. For a one point calibration, press (▦) and (△) / (▽) to edit the slope and press (🌡) to return to the measurement mode.
   b. For a two or more point calibration, the meter will automatically proceed to the measurement mode after the slope is displayed.

Attachment 14
SPLP worksheet for correcting fluid pH

Dilution of Wrong SPLP pH with Water

	Inputs	Units	Note
pH of solution	1.29		Make sure is below Target pH
pH of Water	5.23		Elga pH is usually 5.25
Target pH	4.2		NOT pH 7
Target Volume (L)	45	L	
		Units	
Required Volume of Water	44.95	L	
Required Volume of Solution	0.05	L	

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Denver

Electronic Document Cover

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Title: GC/MS Analysis Based On Method 8270D

Approvals (Signature/Date):

Sarah Tinkham 10/30/15
Sarah Tinkham Date
Technical Specialist

Adam W Alban 30 Oct 15
Adam Alban Date
Health & Safety Manager / Coordinator

Margaret S. Sleevi 10/30/15
Margaret S. Sleevi Date
Quality Assurance Manager

10/30/15
William S. Cicero Date
Laboratory Director

Facility Distribution No. ________ **Distributed To:** ________________

1.0 Scope and Application

1.1 This method is based upon standard method SW846 8270D, and is applicable to the determination of the concentration of semivolatile organic compounds in extracts prepared from solid and aqueous matrices.

1.1.1 The modifications presented in Appendix A may be followed for analysis of samples following method 8270D_LL (best practices).

1.1.2 Direct injection of a sample may be used in limited applications.

1.1.3 Refer to Tables 1 and 2 for the list of compounds applicable for this method. Note that the compounds are listed in approximate retention time order. This method may be amenable to additional compounds. If non-standard analytes are required, they must be validated by the procedures described in Section 13 before sample analysis.

1.2 The following compounds may require special treatment when being determined by this method:

1.2.1 Benzidine can be subject to oxidative losses during solvent concentration and exhibits poor chromatography. Neutral extraction should be performed if this compound is expected.

1.2.2 Hexachlorocyclopentadiene is subject to thermal decomposition in the inlet of the gas chromatograph, chemical reaction in acetone solution, and photochemical decomposition.

1.2.3 N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be distinguished from diphenylamine.

1.2.4 Pentachlorophenol, 2,4-dinitrophenol, 4-nitrophenol, 4,6-dinitro-2-methylphenol, 4-chloro-3-methylphenol, benzoic acid, 2-nitroaniline, 3-nitroaniline, 4-chloroaniline, and benzyl alcohol are subject to erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material.

1.2.5 3-Methylphenol cannot be separated from 4-methylphenol by the conditions specified in this method. They are reported as 3&4-methylphenol.

1.2.6 Hexachlorophene analysis is not quantitatively reliable by this method, as it is calibrated using a single-point calibration on the day of sample analysis.

1.2.7 Kepone should be analyzed by GC/ECD.

1.2.8 Azobenzene is formed by decomposition of 1,2-diphenlyhydrazine. If 1,2-diphenylhydrazine is requested, it will be analyzed as azobenzene.

1.3 The standard reporting limit (SRL) of this method for determining an individual compound is approximately 0.33 – 3.3 mg/kg (wet weight) for soil/sediment samples, 1 - 200 mg/kg for wastes (dependent on matrix and method of preparation), and 1-100 µg/L for groundwater samples. Some compounds have higher reporting limits. Refer to Tables 1 and 2 for specific SRLs. Reporting limits will be proportionately higher for sample extracts that require dilution. Reporting limits are adjusted for dry weight for soil samples.

2.0 Summary of Method

2.1 Aqueous samples are extracted with methylene chloride using a continuous extractor or a separatory funnel.

2.1.1 TestAmerica Denver performs extractions using either a one liter sample aliquot or a 250 mL aliquot. The extract is dried, concentrated to 1 mL and analyzed by GC/MS. Samples extracted using 250 mL are analyzed following the Large Volume Injection (LVI) procedures described in this SOP.

2.1.2 LVI is used only for aqueous samples. It is utilized to maintain reporting limits while reducing the initial volume of the sample required for extraction. The extraction procedure is the same, proportionately adjusting only sample size, spike concentrations and volume of extraction solvent.

2.2 Solid samples are extracted with methylene chloride / acetone using sonication. The extract is dried, concentrated to a volume of 1 mL, and analyzed by GC/MS.

2.3 Waste dilution is used for samples that are miscible with the solvent.

2.4 Extraction procedures are detailed in the following SOPs:

DV-OP-0006	Extraction of Aqueous Samples by Separatory Funnel, SW846 3510C and EPA 600 Series
DV-OP-0007	Concentration of Organic Extracts, SW846 3510C, 3520C, 3540C, 3550B, 3550C, 3660B, 3665A and EPA 600 Series
DV-OP-0008	Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C and Method 625
DV-OP-0012	Waste Dilution Preparation for Non-Aqueous Waste Samples, SW-846 3540C
DV-OP-0016	Ultrasonic Extraction of Solid Samples, SW846 3550C

2.5 Qualitative identification of the analytes in the extract is performed using the retention time and the relative abundance of characteristic ions. Quantitative analysis is performed using the internal standard technique with a single characteristic ion and a minimum of a five-point calibration curve.

2.6 For LVI, the GC/MS analysis is the same with the exception of the injection liner, injection volume and standard concentrations.

3.0 Definitions

3.1 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. The Quality Control batch must contain a matrix spike / matrix spike duplicate (MS/MSD), a Laboratory Control Sample

(LCS), and a method blank (MB). If it is not possible to prepare both an MS and MSD due to limitations of sample amount, then a duplicate LCS should be prepared and analyzed. The RPD between the LCS and LCSD must be less than or equal to the RPD limit established for the MS/MSD.

3.2 Batches are defined at the sample preparation stage. Batches should be kept together through the whole analytical process to the extent possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the TAL QC Program document (DV-QA-003P) for further details of the batch definition.

3.3 Method Blank (MB) - An analytical control consisting of all reagents, internal standards and surrogate standards that is carried through the entire analytical procedure. The method blank is used to define the level of laboratory background and reagent contamination.

3.4 Laboratory Control Sample (LCS) - A blank matrix (reagent water or Ottawa Sand) spiked with the analytes of interest that is carried through the entire analytical procedure. Analysis of this sample with acceptable recoveries of the spiked analytes demonstrates that the laboratory techniques for this method are acceptable.

3.5 Matrix Spike (MS) – An aliquot of a matrix (water or soil) fortified (spiked) with known amounts of specific analytes and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

3.6 Matrix Spike Duplicate (MSD) - A second aliquot of the same sample as the matrix spike (above) that is spiked in order to determine the precision of the method by measuring the relative percent difference (RPD) between the MS and MSD results.

3.7 Surrogates - Organic compounds which are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples. Each sample, blank, LCS, MS, and 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.

4.0 Interferences

4.1 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the sample. Cleanup procedures may help to eliminate select interferences, as follows:

- Method 3640A, Gel-Permeation Chromatography (GPC) - Removes higher molecular weight hydrocarbons by size exclusion chromatography, which is most frequently used for biological samples (TestAmerica Denver does not have a GPC unit).
- Method 3660B, Sulfur Cleanup – If a sulfur peak is detected, copper or mercury can be used to treat the extract and remove the sulfur.
- Other, more aggressive cleanup procedures listed in SW-846 may be used for select compounds listed in this procedure, but may cause degradation of some of the more reactive compounds. Consult with a technical expert in the laboratory for more difficult interference problems.

Details concerning cleanup steps are described in the organic extraction SOP DV-OP-0007.

4.2 Contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts may cause method interferences. 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 (Section 9.3). Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. If an interference is detected, it is necessary to determine if the source of interference is in the preparation and/or cleanup of the samples; then take corrective action to eliminate the problem.

4.3 The use of high purity reagents, solvents, and gases helps to minimize interference problems.

4.4 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed with solvent between samples. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross contamination.

4.5 Phthalate contamination is commonly observed in this analysis and its occurrence should be carefully evaluated as an indicator of a contamination problem in the sample preparation step of the analysis.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual and this document.

5.2 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.

5.3 Specific Safety Concerns or Requirements

5.3.1 Eye protection that satisfies ANSI Z87.1, laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated must be removed and discarded; non-disposable gloves must be cleaned immediately.

NOTE: Latex and vinyl gloves provide no protection against the organic solvents used in this method. Nitrile or similar gloves must be used.

5.3.2 The 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.

5.3.3 The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

5.3.4 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 before performing any maintenance.

5.4 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.

Materials with Significant or Serious Hazard Rating

Material	Hazards	Exposure Limit (1)	Signs and Symptoms of Exposure
Methanol	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.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
(1) Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Gas chromatograph/mass spectrometer system: an analytical system complete with a temperature-programmable gas chromatograph suitable for split/splitless injection and all required accessories, including syringes, analytical columns, and gases. The capillary column should be directly coupled to the source.

6.2 Column: 30 m x 0.25 mm I.D., 0.5-µm film thickness fused-silica capillary column coated with 5% diphenyl/95% dimethyl polysiloxane (Agilent VF 5MS). Alternate columns are acceptable if they provide acceptable performance.

6.3 Mass Spectrometer: Capable of scanning from 35 to 500 u (previously “amu”) every one second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for decafluorotriphenylphosphine (DFTPP) that meets all of the criteria in Table 4 when 25 ng of the GC/MS tuning standard is injected through the GC.

6.4 Autosampler: HP7683 Autosampler or equivalent.

6.5 GC/MS Interface: Any GC-to-MS interface that gives acceptable calibration points and achieves acceptable tuning performance criteria may be used.

6.6 Data System: A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as the Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIH Mass Spectral Library is recommended.

6.7 Syringe: 5 µL or 10 µL Hamilton Laboratory grade syringes or equivalent. The 5 µL syringe is used for the Agilent ALS to be able to inject 0.5 µL and either the 5 µL or 10 µL syringe is commonly used for the Large Volume Injection

6.8 Sample Aliquot Equipment: laboratory grade syringes and pipettes as appropriate to dilute and aliquot extracts. Also, amber glass aliquot vials with polytetrafluoroethylene (PTFE)-lined screw or crimp caps and suitable for use with autosampler.

6.9 Carrier gas: Ultra high-purity helium.

6.10 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on R:\QA\Read\Master List of Documents\|Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

7.1 Methylene Chloride, equivalent to pesticide quality or better, used to dilute samples as needed.

7.2 Stock standards are received from the vendor in multiple mixtures for each set of calibration standards, for both primary ICAL standards and second source verification standards. Other standards may be used to accommodate client-specific target lists or reporting limit requirements.

7.2.1 Surrogate Standards:

Restek 567685	Surrogates at 5000 ug/mL

7.2.2 Internal Standards:

Restek 567684	Internal Standards at 2000 ug/mL

7.2.3 HSL (Primary) Standards:

Restek 567672	Mega Mix at 1000 ug/mL
Restek 567673	Amine Mix at 2000 ug/mL
Restek 567674	Benzoic Acid at 2000 ug/mL
Restek 567675	Indene at 2000 ug/mL
Restek 568023	Famphur at 2000 ug/mL
Restek 568033	HSL Custom Mix at 4000 ug/mL
Restek 568038	N-Nitrosodiphenylamine at 2000 ug/mL

7.2.4 AP9 Standards:

Restek 567678	Supplemental Standard 1 at 1000 ug/mL
Restek 567679	List 2 Standard 2 at 1000 ug/mL
Restek 567680	List 2 Standard 3 at 2000 ug/mL
Restek 567681	List 2 Standard 4 at 1000 ug/mL
Restek 567682	List 2 Standard 5 at 2000 ug/mL
Accustandard H-173N	Dibenz[a,j]acridine, neat

7.2.5 Benzaldehyde Standards:

Restek 567677	Benzaldehyde at 2000 ug/mL

7.2.6 Hexachlorophene Standards:

Restek 31811	Hexachlorophene at 2000 ug/mL

7.3 A minimum of seven calibration standards are typically prepared. A minimum five-point calibration curve is prepared when average response factors or linear regression curve fitting is used. Six calibration points are required for second-order curve fits. The low point should be at or below the reporting limit. Refer to Tables 10 and 11 for typical calibration levels for all analytes by the standard volume method. Other calibration levels may be used, depending on instrument capability, but the low standard must support the reporting limit and the high standard defines the range of the calibration. Tables LVI-1, and LVI-2 provide calibration levels for the LVI procedure.

7.4 An internal standard (IS) solution is prepared. Compounds in the IS Mix are acenaphthene-d_{10}, chrysene-d_{12}, 1,4-dichlorobenzene-d_4, naphthalene-d_8, perylene-d_{12}, and phenanthrene-d_{10}.

7.4.1 Internal standards are added to all standards and extracts to result in a final concentration of 40 µg/mL. For example, if the volume of an extract aliquot used was 200 µL, 20 µL of a 400 µg/mL internal standard solution would be added to the aliquot.

7.4.2 See Appendix B for the levels used for the 8270 best practice method.

7.5 Surrogate Standard Spiking Solution: Prepare as indicated in the extraction SOPs (refer to Section 2.4 for extraction SOPs numbers). Surrogate compounds and levels are listed in Table 9.

Acid Surrogates	Base Surrogates
2-Fluorophenol	2-Fluorobiphenyl
2,4,6-tribromophenol	Terphenyl-d_4
Phenol-d_5	Nitrobenzene-d_5
2-chlorophenol-d_4[1]	1,2,-Dichlorobenzene-d_4[1]

[1] These two surrogates are in the mix but are not evaluated or reported.

7.6 GC/MS Tuning Standard: A methylene chloride solution containing 50 µg/mL of decafluorotriphenylphosphine (DFTPP) is prepared. Pentachlorophenol, benzidine, and DDT should also be included in the Tuning Standard at 50 µg/mL.

7.7 Laboratory Control Spiking Solution: Prepare as indicated in the extraction SOPs (refer to Section 2.4 for extraction SOPs). LCS compounds and levels are listed in Table 7.

7.8 Matrix Spike Solution: Prepare as indicated in the extraction SOPs (refer to Section 2.4 for extraction SOPs). The matrix spike compounds and levels are the same as the LCS compounds.

7.9 The standards listed in sections 7.1 to 7.8 must be stored at -10°C to -20°C if it can be demonstrated that analytes do not fall out of solution at these temperatures. If not stable, the standards should be stored between 0°C and 6°C. The standard stock solutions expire after one year from preparation date or at the earliest expiration date assigned by the vendor to any parent standard, whichever is earlier. The continuing calibration standard should be replaced when there are visible signs of degradation or when the standard fails to meet QC criteria. The continuing calibration standard is stored at -10°C to -20°C.

8.0 Sample Collection, Preservation, Shipment and Storage

Matrix	Sample Container	Min. Sample Size	Preservation	Extraction Holding Time	Analysis Holding Time	Reference
Water	1 liter amber	1 Liter	Cool, $\leq$ 6°C and not frozen	7 Days	40 Days from extraction	40 CFR Part 136.3 and SW846 Chapter 4
Water[1]	250 mL amber	250 mL	Cool, $\leq$ 6°C and not frozen	7 Days	40 Days from extraction	40 CFR Part 136.3 and SW846 Chapter 4
Soil	4 oz Jar	30 grams	Cool, $\leq$ 6°C and not frozen	14 Days	40 Days from extraction	SW846 Chapter 4

[1] Samples extracted using 250 mL are analyzed following the LVI procedure.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Assurance Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs.

9.1.3 Table 16 details the components of the DoD QSM 5.0 and DoE QSAS 3.0 that are different from TestAmerica Denver's standard procedures, for further details, see DV-QA-024P. Also listed are the variances that TestAmerica is requesting for this analysis; these alternate criteria are only used with project-specific approval.

9.1.4 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 Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.5 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

9.2.1 Before analyzing samples, the laboratory must establish a method detection limit (MDL). See Section 13 for a discussion of detection limit studies.

9.2.2 In addition, an initial demonstration of capability (IDOC) must be performed by each analyst. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 13 for more details.

9.3 Control Limits

9.3.1 In-house historical control limits must be determined for surrogates, matrix spikes, and laboratory control samples (LCS). These limits are determined periodically (See SOP DV-QA-003P). The recovery limits are the mean recovery ±3 standard deviations for surrogates, MS, and LCS. The Precision limit for the MS/MSD pair results is the absolute value of the mean relative percent difference (RPD) +3 standard deviations.

9.3.2 These limits do not apply to dilutions, but surrogate and matrix spike recoveries will be reported unless the dilution is 4x or more.

9.3.3 All surrogate, LCS, and MS recoveries (except for dilutions) must be entered into the LIMS or other database so that accurate historical control limits can be generated. For multiple dilutions reported from the same extract, surrogates will be reported for all dilutions of less than 4x. For tests without a separate extraction, surrogates and matrix spikes will be reported for all dilutions.

9.3.4 Refer to the QC program document, DV-QA-003P, for further details of control limits.

9.4 Method Blank (MB)

For aqueous sample batches, the method blank is reagent water; for solid sample batches, the method blank is clean sand. In either case, the method blank is free of the analytes of interest and is spiked with the surrogates. At least one method blank must be processed with each preparation batch.

Acceptance Criteria: The result for the method blank must be less than ½ of the reporting limit or less than 10% of the analyte concentration found in the associated samples, whichever is higher. When a compound is above ½ the reporting limit an NCM needs to be completed.

NOTE: All programs require that the maximum blank concentration must be less than one-half of the reporting limit or less than 10% of the lowest sample concentration.

Corrective Action: Re-preparation and reanalysis of all samples associated with an unacceptable method blank. If the analyte was not detected in the samples, the data may be reported with qualifiers (check project requirements to be sure this is allowed) and it must be addressed in the project narrative.

9.5 Instrument Blank

Instruments must be evaluated for contamination during each 12-hour analytical run. This may be accomplished by analysis of a method blank. If a method blank is not available, an instrument blank must be analyzed. An instrument blank consists of methylene chloride with the internal standards added. It is evaluated in the same way as the method blank (see Section 9.4).

9.6 Laboratory Control Sample (LCS)

The LCS is prepared using reagent water for aqueous methods and Ottawa sand for solid sample methods. A laboratory control sample (LCS) is prepared and analyzed with every batch of samples. The LCS is spiked with the compounds listed in Tables 7 and 8 unless specified by a client or agency. The compounds must be spiked at a concentration equivalent to 80 μg/L, unless a special QAS states a specific level. The LVI method uses the same concentration of analytes for the LCS. Ongoing monitoring of the LCS provides evidence that the laboratory is performing the method within accepted QC guidelines for accuracy and precision.

Acceptance Criteria: All analytes must be within established control limits. See QC Policy DV-QA-003P for details on establishing control limits.

Corrective Action: If any analyte in the LCS is outside the laboratory-established historical control limits or project-specific control limits, as applicable, corrective action must occur. Corrective action may include re-extraction 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 and the report. An example 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 are not possible due to limited sample volume or other constraints, the failed LCS is reported, all associated samples are flagged, and appropriate comments are made in a narrative to provide further documentation.

9.7 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

The matrix spike is a second aliquot of one of the samples in the batch. The matrix spike duplicate is a third aliquot of the same sample. The MS and MSD are spiked with the same analytes as the LCS (See Tables 7 and 8). An MS/MSD pair is prepared and analyzed with every batch of samples.

Acceptance Criteria: The percent recovery (%R) must fall within either historical limits or project-specific limits, as applicable. The relative percent difference (RPD) between the MS and MSD results must be less than or equal to the established historical or project-specific limit. See QC Policy DV-QA-003P for details on establishing control limits

Corrective Action: The information obtained from MS data are sample/matrix specific and are not normally used to determine the validity of the entire batch. If the MS and/or MSD recovery falls outside of the established control limits, the CCV and batch LCS recoveries must be within control limits in order to accept results for the associated samples. The following corrective actions are required for MS/MSD recovery failures to rule out lab error:

- When the MS/MSD concentration is above the linear range; the MS/MSD and parent sample **MUST** be re-analyzed at a dilution.

- Check calculation and instrument performance;
- Verify, if possible, that the MS and MSD were spiked correctly (e.g., very low or very high recoveries);
- Consider objective evidence of matrix interference (e.g., heterogeneous sample, interfering peaks seen on chromatograms, or interference demonstrated by prior analyses);
- Flag the data for any results outside of acceptance limits and note it on the final report.
- For any single RPD failure, check calculations; verify, if possible, that the MS and MSD were spiked correctly; check instrument performance; consider objective evidence of matrix interference or sample inhomogeneity; and flag the data.

NOTE: Some client programs require reanalysis to confirm matrix interferences. Check special project requirements for this corrective action.

9.8 Surrogates

9.8.1 Each sample, blank, and QC sample is spiked with the surrogate standards. Surrogate compounds must be spiked at 100 ug/L for standard injection or 25 ug/L for LVI. The compounds routinely included in the surrogate spiking solution, along with recommended standard concentrations, are listed in Table 9. For the Best Practice method, see Table A-4 in Appendix A.

Acceptance Criteria: Surrogate spike recoveries must be evaluated by determining whether the concentration (measured as percent recovery) falls within the required recovery limits.

Corrective Action: If any surrogates are outside of the limits, then 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 the extract if either of the above checks reveals a problem.
- Re-extract and reanalyze the sample or flag the data as “Estimated Concentration” if neither of the above resolves the problem.

NOTE: The decision to reanalyze or flag the data for failed QC should be made in consultation with the client. It is only necessary to reprepare / reanalyze a sample 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.

9.8.2 If the sample with failed surrogate recoveries was a sample used for an MS/MSD pair and the surrogate recoveries in the MS/MSD are also outside of the control limits, then the sample and the MS and the MSD do not require reanalysis. This phenomenon indicates a possible matrix problem.

9.8.3 If the sample is reanalyzed and the surrogate recoveries in the reanalysis are acceptable, then the problem was within the analyst's control and only the reanalyzed data should be reported. (If the re-analysis was outside holding times, both sets of results may be reported, with appropriate flags and discussion in the case narrative. Consult client and/or program specifications for reporting requirements.)

9.8.4 If the reanalysis does confirm the original results, the original analysis is reported and the data flagged as estimated due to matrix effects.

9.9 Internal Standards

9.9.1 The peak areas of the internal standards are monitored in all field and QC samples.

Acceptance Criteria: The peak area for each internal standard should be between 50% and 200% of the peak area for the designated midpoint calibration ("ICIS") standard in the initial calibration. This is typically the 80 ppm standard for standard 8270D and the 20 ppm standard for LVI.

Corrective action: If recovery for any internal standard is outside of the control limits, check for calculation errors or instrument problems, and reanalyze the associated samples at a dilution for the compounds quantified against the internal standard that was outside of control limits.

9.9.2 The retention times of the internal standards are monitored in all field samples and QC samples.

Acceptance Criteria: The retention time for any internal standard must be within +/- 0.5 minutes of the last continuing calibration standard.

Corrective Action: If the retention time of any internal standard is greater than +/- 0.5 minutes the chromatographic system must be inspected for malfunctions and corrected. Reanalysis of samples analyzed if the retention time is outside of limits is required. If the retention time of any internal standard is between +/-0.1 minutes and +/-0.5 minutes, from the preceding continuing calibration standard, the data must be carefully evaluated to ensure that no analytes have shifted outside their retention time windows.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 Sample Preparation

Samples are prepared according to the following organic preparation SOPs, as applicable:

DV-OP-0006	Extraction of Aqueous Samples by Separatory Funnel, SW846 3510C and EPA 600 Series
DV-OP-0007	Concentration of Organic Extracts, SW846 3510C, 3520C, 3540C, 3550B, 3550C, 3660B, 3665A and EPA 600 Series
DV-OP-0008	Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C and Methods 625 and 607
DV-OP-0016	Ultrasonic Extraction of Solid Samples, SW846 3550C

10.4 Sample Analysis Procedure

10.4.1 Calibrate the instrument as described in Section 11. Depending on the target compounds required by the client, it may be necessary to use more than one set of calibration standards.

10.4.2 All samples must be analyzed using the same instrument conditions as the preceding continuing calibration verification (CCV) standard. Extracts are allowed to warm to room temperature before aliquotting. Excess extract is returned to the ≤6°C refrigerator for storage.

10.4.3 Internal Standard

Add internal standard to an aliquot of the extract to result in a 40-ng/µL concentration (for example, 20 µL of internal standard solution at 400 µg/mL in 200 µL of extract). Mix thoroughly before injection into the instrument.

10.4.4 Inject the aliquot into the GC/MS system using the same injection technique as used for the standards.

10.4.4.1 For standard volume extracts the injection volume is 0.5 µL using a 5 µL syringe.

10.4.4.2 For LVI, the injection volume is 2.5 µL using either a 5 µL or a 10 µL syringe.

10.4.5 The data system will determine the concentration of each analyte in the extract using calculations equivalent to those in Section 12. Quantitation is based on the initial calibration, not the continuing calibration verification.

10.4.6 Identified compounds are reviewed for proper integration. Manual integrations are performed if necessary and are documented by the analyst (see DV-QA-0033, Acceptable Manual Integration Practices) or automatically by the data system. The minimum documentation required includes a chromatogram of original data system peak integration and a similarly scaled chromatogram showing the manual integration with analyst initials, date and reason for manually integrating.

10.4.7 Target compounds identified by the data system are evaluated using the criteria listed in Section 12.1.

10.4.8 Library searches of peaks present in the chromatogram that are not target compounds, i.e., Tentatively Identified Compounds (TIC), may be performed if required by the client. They are evaluated using the criteria in Section 12.2.

10.4.9 The internal standard response in the sample must be within 50 - 200% of the response in the CCV.

10.4.10 Structural isomers that produce very similar mass spectra should be quantitated 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 less than 50% of the average of the two peak heights.

10.5 Dilutions

If the response for any compound exceeds the working range of the GC/MS system, a dilution of the extract is prepared and analyzed. An appropriate dilution should be in the upper half of the calibration range. Samples may be screened to determine the appropriate dilution for the initial run. If the initial diluted run has no hits or hits below 20% of the calibration range and the matrix allows for analysis at a lesser dilution, the sample must be reanalyzed at a dilution targeted to bring the largest hit above 50% of the calibration range.

10.5.1 Guidance for Dilutions Due to Matrix

If the sample is initially run at a dilution and the baseline rise is less than the height of the internal standards, or if individual non-target peaks are significantly less than two times the height of the internal standards, the sample should be reanalyzed at a more concentrated dilution. This requirement is approximate and subject to analyst judgment. For example, samples containing organic acids may need to be analyzed at a higher dilution to avoid destroying the column.

10.5.2 Reporting Dilutions

The most concentrated dilution with no target compounds above the calibration range will be reported. Other dilutions will be reported only at client request.

10.6 Perform all qualitative and quantitative measurements. When the extracts are not being used for analyses, refrigerate them at ≤ 6°C, protected from light in screw cap vials equipped with unpierced Teflon lined septa.

10.7 Retention Time Criteria for Samples

10.7.1 If the retention time for any internal standard changes by more than 0.5 minutes from the last continuing calibration standard, the chromatographic system must be inspected for malfunctions and corrected. Reanalysis of samples analyzed while the system was malfunctioning is required.

10.7.2 If the retention time of any internal standard in any sample varies by more than 0.1 minute from the preceding continuing calibration standard, the data must be carefully evaluated to ensure that no analytes have shifted outside their retention time windows.

10.8 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 DV-WC-0023 for determination of percent moisture.

10.9 Data Review

10.9.1 All data are reviewed by the analyst, Level 1 Data Review, and documented on a checklist, GCMS-BNA TALS Data Review. See SOP DV-QA-0020 and DV-WI-0025.

10.9.2 The data package and review checklist are submitted to a peer reviewer (or supervisor) for the level 2 review. All manual integrations must be evaluated by the peer reviewer. The level 2 review is documented on the review checklist initiated at the level 1 review. See SOP DV-QA-0020 and DV-WI-0025.

10.10 Troubleshooting Guide

10.10.1 Daily Instrument Maintenance

In addition to the checks listed in Appendix B, the following daily maintenance should be performed.

- Clip column as necessary.
- Install new or cleaned injection port liner as necessary.
- Install new septum as necessary.
- Install new or cleaned gold seal and washer as necessary.
- Perform mass calibration as necessary.

10.10.2 Major Maintenance

A new initial calibration is necessary following certain maintenance procedures. These maintenance procedures include changing the column, cleaning the repeller, cleaning the source, replacing the multiplier, and replacing the “top board” or RF-related electronics. Refer to the manufacturer's manual for specific guidance.

11.0 Calibration

11.1 Summary

The instrument is tuned for DFTPP, calibrated initially with a minimum of a five levels, and verified each 12-hour shift with one or more continuing calibration standard(s). Recommended instrument conditions for both the standard analysis and LVI are listed in Table 3.

11.2 All standards and extracts are allowed to warm to room temperature before injecting.

11.3 Instrument Tuning

11.3.1 At the beginning of every twelve-hour shift when analyses are to be performed, the GC/MS system must be checked to see if the acceptance criteria are achieved for DFTPP (decafluorotriphenylphosphine), see Table 4. The mass spectrum is acquired with three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired within 20 scans of the elution of DFTPP. The background subtraction should be designated only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak or any other discrete peak that does not co-elute with DFTPP.

11.3.2 Inject 25 ng of the GC/MS tuning standard (Section 7.6) into the GC/MS system. Obtain a background-corrected mass spectra of DFTPP and confirm that all the key m/z criteria in Table 4 are achieved. If all the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are achieved. The performance criteria must be achieved before any samples, blanks, or standards are analyzed.

11.3.3 The GC/MS tuning standard should also be used to evaluate the inertness of the chromatographic system. The acceptance criteria for the peak tailing factor for benzidine is < 2.0 and pentachlorophenol is < 2.0. DDT breakdown to DDD and DDE must be <20%. Refer to section 12 for the appropriate calculations.

11.4 Initial Calibration

11.4.1 Detailed information regarding calibration models and calculations can be found in Corporate SOP CA-Q-P-003 *Calibration Curves and the Selection of Calibration Points* and in the corporate memorandum CA-Q-QM-009*, Quality Control Requirements for SW-846 Method 8270D.*

11.4.2 Internal Standard (IS) Calibration Procedure: Internal standards are listed in Table 5. Use the base peak m/z as the primary m/z for quantitation of the standards. If interferences are noted, use one of the next two most intense masses for quantitation.

11.4.3 Compounds are typically assigned to the IS with the closest retention time. The laboratory tries to maintain consistent internal standard references across instruments. As a result, there may be a few cases where compounds are very close to two different internal standards that this is not true.

11.4.4 Evaluation of retention times – The retention time (RT) of each target analyte in each calibration standard should agree within 0.5 minutes.

11.4.5 A minimum of seven calibration standards are typically prepared, however, the number of calibration points may vary. A minimum of five concentration levels for each parameter of interest when average response factors or linear regression curve fits are used. Six standards must be used for a quadratic least-squares calibration. It may also be useful to analyze six or seven calibration levels and use the lower five or six for most analytes and the upper five or six for analytes that have poor response.

11.4.6 Rejection of Calibration Points

11.4.6.1 Generally, it is NOT acceptable to remove 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 run log or maintenance log. Then the calibration standard(s) must be reanalyzed.

11.4.6.2 If no problems are found or there is documented evidence of a problem with a calibration point (e.g., obvious misinjection explained in the run log), then one point might be rejected, but only if all of the following conditions are met:

- The rejected point is the highest or lowest on the curve, i.e., the remaining points used for calibration must be contiguous; and
- The lowest remaining calibration point is still at or below the project reporting limit; and
- The highest remaining calibration point defines the upper concentration of the working range, and all samples producing results above this concentration are diluted and reanalyzed; and
- The calibration must still have the minimum number of calibration levels required by the method, i.e. five levels for calibrations modeled with average response factors or linear regressions, or six levels for second-order curve fits.

11.4.7 Internal Standards

For analysis of standard volume extraction or soil add the internal standard mixture to result in a 40-ng/µL final concentration. (For example, if the volume of the calibration standard used is 0.5 mL, add 50 µL of the 400 µg/mL internal standard).

11.5 The concentrations of all analytes in the calibration standards are listed in Tables 10 and 11. For the Best Practice method, see Table A-1 in Appendix A. For LVI see Tables LVI-1 and LVI-2

11.6 Analyze each calibration standard and tabulate the area of the primary characteristic m/z against the concentration for each compound and internal standard. Calculate the response factors (RF), average response factors, and the percent RSD of the response factors for each compound using the equations in section 12. No sample analysis may be performed unless the following criteria are met. See Table 15 for DoD QSM 5.0 criteria. For DoD work, the criteria in Table 15 take precedence over the method criteria.

11.6.1 The RSD must be < 20% for each compound of interest.

11.6.1.1 If the RSD in the initial calibration is > 20%, then calibration using a curve fit must be used for those analytes with RSD > 20%. Linear or quadratic curve fits may be used. Use of a weighted regression is recommended to improve the accuracy of quantitation at the low end of the curve. The analyst should consider instrument maintenance to improve the linearity of response.

NOTE: For DoD QSM 5.0, the initial calibration requirement for RSD is 15%. If this criterion is not met, linear or quadratic curve fits must be used.

11.6.1.2 If a linear regression equation is used, the correlation coefficient r must be greater than 0.995 (equivalent to r^2 greater than 0.990). Use of second-order regression equations may be used on rare occasions. In these cases, the intercept and degree of curvature should be examined to be sure that results will be reliable throughout the working range, and the coefficient of determination r^2 must be greater than 0.990.

11.6.1.3 When linear regression is used, the first point of the calibration is recalculated under the new calibration, and the values must agree within 30% of the true values.

11.6.1.4 If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum requirements for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Clean or replace the injector liner and/or column, then repeat the calibration procedure.

11.6.2 Any individual analyte that fails both 20% RSD and the alternate curve fit criteria must have any positive result flagged as estimated (or can be noted in the narrative). This flagging of positive results is undesirable – every effort should be made to reanalyze on an instrument with a passing calibration.

11.6.3 Non-detect results for any analyte that fails both 20% RSD and 0.990 correlation coefficient may be reported without flagging if (and only if) there has been a successful analysis of a LLCCV (CCV at the reporting limit) in the same analytical batch. The LLCCV must be detected for the analyte and qualitative identification criteria in the method must be met.

NOTE: No more than one or two of the poorest performing analytes should fail both 20% RSD and 0.990 correlation. If several analytes fail both criteria, corrective action should include instrument and column maintenance and recalibration.

11.6.4 The minimum response factor for the most common target analytes from Table 14 must be met.

11.6.5 Weighting of Calibration Data Points

In a linear or quadratic calibration fit, the points at the lower end of the calibration curve have less weight in determining the curve generated than points at the high concentration end of the curve. However, in environmental analysis, accuracy at the low end of the curve is very important. For this reason, it is preferable to increase the weighting of the lower concentration points. 1/Concentration or 1/Concentration^2 weighting (often called 1/x or 1/x^2 weighting) will improve accuracy at the low end of the curve and should be used if the data system has this capability.

11.7 Initial Calibration Verification (ICV)

An initial calibration verification containing all components from a second source (an alternate vendor or a unique lot from the same vendor) must be analyzed immediately following the initial calibration. Acceptance criteria for ICV percent recovery (%R) are 80-120% for DoD QSM 4.2 or 5.0 and 70-130% for commercial work (See Method 8270D.)

NOTE: Several states (Arizona) and/or federal programs have special requirements. Be sure to review state QAS summaries and SOP DV-QA-024P for these special requirements. Criteria for DoD QSM 5.0 is detailed in Table 15.

11.8 If time remains in the 12-hour period initiated by the DFTPP injection before the initial calibration, samples may be analyzed.

NOTE: Quantitation is performed using the calibration curve or average response factor from the initial curve, not the continuing calibration. For additional information on calibrations see SOP CA-Q-P-003.

11.9 Continuing Calibration Verification (CCV)

11.9.1 At the start of each 12-hour period, the GC/MS tuning standard must be analyzed. A 25-ng injection of DFTPP must result in a mass spectrum for DFTPP, which meets the criteria given in Table 4.

11.9.2 Following a successful DFTPP analysis, the continuing calibration verification (CCV) standard(s) are analyzed. The standard(s) must contain all semivolatile analytes, including all required surrogates. A mid-level calibration standard (80 µg/mL for standard volume extraction and 20 ug/mL for LVI) is used for the CCV.

11.9.3 The following criteria must be met for the CCV to be acceptable:

- The percent difference or drift (%D) of each compound must be ≤ 20%. (See Section 12 for calculations.)

  NOTE: Some states (Wisconsin) have special continuing calibration requirements when initial calibration is performed using a quadratic curve. Please refer to the state specific QAS.

- Due to the large numbers of compounds that may be analyzed by this method, it is expected that some compounds will fail to meet the criterion. At least 80% of analytes included in the calibration must have the %D less than or equal to 20%. In cases where compounds fail, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit. For situations when the failed compound is present, the concentrations must be reported as estimated values or the system must be recalibrated and the extracts reanalyzed.

- Any sample detections for an analyte that fails the SOP CCV criteria must be flagged as estimated, or described in the narrative. In all cases, every effort should be made to reanalyze on an instrument with a passing CCV.

- Any sample non-detects for an analyte that fails the criteria low, must have a low level CCV (LLCCV) in the batch as a sensitivity demonstration. The criterion for a passing LLCCV is detection only, and a passing LLCCV allows non-detects to be reported without flagging.

  NOTE: Use of a LLCCV is not applicable for DoD work.

- The internal standard response of the CCV must be within 50 - 200% of the response in the same level of the corresponding calibration.

- If any internal standard retention time in the CCV changes by more than 30 seconds from that of the same level of the corresponding initial calibration, the chromatographic system must be inspected for malfunctions and corrections made, as required.

11.9.4 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 DFTPP have passed. (A sample injected less than or equal to 12 hours after the DFTPP is acceptable.)

11.9.5 Each of the most common target analytes in the CCV must meet the minimum response factors listed in Table 14. If they are not met, the system is evaluated, and corrective action takes place before sample analysis begins. Possible problems include standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system.

11.10 Closing CCV for DoD 5.0

DoD QSM 5.0 requires a closing CCV (CCVC) injected within 12 hours of the DFTPP injection that initiated the sequence. The acceptance criteria for the CCVC is ± 50% for each compound. See Table 15 for additional details.

12.0 Calculations / Data Reduction

12.1 Qualitative Identification

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 NBS library. 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.

12.1.1 The sample component retention time must compare to within ± 30 sec retention of the standard component. For reference, the standard must be run within the same twelve hours as the sample.

12.1.2 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.

12.1.3 The characteristic ions of a compound must maximize in the same scan or within one scan of each other.

12.1.4 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%.)

12.1.5 If a compound cannot be verified by all the above criteria, but in the technical judgment of the analyst the identification is correct, the analyst shall report that identification and proceed with quantitation.

12.2 Tentatively Identified Compounds

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the type of analyses being conducted. Computer generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Only after visual comparison of sample spectra with the nearest library searches shall the mass spectral interpretation specialist assign a tentative identification. Following are guidelines for making tentative identification:

12.2.1 Relative intensities of major ions in the reference spectrum (ions >10% of the most abundant ion) should be present in the sample spectrum.

12.2.2 The relative intensities of the major ions should agree to within ±30%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance should be between 20%and 80%.)

12.2.3 Molecular ions present in the reference spectrum should be present in the sample spectrum.

12.2.4 Ions present in the sample spectrum, but not in the reference spectrum, should be reviewed for possible background contamination or the presence of co-eluting compounds.

12.2.5 Ions present in the reference spectrum, but not in the sample spectrum, should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.

12.2.6 Automatic background subtraction can severely distort spectra from samples with unresolved hydrocarbons.

12.3 Isomers with identical mass spectra and close elution times pose problems for definitive identification. The following compounds, listed in elution order, fall into this category:

Aniline and bis(2-chloroethyl) ether
N-Nitrosodiphenylamine and diphenylamine
1,3-Dichlorobenzene, 1,4-dichlorobenzene, and 1,2-dichlorobenzene
Benzyl alcohol, 2-Methylphenol, 3-methylphenol, and 4-methylphenol
(Note: 3-methylphenol and 4-methylphenol co-elute)
2- methylnaphthalene and 1-methylnaphthalene
2,4-Dimethylphenol and 3,5-Dimethylphenol
2,4,6-Trichlorophenol and 2,4,5-trichlorophenol
Phenanthrene and anthracene
Fluoranthene and pyrene
Benzo(a)anthracene and chrysene
Benzo(e)pyrene and Benzo(a)pyrene
bis(2-Ethylhexyl)phthalate and di-n-octyl phthalate
Benzo(b) and (k)fluoranthene
Indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene
Safrole and 1-chloronaphthalene
1-naphthylamine and 2-naphthylamine
1-chloronaphthalene and 2-chloronaphthalene
2,4,6-tribromophenol and 2,4,5-tribromophenol

Identification of these compounds requires both experience and extra precautions on the part of the analyst. Specifically, the analyst must more closely scrutinize the comparison of retention times between the unknown and the calibration standard. The analyst must check that all isomers have distinct retention times and that peak resolution is sufficient (valley height of less than 25% of the sum of the two peak heights).

12.4 A second category of problem compounds consists of the poor responders or compounds that chromatograph poorly. The integrations for these types of compounds should be checked manually. The following compounds are included in this category:

Benzoic acid
Chloroanilines
Nitroanilines
2,4-Dinitrophenol
4-Nitrophenol
Pentachlorophenol
3,3'-Dichlorobenzidine
Benzyl alcohol
4,6-Dinitro-2-methylphenol
Atrazine
Famphur
Benzidine

12.5 Relative Response Factor Calculation

$$RF = \frac{A_x C_{is}}{A_{is} C_x}$$

Where:

A_x = Area of the characteristic ion for the compound being measured
A_{is} = Area of the characteristic ion for the specific internal standard
C_x = Concentration of the compound being measured (µg/L)
C_{is} = Concentration of the specific internal standard (µg/L)

12.6 Calculating the Percent Relative Standard Deviation for Initial Calibration

$$\%RSD = \frac{SD}{\overline{\overline{RF}}} \times 100\%$$

Where:

$\overline{RF}$ = Mean of RFs from the initial calibration for a compound
SD = Standard deviation for the mean RF from the initial calibration for a compound

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\left(RF_i - \overline{RF}\right)^2}{n-1}}$$

RF_i = RF for each of the calibration levels
n = Number of RF values

12.7 Calculating the Continuing Calibration Percent Drift

$$\%Drift = \frac{C_{found} - C_{actual}}{C_{actual}} \times 100\%$$

Where:

C_{actual} = Known concentration in standard
C_{found} = Measured concentration using selected quantitation method

12.8 Calculating the Concentration in the Extract

The concentration of each identified analyte and surrogate in the extract is calculated from the average RF, or linear or quadratic curve fitted to the initial calibration points. Start with the simplest model, i.e., a straight line through the origin and progress through the other options until the calibration acceptance criteria are met.

12.8.1 Average Response Factor Calibration

If the RSD of the response factors for each compound of interest in the initial calibration is ≤15% for DoD or ≤20% for commercial applications of Method 8270D, the average response factor from the initial calibration may be used for quantitation. Average response factor is calculated as follows:

$$C_{ex} = \frac{R_x C_{is}}{R_{is} \overline{RF}}$$

Where:

C_{ex} = Concentration in the extract, µg/mL
R_x = Response for the analyte
R_{is} = Response for the internal standard
C_{is} = Concentration of the internal standard
$\overline{RF}$ = Average response factor

12.8.2 Linear Fit Calibration

If the RSD of the response factors for each compound of interest in the initial calibration is >15% for DoD or >20% for commercial applications of Method 8270D, the linear fit calibration may be used for quantitation. To calculate the concentration in an unknown sample extract, the regression equation is solved for:

$$C_{ex} = \frac{\left[\frac{R_x C_{is}}{R_{is}} - b\right]}{m_1}$$

Where:

C_{ex} = Extract analyte concentration, µg/L

R_x = Response for analyte
R_{is} = Response for internal standard
C_{is} = Concentration of internal standard
b = y – Intercept
m_1 = Slope

12.8.3 Quadratic Fit Calibration

When the instrument response does not follow a linear model over a sufficiently wide working range, or when the previously described calibration approaches fail acceptance criteria, a non-linear, second-order calibration model may be employed. To calculate the concentration in an unknown sample extract, the roots of the quadratic equation are solved for:

$$C_{ex} = \frac{-m_1 \pm \sqrt{(m_1)^2 - 4(m_2)\left(b - \frac{R_x C_{is}}{R_{is}}\right)}}{2m_2}$$

Where:

C_{ex} = Extract analyte concentration, µg/L
R_x = Response for analyte
R_{is} = Response for internal standard
C_{is} = Concentration of internal standard
m_2 = Curvature
m_1 = Slope
b = y - Intercept

12.9 Calculating the Concentration in the Sample

12.9.1 Calculation for Aqueous Samples

$$\text{Concentration, } \mu\text{g / L} = \frac{C_{ex} V_t}{V_o}$$

Where:

C_{ex} = Concentration in the extract
V_t = Volume of total extract in µL, taking into account dilutions (i.e., a 1-to-10 dilution of a 1-mL extract will mean that V_t = 10,000 µL. If half of the base/neutral extract and half of the acid extract are combined, then V_t = 2,000 µL.)
V_o = Volume of the sample that was extracted (mL)

12.9.2 Calculation for Sediment, Soil, Sludge, and Waste Samples

Results for sediments, sludges, and soils are usually calculated on a dry-weight basis, and for waste, on a wet-weight basis.

$$\text{Concentration, } \mu\text{g/kg} = \frac{C_{ex} V_t}{W_s D}$$

Where:

C_{ex} = Concentration in the extract
V_t = Volume of total extract in µL, taking into account dilutions (i.e., a 1-to-10 dilution of a 1-mL extract will mean that V_t = 10,000 µL. If half of the base/neutral extract and half of the acid extract are combined, then V_t = 2,000 µL.)
W_s = Weight of sample extracted or diluted in grams
D = (100 - % moisture in sample)/100, for a dry-weight basis or 1 for a wet-weight basis

12.10 MS/MSD Percent Recovery Calculation

$$\text{Matrix Spike Recovery} = \frac{S_{SR} - S_R}{S_A} \times 100\%$$

Where:

S_{SR} = Spike sample result
S_R = Sample result
S_A = Spike added

12.11 Calculating the Relative Percent Difference (RPD) MS/MSD Pair

$$RPD = \frac{|MS_R - MSD_R|}{1/2(MS_R + MSD_R)} \times 100$$

Where:

RPD = Relative percent difference
MS_R = Matrix spike result
MSD_R = Matrix spike duplicate result

12.12 Calculation of TICs

The calculation of TICs (tentatively identified compounds) is identical to the RF calculation (Section 12.5) with the following exceptions:

A_x = Area of the total ion chromatogram for the compound being measured
A_{is} = Area of the total ion chromatogram for the nearest internal standard without interference
RF = 1

12.13 Calculating Percent DDT Breakdown

$$\%\ \text{DDT breakdown} = \frac{\text{DDEarea} + \text{DDDarea}}{\text{DDTarea} + \text{DDEarea} + \text{DDDarea}}$$

The areas for the m/z 235 ion are used for this calculation.

12.14 Calculating the Peak Tailing Factor

$$\text{Tailing Factor} = \frac{BC}{AB}$$

Where:

Peak width (AC) is measured at 10% peak height, and divided into two line segments at the peak centroid, so that

AC = AB + BC, with
AB = left-hand segment
BC = right-hand segment

13.0 Method Performance

13.1 Method Detection Limit Study (MDL)

13.1.1 The method detection limit (MDL) 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 is determined according to the laboratory's MDL policy in DV-QA-005P. MDLs 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 studies for analyses performed; these are verified at least annually unless method or program requirements require a greater frequency.

13.1.2 Non-standard Analytes

For non-standard analytes, an MDL study must be performed and calibration curve generated before analyzing any samples, unless lesser requirements are previously agreed to with the client. In any event, the minimum initial demonstration should include the analysis of an extracted standard at the reporting limit and a single point calibration.

13.2 Demonstration of Capabilities

All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows.

13.2.1 Four aliquots of the QC check sample are analyzed using the same procedures used to analyze samples, including sample preparation. The concentration of the QC check sample should be equivalent to a mid- level calibration.

13.2.2 Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

13.2.3 If any analyte does not meet the acceptance criteria, the test must be repeated.

Only those analytes that did not meet criteria in the first test need to be evaluated. TNI 2009 requires consecutive passing results. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

13.2.4 Until the IDOC is approved by the QA Manager (or designee); the trainer and trainee must be identified in the batch record.

13.2.5 Further details concerning demonstrations of proficiency are described in SOP DV-QA-0024.

13.3 Training Requirements

The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. A new analyst must be working under supervision prior to approval of the IDOC. Documentation that a new analyst is performing under supervision must be entered into the batch record (View Batch Information) until that analyst's IDOC has been approved by the QA Manager (or designee). See requirements for demonstration of analyst proficiency in SOP DV-QA-0024.

14.0 Pollution Control

14.1 Standards and reagents should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.2 The LVI method utilizes smaller sample sizes and extraction volumes resulting in a decrease in the amount of waste generated for the analysis of water samples.

15.0 Waste Management

15.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in section 13, "Waste Management and Pollution Prevention", of the Corporate Safety Manual, and HS-001, "Waste Management Program."

15.2 The following waste streams are produced when this method is carried out

15.2.1 Expired Chemicals/Reagents/Standards – Contact Waste Coordinator

15.2.2 Methylene Chloride- B

15.2.3 Flammable Solvent- Waste Stream C

15.2.4 Used vials- Waste Stream A

NOTE: Radioactive, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Waste Coordinator for proper management of radioactive or potentially radioactive waste generated by this procedure.

16.0 References / Cross-References

16.1 SW846, Test Methods for Evaluating Solid Waste, Third Edition and all promulgated updates, EPA Office of Solid Waste, January 2005.

16.1.1 Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Capillary Column Technique, Update IV, Revision 4, February 2007

16.1.2 Method 8000B, Determinative Chromatographic Separations, Revision 2, December 1996.

16.1.3 Method 8000C, Determinative Chromatographic Separations, Revision 3, March 2003.

16.1.4 Method 3510C, Separatory Funnel Liquid-Liquid Extraction, Revision 3, December 1996.

16.1.5 Method 3520C, Continuous Liquid-Liquid Extraction, Revision 3, December 1996.

16.1.6 Method 3540C, Soxhlet Extraction, Revision 3, December 1996.

16.1.7 Method 3550B, Ultrasonic Extraction, Revision 2, December 1996.

16.1.8 Method 3550C, Ultrasonic Extraction, Revision 3, February 2007.

16.1.9 Method 3580, Waste Dilution, Revision 1, July 1992.

16.1.10 Method 3620C, Florisil Cleanup, Revision 3, February 2007.

16.1.11 Method 3660A, Sulfur Cleanup, Revision 1, July 1992.

16.1.12 Method 3660B, Sulfur Cleanup, Revision 2, December 1996.

16.1.13 Method 3665A, Sulfuric Acid/Permanganate Cleanup, Revision 1, December 1996.

16.1.14 Quality Systems Manual (QSM) for Environmental Laboratories, DoD Quality Systems Manual Version 5.0, July 2013.

17.0 Method Modifications:

17.1 Modifications from Reference Method

17.1.1 A retention time window of 0.5 minutes is used for all components, since some data systems do not have the capability of using the relative retention time units specified in the reference method.

Method 8270D stipulates qualitative identification based on relative retention time (RRT), which is calculated by dividing the retention time (RT) of the target analyte by the RT of the internal standard. The RRT of the suspected target analyte in the sample extract must be within ± 0.06 RRT units of the RRT for that analyte in the calibration standard. This SOP stipulates qualitative identification based on an absolute RT. Namely the RT of the suspected target analyte in the sample extract must be within ± 0.5 minute of the RT for that analyte in the calibration standard. Additionally, the RT for the internal standard in the sample extract must also be within ± 0.5 minute of the RT for the internal standard in the calibration standard.

17.1.2 The quantitation and qualifier ions for some compounds have been changed from those recommended in SW-846 in order to improve the reliability of qualitative identification.

17.1.3 This procedure includes the option for weighted linear regression curves using 1/concentration and 1/concentration^2 weighting factors. Section 7.5.2 of Method 8000B discusses the use of weighted least square regression based on 1/standard deviation^2 weighting factors, which would require multiple analyses of each standard to determine the standard deviation. IAETL has presented information to the EPA Office of Solid Waste demonstrating that the variance (standard deviation^2) is proportional to the standard concentration. EPA accepted this argument and issued a memorandum dated August 7, 1998 (Attachments dated July 1998), which authorizes the use of 1/concentration^2 weighting factors.

17.1.4 The Large Volume Injection technique utilizes modifications in the source methods regarding both sample size and injection volume. These modifications are explicitly allowed by EPA. SW-846, Chapter Two lists as acceptable variations adjustment to both the sizes of sample prepared and injection volumes. See TestAmerica White Paper No. CA-Q-W-010, “Large Volume Injection (LVI) Technique for Organic Preparation and Analysis Methods” for detailed discussions. Reporting limits remain the same as the standard volume procedure for this technique.

17.1.5 Method 8270D lists the primary ion for Benzoic acid as m/z 122 and the secondary ion as m/z 105. The laboratory analyzes for 3,5-Dimethylphenol which can co-elute with the Benzoic acid primary ion 122 on some instruments. In order to distinguish between the two peaks, Benzoic acid has been assigned 105 as the primary ion and 122 as the secondary ion. 3,5-Dimethylphenol has 107 as the primary ion and 122 as the secondary ion.

18.0 Attachments

Table 1.	TAL Primary Standard and Standard Reporting Limits
Table 2.	TAL Appendix IX Standard Reporting Limits
Table 3.	Suggested Instrument Conditions
Table 4.	DFTPP Key Ions and Ion Abundance Criteria
Table 5.	Characteristic Ions, Primary Standard (in approximate retention time order)
Table 6.	Characteristic Ions, Appendix IX Standard (in approximate retention time order)
Table 7.	8270D LCS Compounds
Table 8.	TCLP LCS Compounds
Table 9.	8270D Surrogate Compounds

Table 10. Calibration Levels, Primary Standard, µg/mL
Table 11. Calibration Levels, Appendix IX Standard, µg/mL
Table 12. List 1 Reliably Performing Compounds
Table 13. List 2 Poorly Performing Compounds
Table 14 Minimum Response Factor Criteria for Initial and Continuing Calibration Verification
Table 15 Specific DoD QSM 5.0 and DoE QSAS 3.0 Requirements for 8270D
Table LVI-1 LVI Calibration Levels, Primary (HSL) Standard, µg/mL
Table LVI-2 LVI Calibration Levels, Appendix IX Standard, µg/mL

APPENDIX A. Modifications Required for Analysis of Wastewater Following Method 8270 Best Practice (8270D_LL)

Table A-1. TAL Method 8270D_LL Standard Reporting Limits
Table A-2. Method 8270D_LL Calibration Levels
Table A-3. Method 8270D_LL LCS Spike Concentrations
Table A-4. 8270D_LL Surrogate Compounds
Table A-5. Suggested Instrument Conditions for 8270D_LL

APPENDIX B. Suggeste0d Instrument Maintenance Schedules - Mass Spectrometer & Gas Chromatograph

19.0 **Revision History**

- Revision 8, dated 30 September 2015
    - Removed all details pertaining to Method 3546. This method is not longer used to prep soil samples for analysis by Method 8270.
    - Removed all references to South Carolina requirements. Lab is no longer certified in South Carolina for this method.
    - Revised Section 9.7 to reflect current practice
    - Updated reference to corporate SOP to reflect current document and added reference to corporate memo on QC requirements for Method 8270D
    - Revised Section 11.6.1.2 to reflect both DoD and method criteria
    - Revised list of compounds in Section 12.3 to review for correct identification due to closely eluting analytes based on revision to data review checklist.
    - Revised Section 12.8.1 and 12.8.2 to reflect both DoD and method criteria.
    - Revised Section 13 to reflect current practice.
    - Added Section 17.1.5 describing mass assignments for benzoic acid and 3,5-dimethylphenol to distinguish the two closely eluting compounds
    - Removed Table 12 which referenced method 625 and renumbered remaining tables that followed it.
    - Updated Table 15 to include tune, breakdown and ICAL requirements that were inadvertently omitted in previous version.
    - Updated all tables to reflect current target analyte list and routine spike compounds
    - Formatting and editorial changes throughout.

- Revision 7, dated 29 August 2014
    - Corrected references from 8270C to 8270D.
- Revision 6, dated 9 April 2014

  - Added Table 16, Specific DoD QSM 5.0 and DoE QSAS 3.0 Requirements for 8270D.
  - Updated calibration standards and their corresponding sublists throughout the SOP (including text, tables and appendices).
    - 1,1-Biphenyl, Acetophenone, 3-Methylphenol, 1,2,4,5-Tetrachlorobenzene, 1,3-Dinitrobenzene and 2,3,4,6-Tetrachlorophenol moved into the HSL sublist
    - 4,4'-Methylene bis(2-chloroaniline), 6-Methylchrysene, Acrylamide, Dibenz(a,h)acridine, and Quinoline moved into the AP9 sublist.
  - Modified the large volume injection (LVI) injection volume to 2.5 µL and internal standard concentration to 40 µg/mL.
  - Formatting and editorial changes throughout.
  - Added reference to DoD QSM 5.0
- Revision 5, dated 19 August 2013
  - Added statement to Section 2.1 that LVI must not be used on SC samples.
- Revision 4, dated 27 February 2013
  - Added information to analyze water extracts using Large Volume Injection throughout the SOP
  - Added Tables LVI-1 and LVI-2 for LVI calibration standards
  - Removed AFCEE calibration curve (no longer used)
  - Revised sections 9.1, 10.1 and 10.2 to reflect current practice
  - Formatting and editorial changes throughout
- Revision 3, dated 4 January 2013
  - Changed storage of extracts from freezer to refrigerator.
- Revision 2, dated 30 November 2012
  - Deleted Section 5.1.5 – About the use of Separatory Funnels
  - Updated the Hazardous Materials table in Section 5.2 to reflect current solvent used.
  - Updated and clarified language in Attachments to reflect current practices.
- Revision 1.1, dated 01 December 2011
  - Added note to section 1.1.1 and Appendix A restricting use of Best Practice method
  - Revised sections 9.5, 9.6 and 9.7 to clarify use of flags and documentation in narrative for failed QC
  - Revised section 9.8.1 to clarify modifications might be made to accommodate the chemistry of the sample.
  - Added statement to 11.5.3 to flag data if target analyte reported for failed CCV.
  - Expanded the discussion in section 17.1.1 to clarify how the use of RT windows stipulated in this SOP meets or exceeds the requirements of Method 8270D.
  - Clarified reference from EPA for source of inverse weighted least squares regression for calibrations.
- Revision 1.0, dated 31 January 2011
  - Updated Table 3, Suggested Instrument Conditions
  - Added components and changed spike levels in Table 7, 8270D LCS Compounds
  - Added low level calibration standard to Table 11, Calibration Levels, Primary Standard
  - Minor grammatical, spelling and formatting changes were made throughout.

Earlier revision histories have been archived and are available upon request.

Table 1.
TAL Primary Standard and Standard Reporting Limits

Analytes	CAS Number	Standard Reporting Limits	
		Aqueous (µg/L)	Low Soil/Sediment (µg/kg)
Pyridine	110-86-1	20	660
N-Nitrosodimethylamine	62-75-9	10	330
Aniline	62-53-3	10	330
Phenol	108-95-2	10	330
Bis(2-chloroethyl)ether	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	4	330
1,4-Dichlorobenzene	106-46-7	4	330
Benzyl alcohol	100-51-6	10	330
1,2-Dichlorobenzene	95-50-1	4	330
2-Methylphenol	95-48-7	10	330
2,2’-oxybis(1-chloropropane)	108-60-1	10	330
4-Methylphenol	106-44-5	10	330
N-Nitroso-di-n-propylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
Benzoic acid	65-85-0	50	1600
Bis(2-chloroethoxy)methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
1,2,4,5-Tetrachlorobenzene	95-94-3	10	330
4-Chloro-3-methylphenol	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	50	1600
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	10	330
2-Chloronaphthalene	91-58-7	4	330
2-Nitroaniline	88-74-4	10	1600
Dimethyl phthalate	131-11-3	4	330
1,3-Dinitrobenzene	99-65-0	10	330
Acenaphthylene	208-96-8	4	330
3-Nitroaniline	99-09-2	10	1600
Acenaphthene	83-32-9	4	330
2,4-Dinitrophenol	51-28-5	30	1600
4-Nitrophenol	100-02-7	10	1600
Dibenzofuran	132-64-9	4	330
2,3,4,6-Tetrachlorophenol	58-90-2	50	1600
2,4-Dinitrotoluene	121-14-2	10	330
2,6-Dinitrotoluene	606-20-2	10	330

Table 1.
TAL Primary Standard and Standard Reporting Limits (cont.)

Analytes	CAS Number	Standard Reporting Limits	
		Aqueous (µg/L)	Low Soil/Sediment (µg/kg)
Diethylphthalate	84-66-2	4	330
4-Chlorophenyl phenyl ether	7005-72-3	10	330
Fluorene	86-73-7	4	330
4-Nitroaniline	100-01-6	10	1600
4,6-Dinitro-2-methylphenol	534-52-1	20	1600
N-Nitrosodiphenylamine	86-30-6	10	330
Azobenzene	103-33-3	10	330
4-Bromophenyl phenyl ether	101-55-3	10	330
Hexachlorobenzene[3]	118-74-1	10	330
Pentachlorophenol	87-86-5	50	1600
Phenanthrene	85-01-8	4	330
Anthracene	120-12-7	4	330
Carbazole	86-74-8	4	330
Di-n-butyl phthalate	84-74-2	4	330
Fluoranthene	206-44-0	4	330
Benzidine	92-87-5	100	3300
Pyrene	129-00-0	10	330
Butyl benzyl phthalate	85-68-7	4	330
3,3'-Dichlorobenzidine	91-94-1	50	1600
Benzo(a)anthracene	56-55-3	4	330
Bis(2-ethylhexyl)phthalate	117-81-7	10	330
4,4-Methylenebis(2-chloroaniline)	101-14-4	100	330
Chrysene	218-01-9	4	330
Di-n-octylphthalate	117-84-0	4	330
Benzo(b)fluoranthene	205-99-2	4	330
Benzo(k)fluoranthene	207-08-9	4	330
Benzo(a)pyrene	50-32-8	4	330
Indeno(1,2,3-cd)pyrene	193-39-5	4	330
Diethyl phthalate	84-66-2	4	660
Dibenz(a,h)anthracene	53-70-3	4	330
Benzo(g,h,i)perylene	191-24-2	4	330
Acetophenone	98-86-2	10	330
3/4-Methylphenol	15831-10-4	10	330
1,4-Dioxane	54841-74-6	20	660
Benzaldehyde	100-52-7	10	330
2,6-Dichlorophenol	87-65-0	10	330
1,1-Biphenyl	92-52-4	10	330

1. The TAL primary standard is the standard normally used. Additional standards, such as the Appendix IX standard (Table 2) may be necessary to include all target analytes required for some clients.
2. 2,2'-Oxybis(1-chloropropane) was formerly known as bis(2-chloroisopropyl)ether.
3. May also be analyzed by method 8081, which can achieve lower reporting limits.

Table 2.
TAL Appendix IX Standard Reporting Limits

Semivolatiles	CAS Number	Standard Reporting Limits Aqueous (µg/L)	Standard Reporting Limits Low Soil/Sediment (µg/kg)
2-Picoline	109-06-8	20	660
N-Nitrosomethylethylamine	10595-95-6	10	330
Methyl methanesulfonate	66-27-3	10	330
N-Nitrosodiethylamine	55-18-5	10	330
Ethyl methanesulfonate	62-50-0	10	330
Pentachloroethane	76-01-7	50	1600
N-Nitrosopyrrolidine	930-55-2	10	330
N-Nitrosomorpholine	59-89-2	10	330
o-Toluidine	95-53-4	10	660
N-Nitrosopiperidine	100-75-4	10	330
O, O', O"-Triethylphosphorothioate[2]	126-68-1	50	1600
a,a-Dimethyl-phenethylamine	122-09-8	50	1600
Hexachloropropene	1888-71-7	100	3300
p-Phenylenediamine	106-50-3	100	1600
n-Nitrosodi-n-butylamine	924-16-3	10	330
Safrole	94-59-7	50	1600
Isosafrole	120-58-1	20	660
1,4-Dinitrobenzene	100-25-4	10	330
1,4-Naphthoquinone	130-15-4	50	1600
Pentachlorobenzene	608-93-5	10	330
1-Naphthylamine	134-32-7	10	330
2-Naphthylamine	91-59-8	10	330
5-Nitro-o-toluidine	99-55-8	20	660
Thionazin[2]	297-97-2	10	1600
1,3,5-Trinitrobenzene	99-35-4	50	1600
Sulfotepp[2]	3689-24-5	50	1000
Phorate[2]	298-02-2	50	1600
Phenacetin	62-44-2	20	660
Diallate[3]	2303-16-4	20	660
Dimethoate[2]	60-51-5	20	660
4-Aminobiphenyl	92-67-1	50	1600
Pentachloronitrobenzene	82-68-8	50	1600
Pronamide	23950-58-5	20	660
Disulfoton[2]	298-04-4	50	1600
2-secbutyl-4,6-dinitrophenol (Dinoseb)	88-85-7	10	660
Methyl Parathion[2]	298-00-0	50	1600
1-chloronaphthalene	90-13-1	10	330
4-Nitroquinoline-1-oxide	56-57-5	100	3300
Parathion	56-38-2	50	1600
Methapyrilene	91-80-5	50	1600

Table 2.
TAL Appendix IX Standard Reporting Limits (cont.)

Semivolatiles	CAS Number	Standard Reporting Limits	
		Aqueous (µg/L)	Low Soil/Sediment (µg/kg)
Aramite	140-57-8	20	660
Isodrin[3]	465-73-6	10	330
p-(Dimethylamino)azobenzene	60-11-7	20	660
p-Chlorobenzilate	510-15-6	10	330
3,3'-Dimethylbenzidine	119-93-7	20	660
2-Acetylaminofluorene	53-96-3	100	3300
Dibenz(a,j)acridine	224-42-0	10	660
7,12-Dimethylbenz(a)anthracene	57-97-6	20	660
3-Methylcholanthrene	56-49-5	20	660
Diphenylamine	122-39-4	10	330

1. The Appendix IX standard contains additional analytes required for the Appendix IX list. The TAL primary standard must also be analyzed to include all of the Appendix IX list.
2. May also be analyzed by method 8141, which can achieve lower reporting limits.
3. May also be analyzed by method 8081, which can achieve lower reporting limits.

Table 3.
Suggested Instrument Conditions[1]

Parameter	Settings	
	Standard Analysis	**Large Volume Injection**
Mass Range:	35 - 500 amu	35-500 amu
Scan Time:	≤ 1 second/scan	≤ 1 second/scan
Initial Column Temperature/Hold Time:	55 °C for 1 minute	55 °C for 1.5 minute
Column Temperature Program:	55-250 °C at 25 °C/min 250-315°C at 5°/min	55 - 250 °C at 25 °C/min 250 - 315 °C at 28 °C/min
Final Column Temperature/Hold Time:	315 °C (until at least one minute after benzo(g,h,i)perylene has eluted)	315 °C (until at least one minute after benzo(g,h,i)perylene has eluted)
Injector Temperature:	250 °C	250 °C
Transfer Line Temperature:	300 °C	300 °C
Source Temperature:	According to manufacturer's specifications	According to manufacturer's specifications
Injector:	Restek liner #23300.5 or equivalent	Restek liner #23300.5 or equivalent
Syringe	5 or 10 µL	10 µL
Sample Volume:	0.5 µl	5 µL
Carrier Gas:	Helium at 3.4 mL/min	Helium at 3.4 mL/min

[1] The GC parameters should be optimized to provide appropriate resolution for benzo(b)fluoranthene and benzo(k)fluoranthene and dibenz(a,h)anthracene and indeno(1,2,3-cd)pyrene.

Table 4.
DFTPP Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
51	30 - 60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40 - 60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5 - 9% of mass 198
275	10 - 30% of mass 198
365	>1% of mass 198
441	Present, but less than mass 443
442	40 - 100% of mass 198
443	17 - 23% of mass 442

Table 5.
Characteristic Ions, Primary Standard (in alpha-numeric order)

Analyte	Primary	Secondary	Tertiary	IS	Surr
1,1-Biphenyl	154	153	76	3	2
1,2,4,5-Tetrachlorobenzene	216	214	218	2	4
1,2,4-Trichlorobenzene	180	182	145	2	4
1,2-Dichlorobenzene	146	148	113	1	4
1,3-Dichlorobenzene	146	148	113	1	4
1,3-Dinitrobenzene	168	50	76	3	2
1,4-Dichlorobenzene	146	148	113	1	4
1,4-Dichlorobenzene-d_4 (Internal Standard)	152	150	115	1	-
1,4-Dioxane	88	58	-	1	3
2,2'-oxybis(1-chloropropane)[1]	45	77	79	1	4
2,3,4,6-Tetrachlorophenol	232	230	131	3	2
2,4,5-Trichlorophenol	196	198	200	3	1
2,4,6-Tribromophenol (Surrogate Standard)	330	332	141	3	1
2,4,6-Trichlorophenol	196	198	200	3	1
2,4-Dichlorophenol	162	164	98	2	3
2,4-Dimethylphenol	107	121	122	2	3
2,4-Dinitrophenol	184	63	154	3	1
2,4-Dinitrotoluene	165	63	89	3	2
2,6-Dichlorophenol	162	164	63	2	4
2,6-Dinitrotoluene	165	63	89	3	2
2-Chloronaphthalene	162	164	127	3	2
2-Chlorophenol	128	64	130	1	3
2-Fluorobiphenyl (Surrogate Standard)	172	171	170	3	2
2-Fluorophenol (Surrogate Standard)	112	64	63	1	3
2-Methylnaphthalene	142	141	115	2	2
2-Methylphenol	108	107	77	1	3
2-Nitroaniline	65	92	138	3	2
2-Nitrophenol	139	65	109	2	3
3,3'-Dichlorobenzidine	252	254	126	5	2
3/4-Methylphenol	108	107	77	1	3
3-Nitroaniline	138	108	92	3	2
4,6-Dinitro-2-methylphenol	198	105	51	4	1
4-Bromophenylphenylether	248	250	141	4	2
4-Chloro-3-methylphenol	107	144	142	2	1
4-Chloroaniline	127	129	65	2	4
4-Chlorophenylphenylether	204	206	141	3	2
4-Methylphenol	108	107	79	1	3
4-Nitroaniline	138	92	108	3	2
4-Nitrophenol	109	139	65	3	1
Acenaphthene	153	152	154	3	6
Acenaphthene-d_{10} (Internal Standard)	164	162	160	3	-
Acenaphthylene	152	151	153	3	6
Acetophenone	105	77	120	1	3
Aniline	93	66	-	1	3
Anthracene	178	179	176	4	6
Azobenzene	77	182	105	3	2
Benzaldehyde	106	105	77	1	--
Benzidine	184	92	185	5	6

Table 5 (continued)
Characteristic Ions, Primary Standard (in alpha-numeric order)

Analyte	Primary	Secondary	Tertiary	IS	Surr
Benzo(a)anthracene	228	229	226	5	6
Benzo(a)pyrene	252	253	125	6	6
Benzo(b)fluoranthene	252	253	125	6	6
Benzo(g,h,i)perylene	276	138	277	6	6
Benzo(k)fluoranthene	252	253	125	6	6
Benzoic Acid	105	122	77	2	3
Benzyl Alcohol	108	79	77	1	4
Bis(2-chloroethoxy)methane	93	95	123	2	4
Bis(2-chloroethyl)ether	93	63	95	1	4
Bis(2-ethylhexyl)phthalate	149	167	279	5	2
Butylbenzylphthalate	149	91	206	5	2
Carbazole	167	166	139	4	1
Chrysene	228	226	229	5	6
Chrysene-d$_{12}$ (Internal Standard)	240	120	236	5	-
Dibenz(a,h)anthracene	278	139	279	6	2
Dibenzofuran	168	139	84	3	2
Diethylphthalate	149	177	150	3	2
Dimethylphthalate	163	194	164	3	2
Di-n-butylphthalate	149	150	104	4	2
Di-n-octylphthalate	149	167	43	5	2
Famphur	218	93	125	5	6
Fluoranthene	202	101	100	4	6
Fluorene	166	165	167	3	6
Hexachlorobenzene	284	142	249	4	2
Hexachlorobutadiene	225	223	227	2	4
Hexachlorocyclopentadiene	237	235	271	3	2
Hexachloroethane	117	201	199	1	4
Indeno(1,2,3-cd)pyrene	276	138	277	5	6
Isophorone	82	95	138	2	4
Naphthalene	128	129	127	2	6
Naphthalene-d$_8$ (Internal Standard)	136	68	54	2	-
Nitrobenzene	77	123	65	2	4
Nitrobenzene-d$_5$ (Surrogate Standard)	82	128	54	2	4
N-Nitrosodimethylamine	74	42	-	1	3
N-Nitroso-di-n-propylamine	70	42	101,130	1	4
N-Nitrosodiphenylamine	169	168	167	4	2
Pentachlorophenol	266	264	268	4	1
Perylene-d$_{12}$ (Internal Standard)	264	260	265	6	-
Phenanthrene	178	179	176	4	6
Phenanthrene-d$_{10}$ (Internal Standard)	188	94	80	4	-
Phenol	94	65	66	1	5
Phenol-d$_5$ (Surrogate Standard)	99	42	71	1	5
Pyrene	202	101	100	5	6
Pyridine	79	52	-	1	3
Terphenyl-d$_{14}$ (Surrogate Standard)	244	122	212	5	6

[1] 2,2'oxybis(1-chloropropane) was formally known as bis(2-chloroisopropyl)ether.

Table 6.
Characteristic Ions, Appendix IX Standard (in alpha-numeric order)

Analyte	Primary	Secondary	Tertiary	IS	SURR
1,3,5-Trinitrobenzene	213	75	120	4	--
1,4-Dinitrobenzene	168	75	122	3	2
1,4-Naphthoquinone	158	104	102	3	2
1-Naphthylamine	143	115	--	3	2
2-Acetylaminofluorene	181	180	223	5	6
2-Naphthylamine	143	115	--	3	2
2-Picoline	93	66	92	1	3
2-secbutyl-4,6-dinitrophenol (Dinoseb)	211	163	147	4	--
3,3'-Dimethylbenzidine	212	106	--	5	6
3-Methylcholanthrene	268	252	253	6	6
4-Aminobiphenyl	169	168	115	4	--
4-Nitroquinoline-1-oxide	190	128	160	4	--
5-Nitro-o-toluidine	152	77	106	3	2
7,12-Dimethylbenz(a)anthracene	256	241	120	6	6
a,a-Dimethyl-phenethylamine	58	91	--	2	4
Aramite 1	185	319	--	5	6
Aramite 2	185	319	--	5	6
Diallate	86	234	--	4	--
Dibenz(a,j)acridine	279	280	--	6	6
Dimethoate	87	93	125	4	--
Diphenylamine	169	168	167	4	2
Disulfoton	88	97	89	4	--
Ethyl methanesulfonate	79	109	97	1	3
Hexachloropropene	213	215	211	2	4
Isodrin	193	66	195	4	--
Isosafrole 1	162	104	131	3	2
Isosafrole 2	162	104	131	3	2
Methapyrilene	97	58	--	4	--
Methyl methanesulfonate	80	79	65	1	3
Methyl parathion	109	125	263	4	--
N-Nitrosodiethylamine	102	44	57	1	3
N-Nitrosodi-n-butylamine	84	57	41	2	4
N-Nitrosomethylethylamine	88	42	43	1	3
N-Nitrosomorpholine	116	56	86	1	3
N-Nitrosopiperidine	114	42	55	2	4
N-Nitrosopyrrolidine	100	41	42	1	3
O,O’,O”-Triethyl-Phosphorothioate	198	121	93	2	4
o-Toluidine	106	107	77	1	3
p-(Dimethylamino)azobenzene	120	225	77	5	--

Table 6. (continued)
Characteristic Ions, Appendix IX Standard (in alpha-numeric order)

Analyte	Primary	Secondary	Tertiary	IS	SURR
Parathion	109	97	291	4	--
p-Chlorobenzilate	251	139	253	5	6
Pentachlorobenzene	250	248	252	3	2
Pentachloroethane	117	119	167	1	3
Pentachloronitrobenzene	237	142	214	4	--
Phenacetin	108	179	109	4	--
Phorate	75	97	121	4	--
p-Phenylenediamine	108	80	54	2	6
Pronamide	173	175	255	4	--
Safrole	162	104	77	2	4
Sulfotepp	97	322	202	4	--
Thionazin	97	96	143	3	2

Table 7.
8270D LCS Compounds

LCS Compounds	Spiking Level ng/µL in extract
1,2,4,5-Tetrachlorobenzene	80
1,1-Biphenyl	80
1,2,4-Trichlorobenzene	80
1,2-Dichlorobenzene	80
1,3-Dichlorobenzene	80
1,3-Dinitrobenzene	80
1,4-Dichlorobenzene	80
1,4-Dioxane	80
1-Methylnaphthalene	80
2-2'-Oxybis(1-chloropropane)	80
2,3,4,6-Tetrachlorophenol	80
2,4,5-Trichlorophenol	80
2,4,6-Trichlorophenol	80
2,4-Dichlorophenol	80
2,4-Dimethylphenol	80
2,4-Dinitrophenol	160
2,4-Dinitrotoluene	80
2,6-Dichlorophenol	80
2,6-Dinitrotoluene	80
2-Chloronaphthalene	80

Table 7 (cont.)
8270D LCS Compounds

LCS Compounds	Spiking Level ng/µL in extract
2-Chlorophenol	80
2-Methylnaphthalene	80
2-Methylphenol	80
2-Nitroaniline	80
2-Nitrophenol	80
3,3-Dichlorobenzidine	80
3&4-Methylphenol	80
3-Methylphenol	80
3-Nitroaniline	80
4,6-Dinitro-2-methylphenol	160
4-Bromophenyl phenyl ether	80
4-Chloro-3-methylphenol	80
4-Chloroaniline	80
4-Chlorophenyl phenyl ether	80
4-Methylphenol	80
4-Nitroanliline	80
4-Nitrophenol	160
Acenaphthene	80
Acenaphthylene	80
Acetophenonoe	80
Aniline	80
Anthracene	80
Azobenzene	80
Benzidine	80
Benzaldehyde	80
Benzo[a]anthracene	80
Benzo[b]fluoranthene	80
Benzo[k]fluoranthene	80
Benzoic acid	80
Benzo[g,h,i]perylene	80
Benzo[a]pyrene	80
Benzyl alcohol	80
Bis(2-chloroethoxy)methane	80
Bis(2-ethylhexyl) phthalate	80

Table 7 (cont.)
8270D LCS Compounds

LCS Compounds	Spiking Level ng/µL in extract
Bis(2-chloroethyl)ether	80
Caprolactam	80
Carbazole	80
Chrysene	80
Di-n-butyl phthalate	80
Di-n-octyl phthalate	80
Dibenz(a,h)anthracene	80
Dibenzofuran	80
Diethyl phthalate	80
Dimethyl phthalate	80
Fluoranthene	80
Fluorene	80
Hexachlorobenzene	80
Hexachlorobutadiene	80
Hexachlorocyclopentadiene	80
Hexachloroethane	80
Indeno(1,2,3-cd)pyrene	80
Isophorone	80
Naphthalene	80
Nitrobenzene	80
N-Nitrosodimethylamine	80
N-Nitrosodi-n-propylamine	80
N-Nitrosodiphenylamine	80
Pentachlorophenol	160
Phenanthrene	80
Phenol	80
Pyrene	80
Pyridine	80

Table 8.
TCLP LCS Compounds

LCS Compounds	Spiking Level, ng/µL in extract
1,4-Dichlorobenzene	50
2,4-Dinitrotoluene	50
Hexachlorobenzene	50
Hexachlorobutadiene	50
Hexachloroethane	50
2-Methylphenol	50
3/4-Methylphenol	100
Nitrobenzene	50
Pentachlorophenol	100
Pyridine	50
2,4,5-Trichlorophenol	50
2,4,6-Trichlorophenol	50

Recovery limits for the LCS and for matrix spikes are generated from historical data and are maintained by the QA group.

Table 9
8270D Surrogate Compounds

Surrogate Compounds	Standard Analysis ng/µL in extract	LVI Analysis ng/µL in extract
Nitrobenzene-d_5	100	25
2-Fluorobiphenyl	100	25
Terphenyl-d_{14}	100	25
Phenol-d_5	100	25
2-Fluorophenol	100	25
2,4,6-Tribromophenol	100	25

Table 10.
Calibration Levels[1], Primary (HSL) Standard, µg/mL

Analyte	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
Pyridine	-	10	20	50	80	120	160	200
1,4-Dioxane	4	10	20	50	80	120	160	200
N-nitrosodimethylamine	-	10	20	50	80	120	160	200
Aniline	-	10	20	50	80	120	160	200
Phenol	-	10	20	50	80	120	160	200
Bis(2-chloroethyl)ether	-	10	20	50	80	120	160	200
2-Chlorophenol	-	10	20	50	80	120	160	200
1,3-Dichlorobenzene	4	10	20	50	80	120	160	200
1,4-Dichlorobenzene	4	10	20	50	80	120	160	200
Benzyl alcohol	-	10	20	50	80	120	160	200
1,2-Dichlorobenzene	4	10	20	50	80	120	160	200
2-Methylphenol	-	10	20	50	80	120	160	200
2,2'-oxybis(1-chloropropane)[2]	-	10	20	50	80	120	160	200
4-Methylphenol	-	10	20	50	80	120	160	200
3-Methylphenol	-	10	20	50	80	120	160	200
Acetophenone	4	10	20	50	80	120	160	200
N-Nitroso-di-n-propylamine	-	10	20	50	80	120	160	200
Hexachloroethane	4	10	20	50	80	120	160	200
Nitrobenzene	-	10	20	50	80	120	160	200
Isophorone	-	10	20	50	80	120	160	200
2-Nitrophenol	-	10	20	50	80	120	160	200
2,4-Dimethylphenol	-	10	20	50	80	120	160	200
Benzoic acid	-	--	20	50	80	120	160	200
Bis(2-chloroethoxy)methane	-	10	20	50	80	120	160	200
2,4-Dichlorophenol	-	10	20	50	80	120	160	200
1,2,4-Trichlorobenzene	4	10	20	50	80	120	160	200
Naphthalene	4	10	20	50	80	120	160	200
4-Chloroaniline	-	10	20	50	80	120	160	200
Hexachlorobutadiene	-	10	20	50	80	120	160	200
1,2,4,5-Tetrachlorobenzene	-	10	20	50	80	120	160	200
4-Chloro-3-methylphenol	-	10	20	50	80	120	160	200
2-Methylnaphthalene	4	10	20	50	80	120	160	200
Hexachlorocyclopentadiene	-	--	20	50	80	120	160	200
2,4,6-Trichlorophenol	-	10	20	50	80	120	160	200
2,4,5-Trichlorophenol	-	10	20	50	80	120	160	200
2-Chloronaphthalene	4	10	20	50	80	120	160	200
2-Nitroaniline	-	--	20	50	80	120	160	200
Dimethyl phthalate	4	10	20	50	80	120	160	200
1,3-Dinitrobenzene	-	10	20	50	80	120	160	200
Acenaphthylene	4	10	20	50	80	120	160	200
3-Nitroaniline	-	--	20	50	80	120	160	200
Acenaphthene	4	10	20	50	80	120	160	200
2,4-Dinitrophenol	-	20	40	100	160	240	320	400
4-Nitrophenol	8	20	40	100	160	240	320	400
Dibenzofuran	4	10	20	50	80	120	160	200
2,3,4,6-Tetrachlorophenol	-	10	20	50	80	120	160	200
2,4-Dinitrotoluene	-	10	20	50	80	120	160	200
2,6-Dinitrotoluene	-	10	20	50	80	120	160	200

Table 10. (continued)
Calibration Levels, Primary (HSL) Standard, µg/mL

Analyte	L1	L2	L3	L4	L5	L6	L7	L8
Diethylphthalate	4	10	20	50	80	120	160	200
4-Chlorophenyl phenyl ether	-	10	20	50	80	120	160	200
Fluorene	4	10	20	50	80	120	160	200
4-Nitroaniline	-	--	20	50	80	120	160	200
4,6-Dinitro-2-methylphenol	-	20	40	100	160	240	320	400
N-Nitrosodiphenylamine	-	10	20	50	80	120	160	200
Azobenzene[3]	4	10	20	50	80	120	160	200
4-Bromophenyl phenyl ether	-	10	20	50	80	120	160	200
Hexachlorobenzene	-	10	20	50	80	120	160	200
Pentachlorophenol	-	20	40	100	160	240	320	400
Phenanthrene	4	10	20	50	80	120	160	200
Anthracene	4	10	20	50	80	120	160	200
Carbazole	4	10	20	50	80	120	160	200
Di-n-butyl phthalate	4	10	20	50	80	120	160	200
Fluoranthene	4	10	20	50	80	120	160	200
Benzidine	-	--	20	50	80	120	160	200
Pyrene	4	10	20	50	80	120	160	200
Butyl benzyl phthalate	4	10	20	50	80	120	160	200
3,3'-Dichlorobenzidine	-	--	20	50	80	120	160	200
Benzo(a)anthracene	4	10	20	50	80	120	160	200
Bis(2-ethylhexyl)phthalate	4	10	20	50	80	120	160	200
Chrysene	4	10	20	50	80	120	160	200
Di-n-octylphthalate	4	10	20	50	80	120	160	200
Benzo(b)fluoranthene	4	10	20	50	80	120	160	200
Benzo(k)fluoranthene	4	10	20	50	80	120	160	200
Benzo(a)pyrene	4	10	20	50	80	120	160	200
Indeno(1,2,3-cd)pyrene	4	10	20	50	80	120	160	200
Dibenz(a,h)anthracene	4	10	20	50	80	120	160	200
Benzo(g,h,i)perylene	4	10	20	50	80	120	160	200
1,1-Biphenyl	-	10	20	50	80	120	160	200
Benzaldehyde	-	10	20	50	80	120	160	200
2,6-Dichlorphenol	-	10	20	50	80	120	160	200

[1] All compounds are spiked in all standard levels (4, 10, 20, 50, 80, 120, 160 and 200 µg/mL). Levels listed in this table are the required spike levels needed in order to calibrate to at the reporting limit for each compound. Additional lower-level standards may be included in the calibrations as long as the ICAL criteria are met.

[2] 2,2'oxybis(1-chloropropane) was formally known as bis(2-chloroisopropyl)ether

[3] Azobenzene is formed by decomposition of 1,2-diphenlyhydrazine. If 1,2-diphenylhydrazine is requested, it will be analyzed as azobenzene.

Table 11.
Calibration Levels, Appendix IX Standard, µg/mL

Semivolatiles	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**
2-Picoline	10	20	50	80	120	160	200
N-Nitrosomethylethylamine	10	20	50	80	120	160	200
Methyl methanesulfonate	10	20	50	80	120	160	200
N-Nitrosodiethylamine	10	20	50	80	120	160	200
Ethyl methanesulfonate	10	20	50	80	120	160	200
Pentachloroethane	--	20	50	80	120	160	200
N-Nitrosopyrrolidine	10	20	50	80	120	160	200
N-Nitrosomorpholine	10	20	50	80	120	160	200
o-Toluidine	10	20	50	80	120	160	200
N-Nitrosopiperidine	10	20	50	80	120	160	200
O,O’,O”-Triethyl-Phosphorothioate	--	20	50	80	120	160	200
a,a-Dimethyl-phenethylamine	--	20	50	80	120	160	200
Hexachloropropene	--	20	50	80	120	160	200
p-Phenylenediamine	--	20	50	80	120	160	200
n-Nitrosodi-n-butylamine	10	20	50	80	120	160	200
Safrole	--	20	50	80	120	160	200
Isosafrole 1 + 2	10	20	50	80	120	160	200
1,4-Dinitrobenzene	10	20	50	80	120	160	200
1,4-Naphthoquinone	--	20	50	80	120	160	200
Pentachlorobenzene	10	20	50	80	120	160	200
1-Naphthylamine	10	20	50	80	120	160	200
2-Naphthylamine	10	20	50	80	120	160	200
N-Nitro-o-toluidine	10	20	50	80	120	160	200
Thionazin	10	20	50	80	120	160	200
1,3,5-Trinitrobenzene	--	20	50	80	120	160	200
Sulfotepp	--	20	50	80	120	160	200
Phorate	--	20	50	80	120	160	200
Phenacetin	10	20	50	80	120	160	200
Diallate 1 + 2	10	20	50	80	120	160	200
Dimethoate	10	20	50	80	120	160	200
4-Aminobiphenyl	--	20	50	80	120	160	200
Pentachloronitrobenzene	--	20	50	80	120	160	200
Pronamide	10	20	50	80	120	160	200
Disulfoton	--	20	50	80	120	160	200
2-secbutyl-4,6-dinitrophenol (Dinoseb)	10	20	50	80	120	160	200
Methyl parathion	--	20	50	80	120	160	200
4-Nitroquinoline-1-oxide	--	20	50	80	120	160	200
Parathion	--	20	50	80	120	160	200
Isodrin	10	20	50	80	120	160	200
Methapyrilene	--	20	50	80	120	160	200
Aramite 1 and 2	10	20	50	80	120	160	200
p-(Dimethylamino)azobenzene	10	20	50	80	120	160	200
p-Chlorobenzilate	10	20	50	80	120	160	200
3,3'-Dimethylbenzidine	10	20	50	80	120	160	200
2-Acetylaminofluorene	--	20	50	80	120	160	200
Dibenz (a,j)acridine	10	20	50	80	120	160	200
7,12-Dimethylbenz(a) anthracene	10	20	50	80	120	160	200
3-Methylcholanthrene	10	20	50	80	120	160	200
Diphenlyamine	10	20	50	80	120	160	200

Table 12.
Analytically Reliably Performing Compounds

Acenaphthene
Acenaphthylene
Acetophenone
Aniline
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzoic acid
Benzyl alcohol
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
Caprolactam
Carbazole
4-Chloroaniline[1]
4-Chloro-3-methylphenol
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
Dibenz(a,h)anthracene
Dibenzofuran
1,4-Dioxane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
Diethyl phthalate
2,4-Dimethylphenol
Dimethyl phthalate
Di-n-butyl phthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
1,2-Diphenylhydrazine (as Azobenzene)
Di-n-octyl phthalate
Famphur
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorocyclopentadiene[1]
Hexachlorobutadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
1-Methylnaphthalene
2-Methylnaphthalene
2-Methylphenol
4-Methylphenol
Naphthalene
2-Nitroaniline
3-Nitroaniline[1]
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitrosodimethylamine
N-Nitroso-di-n-propylamine
N-Nitrosodiphenylamine
2,2’-Oxybis(1-chloropropane) aka "bis(2-chloroisopropyl) ether"
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
Pyridine
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

[1] Even though these analytes perform reliably through the GC/MS, they are known poor performers through the extraction procedure.

Table 13.
Poorly Performing Compounds

2-Acetylaminofluorene
4-Aminobiphenyl
Aramite (#1)
Aramite (#2)
Benzidine
1,1-Biphenyl
Chlorobenzilate
Diallate (#1)
Diallate (#2)
Dibenz(a,j)acridine
2,6-Dichlorophenol
Dimethoate
p-(Dimethylamino)azobenzene
7,12-Dimethylbenz(a)anthracene
3,3'-Dimethylbenzidine
α,α-Dimethylphenethylamine
1,3-Dinitrobenzene
1,4-Dinitrobenzene
Diphenylamine
Disulfoton
Ethyl methanesulfonate
Hexachlorophene
Hexachloropropene
Isosafrole (#1)
Isosafrole (#2)
Isodrin
Methapyrilene
3-Methylcholanthrene
4,4’-Methylenebis(2-chloroaniline)
Methyl methanesulfonate
Methyl Parathion
1-Naphthylamine
2-Naphthylamine
1,4-Naphthoquinone
4-Nitroquinoline-1-oxide
N-Nitrosodiethylamine
N-Nitrosodi-n-butylamine
N-Nitrosomethylethylamine
N-Nitrosomorpholine
N-Nitrosopiperidine
N-Nitrosopyrrolidine
Pentachlorobenzene
Pentachloroethane
Pentachloronitrobenzene
Phenacetin
p-Phenylenediamine
Phorate
2-Picoline
Pronamide
Safrole
2-secbutyl-4,6-dinitrophenol (Dinoseb)
Sulfotepp
1,2,4,5-Tetrachlorobenzene
2,3,4,6-Tetrachlorophenol
Thionazin
O,O’,O”-Triethylphosphorothioate
1,3,5-Trinitrobenzene

Table 14.
Minimum Response Factor Criteria for Initial and Continuing Calibration Verification

Analyte	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)[1]	0.010
Acetophenone	0.010
4-Methylphenol	0.600
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
Hexachlorobutadiene	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
Acenaphthylene	0.900
2,6-Dinitrotoluene	0.200
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dinitrophenol	0.010
Dibenzofuran	0.800
4-Nitrophenol	0.010
2,4-Dinitrotoluene	0.200
Diethylphthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
Fluorene	0.900
4-Chlorophenylphenylether	0.400
4-Nitroaniline	0.010
4,6-Dinitro-2-methylphenol	0.010
N-Nitrosodiphenylamine	0.010
4-Bromophenylphenylether	0.100

[1] 2,2’-Oxybis(1-chloropropane) was formerly known as bis(2-chloroisopropyl)ether

Table 14
Minimum Response Factor Criteria for Initial and Continuing Calibration Verification (cont.)

Analyte	Minimum Response Factor (RF)
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700
Anthracene	0.700
Carbazole	0.010
Di-n-butylphthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butylbenzylphthalate	0.010
Benzo(a)anthracene	0.800
3,3'-Dichlorobenzidine	0.010
Chrysene	0.700
Bis(2-ethylhexyl)phthalate	0.010
Di-n-octylphthalate	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

Note: All target compounds not listed in this table will be assigned a minimum response factor (RF) of 0.01

Table 15
Specific DoD QSM 5.0 and DOE QSAS 3.0 Requirements for 8270D

This table includes components of the DoD QSM 5.0 and DoE QSAS 3.0 that are different from TestAmerica's standard procedures, for a complete description of requirements, see DV-QA-024P. Also listed are the variances that TestAmerica is requesting for this analysis; these alternate criteria are only used with project-specific approval.

Requirement	Variance (if allowed)	DoD QSM 5.0 and DoE QSAS 3.0
Tune Check	--	Perform tune check prior to calibration and prior to each period of every 12 hours during sample analysis. Use method specified ion abundance criteria for BFB or DFTPP. If unsuccessful, retune and verify. No samples shall be analyzed without a valid tune.
Performance Check (Method 8270 only)	--	Performed daily at the beginning of each 12-hour period prior to analysis of samples. Degradation must be ≤20% for DDT. Any problems must be corrected. Do not run samples until degradation is ≤ 20%. Benzidine and pentachlorophenol should be present at their normal responses and peak tailing should not exceed a tailing factor of 2. Correct problem and reanalyze.
Initial Calibration (ICAL) for all analytes including surrogates	--	Perform a minimum 5 point calibration for all analytes prior to sample analysis. (Minimum 6 points for non-linear). Acceptance Criteria options: Option 1: RSD for each analyte $\leq$ 15% Option 2: Linear least squares regression for each analyte: $r^2 \geq 0.99$ ($r \geq 0.995$) Option 3: Non-linear least square regression (quadratic) for each analyte, $r^2 \geq 0.99$. Additional method requirements for evaluation must be met: See method SOPs for details. (e.g., CCCs, SPCCs, low calibration standard analysis and recovery criteria, etc.) Any problems must be corrected and ICAL repeated. No sample can be run until ICAL is successful.
Initial Calibration Verification (ICV)	 4PP	All analytes must be within ± 20% of the true value. Allow ± 30% of true value for known poor performers only if these compounds are not identified as critical compounds of concern by the client for the project under consideration.
Continuing calibration Verification (CCV/CCVC))	 4PP 3HR 7MS	Run before sample and at the end of the analytical batch (end of 12 hours). Acceptance limits for all analytes is ± 20% of true value for the CCV at start of 12 hours. If any analytes fail in a CCV, recalibrate and re-analyze all affected samples or immediately (within one hour) analyze two consecutive CCVs and if both pass for the analytes that failed, the CCV is acceptable. Closing CCV (CCVC) has an acceptance limit of ± 20% of true value. Allow ±30% of true value for known poor performers if these compounds are not identified as critical compounds of concern by the client. If the CCV is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. Allow ± 50% for end of analytical batch excluding poor performing compounds. Reanalysis performed due to failed closing CCV only for the analytes identified by the client as critical compounds of concern for the project, and to report qualified results for other analytes. (7MS)
Internal Standards (IS)	 8ISRT	RT must be ± 10 sec. from RT of the midpoint standard in the ICAL. RT must be ± 30 sec. from RT of the midpoint standard in the ICAL. Daily routine column

Requirement	Variance (if allowed)	DoD QSM 5.0 and DoE QSAS 3.0
		maintenance often results in larger RT changes than 10 sec. within a short time.
LCS		Include all analyte(s) in LCS that are required to be reported, including surrogates, except those compounds listed as “Additional Analytes” by TestAmerica. These compounds are rarely requested and historical limits may not accurately reflect current performance.
	4PP	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project (3HR).
	3HR	Otherwise, correct any problems then re-prep and reanalyze the LCS and all associated samples for failed analytes. If insufficient sample, then apply Q-flag to specific analyte(s) in all samples in the associated prep batch. Flagging is only appropriate when samples cannot be reanalyzed unless 3HR is accepted by the client.
	1SME	Marginal exceedances are not allowed for critical chemicals of concern (risk drivers). Client must notify TestAmerica of these targets or if marginal exceedances will not be allowed. (1SME)
Surrogates		For QC and field samples, correct any problems, then re-prep and reanalyze all failed samples for failed surrogates in the associated prep batch. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.
	3HR	If surrogate recoveries are above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project.

Table LVI-1.
LVI Calibration Levels, Primary (HSL) Standard, µg/mL

Analyte	L1	L2	L3	L4	L5	L6	L7	L8
Pyridine	1	2.5	5	12.5	20	30	40	50
N-nitrosodimethylamine	1	2.5	5	12.5	20	30	40	50
Aniline	1	2.5	5	12.5	20	30	40	50
Phenol	1	2.5	5	12.5	20	30	40	50
Bis(2-chloroethyl)ether	1	2.5	5	12.5	20	30	40	50
2-Chlorophenol	1	2.5	5	12.5	20	30	40	50
1,3-Dichlorobenzene	1	2.5	5	12.5	20	30	40	50
1,4-Dichlorobenzene	1	2.5	5	12.5	20	30	40	50
Benzyl alcohol	1	2.5	5	12.5	20	30	40	50
1,2-Dichlorobenzene	1	2.5	5	12.5	20	30	40	50
2-Methylphenol	1	2.5	5	12.5	20	30	40	50
2,2’-oxybis(1-chloropropane)[1]	1	2.5	5	12.5	20	30	40	50
4-Methylphenol	1	2.5	5	12.5	20	30	40	50
3-Methylphenol	1	2.5	5	12.5	20	30	40	50
Acetophenone	1	2.5	5	12.5	20	30	40	50
N-Nitroso-di-n-propylamine	1	2.5	5	12.5	20	30	40	50
Hexachloroethane	1	2.5	5	12.5	20	30	40	50
Nitrobenzene	1	2.5	5	12.5	20	30	40	50
Isophorone	1	2.5	5	12.5	20	30	40	50
2-Nitrophenol	1	2.5	5	12.5	20	30	40	50
2,4-Dimethylphenol	1	2.5	5	12.5	20	30	40	50
Benzoic acid	2	5	10	25	40	60	80	100
Bis(2-chloroethoxy)methane	1	2.5	5	12.5	20	30	40	50
2,4-Dichlorophenol	1	2.5	5	12.5	20	30	40	50
1,2,4-Trichlorobenzene	1	2.5	5	12.5	20	30	40	50
Naphthalene	1	2.5	5	12.5	20	30	40	50
4-Chloroaniline	1	2.5	5	12.5	20	30	40	50
Hexachlorobutadiene	1	2.5	5	12.5	20	30	40	50
4-Chloro-3-methylphenol	1	2.5	5	12.5	20	30	40	50
2-Methylnaphthalene	1	2.5	5	12.5	20	30	40	50
Hexachlorocyclopentadiene	1	2.5	5	12.5	20	30	40	50
1,2,4,5-Tetrachlorobenzene	1	2.5	5	12.5	20	30	40	50
2,4,6-Trichlorophenol	1	2.5	5	12.5	20	30	40	50
2,4,5-Trichlorophenol	1	2.5	5	12.5	20	30	40	50
2-Chloronaphthalene	1	2.5	5	12.5	20	30	40	50
2-Nitroaniline	1	2.5	5	12.5	20	30	40	50
Dimethyl phthalate	1	2.5	5	12.5	20	30	40	50
1,3-Dinitrobenzene	1	2.5	5	12.5	20	30	40	50
Acenaphthylene	1	2.5	5	12.5	20	30	40	50
3-Nitroaniline	1	2.5	5	12.5	20	30	40	50
Acenaphthene	1	2.5	5	12.5	20	30	40	50
2,4-Dinitrophenol	2	5	10	25	40	60	80	100
4-Nitrophenol	2	5	10	25	40	60	80	100
Dibenzofuran	1	2.5	5	12.5	20	30	40	50
2,3,4,6-Tetrachlorophenol	1	2.5	5	12.5	20	30	40	50
2,4-Dinitrotoluene	1	2.5	5	12.5	20	30	40	50
2,6-Dinitrotoluene	1	2.5	5	12.5	20	30	40	50

Table LVI-1. (continued)
LVI Calibration Levels, Primary Standard, µg/mL

Analyte	L1	L2	L3	L4	L5	L6	L7	L8
Diethylphthalate	1	2.5	5	12.5	20	30	40	50
4-Chlorophenyl phenyl ether	1	2.5	5	12.5	20	30	40	50
Fluorene	1	2.5	5	12.5	20	30	40	50
4-Nitroaniline	1	2.5	5	12.5	20	30	40	50
4,6-Dinitro-2-methylphenol	2	5	10	25	40	60	80	100
N-Nitrosodiphenylamine	1	2.5	5	12.5	20	30	40	50
Azobenzene[2]	1	2.5	5	12.5	20	30	40	50
4-Bromophenyl phenyl ether	1	2.5	5	12.5	20	30	40	50
Hexachlorobenzene	1	2.5	5	12.5	20	30	40	50
Pentachlorophenol	2	5	10	25	40	60	80	100
Phenanthrene	1	2.5	5	12.5	20	30	40	50
Anthracene	1	2.5	5	12.5	20	30	40	50
Carbazole	1	2.5	5	12.5	20	30	40	50
Di-n-butyl phthalate	1	2.5	5	12.5	20	30	40	50
Fluoranthene	1	2.5	5	12.5	20	30	40	50
Benzidine	1	2.5	5	12.5	20	30	40	50
Pyrene	1	2.5	5	12.5	20	30	40	50
Butyl benzyl phthalate	1	2.5	5	12.5	20	30	40	50
3,3'-Dichlorobenzidine	1	2.5	5	12.5	20	30	40	50
Benzo(a)anthracene	1	2.5	5	12.5	20	30	40	50
Bis(2-ethylhexyl)phthalate	1	2.5	5	12.5	20	30	40	50
Chrysene	1	2.5	5	12.5	20	30	40	50
Di-n-octylphthalate	1	2.5	5	12.5	20	30	40	50
Benzo(b)fluoranthene	1	2.5	5	12.5	20	30	40	50
Benzo(k)fluoranthene	1	2.5	5	12.5	20	30	40	50
Benzo(a)pyrene	1	2.5	5	12.5	20	30	40	50
Indeno(1,2,3-cd)pyrene	1	2.5	5	12.5	20	30	40	50
Dibenz(a,h)anthracene	1	2.5	5	12.5	20	30	40	50
Benzo(g,h,i)perylene	1	2.5	5	12.5	20	30	40	50
2,6-Dichlorophenol	--	2.5	5	12.5	20	30	40	50

[1] 2,2’oxybis(1-chloropropane) was formally known as bis(2-chloroisopropyl)ether

[2] Azobenzene is formed by decomposition of 1,2-diphenlyhydrazine. If 1,2-diphenylhydrazine is requested, it will be analyzed as azobenzene.

Table LVI-2.
LVI Calibration Levels, Appendix IX Standard, µg/mL

Semivolatiles	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
2-Picoline	2.5	5	12.5	20	30	40	50
N-Nitrosomethylethylamine	2.5	5	12.5	20	30	40	50
Methyl methanesulfonate	2.5	5	12.5	20	30	40	50
N-Nitrosodiethylamine	2.5	5	12.5	20	30	40	50
Ethyl methanesulfonate	2.5	5	12.5	20	30	40	50
Pentachloroethane	2.5	5	12.5	20	30	40	50
N-Nitrosopyrrolidine	2.5	5	12.5	20	30	40	50
N-Nitrosomorpholine	2.5	5	12.5	20	30	40	50
o-Toluidine	2.5	5	12.5	20	30	40	50
N-Nitrosopiperidine	2.5	5	12.5	20	30	40	50
O,O’,O”-Triethyl-Phosphorothioate	2.5	5	12.5	20	30	40	50
alpha,alpha-Dimethyl-phenethylamine	2.5	5	12.5	20	30	40	50
Hexachloropropene	2.5	5	12.5	20	30	40	50
p-Phenylenediamine	2.5	5	12.5	20	30	40	50
n-Nitrosodi-n-butylamine	2.5	5	12.5	20	30	40	50
Safrole	2.5	5	12.5	20	30	40	50
Isosafrole 1 + 2	2.5	5	12.5	20	30	40	50
1,4-Dinitrobenzene	2.5	5	12.5	20	30	40	50
1,4-Naphthoquinone	2.5	5	12.5	20	30	40	50
Pentachlorobenzene	2.5	5	12.5	20	30	40	50
1-Naphthylamine	2.5	5	12.5	20	30	40	50
2-Naphthylamine	2.5	5	12.5	20	30	40	50
N-Nitro-o-toluidine	2.5	5	12.5	20	30	40	50
Thionazin	2.5	5	12.5	20	30	40	50
1,3,5-Trinitrobenzene	2.5	5	12.5	20	30	40	50
Sulfotepp	2.5	5	12.5	20	30	40	50
Phorate	2.5	5	12.5	20	30	40	50
Phenacetin	2.5	5	12.5	20	30	40	50
Diallate 1 + 2	2.5	5	12.5	20	30	40	50
Dimethoate	2.5	5	12.5	20	30	40	50
4-Aminobiphenyl	2.5	5	12.5	20	30	40	50
Pentachloronitrobenzene	2.5	5	12.5	20	30	40	50
Pronamide	2.5	5	12.5	20	30	40	50
Disulfoton	2.5	5	12.5	20	30	40	50
2-secbutyl-4,6-dinitrophenol (Dinoseb)	2.5	5	12.5	20	30	40	50
Methyl parathion	2.5	5	12.5	20	30	40	50
4-Nitroquinoline-1-oxide	2.5	5	12.5	20	30	40	50
Parathion	2.5	5	12.5	20	30	40	50

Table LVI-2. (continued)
LVI Calibration Levels, Appendix IX Standard, µg/mL

Semivolatiles	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
Isodrin	2.5	5	12.5	20	30	40	50
Methapyrilene	2.5	5	12.5	20	30	40	50
Aramite 1 and 2	2.5	5	12.5	20	30	40	50
p-(Dimethylamino) azobenzene	2.5	5	12.5	20	30	40	50
p-Chlorobenzilate	2.5	5	12.5	20	30	40	50
3,3'-Dimethylbenzidine	2.5	5	12.5	20	30	40	50
2-Acetylaminofluorene	2.5	5	12.5	20	30	40	50
Dibenz (a,j)acridine	2.5	5	12.5	20	30	40	50
7,12-Dimethylbenz(a) anthracene	2.5	5	12.5	20	30	40	50
3-Methylcholanthrene	2.5	5	12.5	20	30	40	50

APPENDIX A

Modifications Required for Analysis of Samples Following Method 8270 Best Practice (8270D_LL)

REQUIREMENTS FOR METHOD 8270 BEST PRACTICE (8270D_LL)

- Method Best Practice is utilized to obtain lower reporting limits while still providing full scan data. The standard analyte list and reporting limits are listed in Table A-1.
- This method is only applicable to the analysis of low level samples. The appropriate range for aqueous samples is 1 to 100 ug/L, and 30 to 1650 ug/Kg for soils. Attempts to analyze samples with concentrations much higher than this for target compounds, or high concentrations of non-target compounds will likely result in a decline in the quality control parameters for the method. Once the instrument has been adversely impacted by high level samples, it may not be possible to bring it back into control in a reasonable time frame.
- The extraction is the same with one exception. The final volume of the extract is 2 mL.
- The tune period for this method is defined as 12 hours.
- Initial calibration curve requirements are as follows:
  - Same as for 8270 detailed in Section 11.4 of this SOP.
  - The calibrations levels are shown in Table A-2.
- Continuing calibration verification requirements are as follows:
  - Same as for 8270 detailed in Section 11.9 of this SOP, except that 7 calibration point levels are used.
- Matrix Spike and LCS requirements are as follows:
  - The spike levels are listed in Table A-3.
- Surrogates: The surrogate concentrations are listed in Table A-4.
- Instrument Conditions are shown in Table A-5.

Table A-1.
TAL Method 8270D_LL Standard Reporting Limits

Analytes	CAS Number	Aqueous, µg/L
Pyridine	110-86-1	20
N-Nitrosodimethylamine	62-75-9	5
Aniline	62-53-3	5
Phenol	108-95-2	10
Bis(2-chloroethyl)ether	111-44-4	1
2-Chlorophenol	95-57-8	5
Benzyl alcohol	100-51-6	5
2-Methylphenol	95-48-7	5
2,2'-Oxybis(1-chloropropane)[1]	108-60-1	5
4-Methylphenol	106-44-5	5
N-Nitroso-di-n-propylamine	621-64-7	5
Hexachloroethane	67-72-1	5
Nitrobenzene	98-95-3	5
Isophorone	78-59-1	5
2-Nitrophenol	88-75-5	5
Benzoic acid	65-85-0	10
Bis(2-chloroethoxy)methane	111-91-1	5
2,4-Dichlorophenol	120-83-2	5
1,2,4-Trichlorobenzene	120-82-1	5
Naphthalene	91-20-3	5
4-Chloroaniline	106-47-8	5
Hexachlorobutadiene	87-68-3	5
4-Chloro-3-methylphenol	59-50-7	5
2-Methylnaphthalene	91-57-6	5
Hexachlorocyclopentadiene	77-47-4	5
2,4,6-Trichlorophenol	88-06-2	5
2,4,5-Trichlorophenol	95-95-4	5
2-Chloronaphthalene	91-58-7	5
2-Nitroaniline	88-74-4	5
Dimethyl phthalate	131-11-3	5
Acenaphthylene	208-96-8	5
3-Nitroaniline	99-09-2	5
Acenaphthene	83-32-9	5
2,4-Dinitrophenol	51-28-5	5
4-Nitrophenol	100-02-7	5
Dibenzofuran	132-64-9	5
2,4-Dinitrotoluene	121-14-2	5
2,6-Dinitrotoluene	606-20-2	5
4-Chlorophenyl phenyl ether	7005-72-3	5
Fluorene	86-73-7	5
4-Nitroaniline	100-01-6	5
4,6-Dinitro-2-methylphenol	534-52-1	10
N-Nitrosodiphenylamine	86-30-6	5
Azobenzene	103-33-3	5

1. 2,2'-Oxybis(1-chloropropane) was formerly known as bis(2-chloroisopropyl)ether

Table A-1.
TAL Method 8270D_LL Standard Reporting Limits (cont.)

Analytes	CAS Number	Aqueous, µg/L
4-Bromophenyl phenyl ether	101-55-3	5
Hexachlorobenzene	118-74-1	1
Pentachlorophenol	87-86-5	10
Phenanthrene	85-01-8	1
Anthracene	120-12-7	5
Carbazole	86-74-8	5
Di-n-butyl phthalate	84-74-2	5
Fluoranthene	206-44-0	1
Benzidine	92-87-5	1
Pyrene	129-00-0	5
Butyl benzyl phthalate	85-68-7	5
3,3'-Dichlorobenzidine	91-94-1	5
Benzo(a)anthracene	56-55-3	1
Bis(2-ethylhexyl)phthalate	117-81-7	5
Chrysene	218-01-9	1
Di-n-octylphthalate	117-84-0	5
Benzo(b)fluoranthene	205-99-2	5
Benzo(k)fluoranthene	207-08-9	5
Benzo(a)pyrene	50-32-8	5
Indeno(1,2,3-cd)pyrene	193-39-5	5
Diethyl phthalate	84-66-2	5
Dibenz(a,h)anthracene	53-70-3	5
Benzo(g,h,i)perylene	191-24-2	5
1,4-Dioxane	123-91-2	1

Table A-2.
Method 8270D_LL Calibration Levels

Calibration Level	Calibration Concentration, µg/mL
1	0.25
2	0.40
3	1.00
4	2.50
5	5.00
6	7.50
7	10.0
8	12.5
9	20.0
10	40.0
CCV	5.0

Table A-3.
Method 8270D_LL LCS Spike Concentrations

LCS Compounds	Spiking Level, ng/µL in extract
Phenol	10
Bis(2-chloroethyl)ether	10
2-Chlorophenol	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
1,2-Dichlorobenzene	10
2,2’-Oxybis(1-chloropropane)	10
N-Nitroso-di-n-propylamine	10
Hexachloroethane	10
Nitrobenzene	10
Isophorone	10
2-Nitrophenol	10
2,4-Dimethylphenol	10
Bis(2-chloroethoxy)methane	10
2,4-Dichlorophenol	10
1,2,4-Trichlorobenzene	10
Naphthalene	10
Hexachlorobutadiene	10
4-Chloro-3-methylphenol	10
Hexachlorocyclopentadiene	10
2,4,6-Trichlorophenol	10
2-Chloronaphthalene	10
Dimethyl phthalate	10
Acenaphthylene	10
Acenaphthene	10
2,4-Dinitrophenol	20
4-Nitrophenol	20
2,4-Dinitrotoluene	10
2,6-Dinitrotoluene	10
Diethylphthalate	10
4-Chlorophenyl phenyl ether	10
Fluorene	10
4,6-Dinitro-2-methylphenol	20
N-Nitrosodiphenylamine	10
4-Bromophenyl phenyl ether	10
Hexachlorobenzene	10
Pentachlorophenol	20
Phenanthrene	10
Anthracene	10
Di-n-butyl phthalate	10
Fluoranthene	10
Benzidine	10
Pyrene	10
Butyl benzyl phthalate	10
3,3'-Dichlorobenzidine	10
Benzo(a)anthracene	10

Table A-3.
Method 8270D_LL LCS Spike Concentrations (cont.)

LCS Compounds	Spiking Level, ng/µL in extract
Bis(2-ethylhexyl)phthalate	10
Chrysene	10
Di-n-octylphthalate	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10
Benzo(a)pyrene	10
Indeno(1,2,3-cd)pyrene	10
Dibenz(a,h)anthracene	10
Benzo(g,h,i)perylene	10
N-Nitrosodimethylamine	10
1,4-Dioxane	10

Table A-4.
8270D_LL Surrogate Compounds

Surrogate Compounds	Spiking Level, ng/µL in extract
Nitrobenzene-d_5	5
2-Fluorobiphenyl	5
Terphenyl-d_{14}	5
Phenol-d_5	5
2-Fluorophenol	5
2,4,6-Tribromophenol	5

Table A-5.
Suggested Instrument Conditions for 8270D_LL

Mass Range:	35 - 500 amu
Scan Time:	≤1 second/scan
Initial Column Temperature/Hold Time:	50 °C for 1 minutes
Column Temperature Program:	50 - 320 °C at 35°C/min.
Final Column Temperature/Hold Time:	325 °C/4 min hold
Injector Temperature:	275 °C
Transfer Line Temperature:	290 °C
Source Temperature:	230 °C
Injector:	Single Taper Direct Connect Liner /splitless
Sample Volume:	0.5 µl
Carrier Gas:	Helium at 1.0mL/min.
Column:	DB-5 Capillary 20m x 0.18mm x 0.36 um film thickness

APPENDIX B

Suggested Instrument Maintenance Schedules - Mass Spectrometer & Gas Chromatograph

MASS SPECTROMETER Instrument Maintenance Schedule

Daily (when used)	Weekly	As Needed	Quarterly	Annually
Check for sufficient gas supply. Check for correct column flow and/or inlet pressure	Check mass calibration (PFTBA or FC-43).	Check level of oil in mechanical pumps and diffusion pump if vacuum is insufficient. Add oil if needed between service contract maintenance.	Check vacuum, relays, gas pressures, and flows.	Replace the exhaust filters on the mechanical rough pump every 1 to 2 years.
Check temperatures of injector, detector. Verify temperature programs.		Replace electron multiplier when the tuning voltage approaches the maximum and/or when sensitivity falls below required levels.		Change the oil in the mechanical rough pump.
Check inlets, septa.		Clean source, including all ceramics and lenses. Source cleaning is indicated by a variety of symptoms, including inability of the analyst to tune the instrument to specifications, poor response, and high background contamination.		Relubricate the turbomolecular pump-bearing wick.
Check baseline level.		Repair/replace jet separator.		
Check values of lens voltages, electron multiplier, and relative abundance and mass assignments of the calibration compounds.		Replace filaments when both filaments burn out or performance indicates the need for replacement.		

APPENDIX B

Suggested Instrument Maintenance Schedules - Mass Spectrometer & Gas Chromatograph (cont.)

GAS CHROMATOGRAPH Instrument Maintenance Schedule (**For GC/MS only.*****)***	
Daily (when used)	***As Needed***
Check for sufficient supply of carrier and detector gases. Check for correct column flow and/or inlet pressures.	Replace front portion of column packing or guard column or break off front portion of capillary columns. Replace column if this fails to restore column performance or when column performance indicates it is required (e.g., peak tailing, poor resolution, high backgrounds, etc.).
Check temperatures of injectors and detectors. Verify temperature programs.	Change glass wool plug in injection port and/or replace injection port liner when front portion of column packing is changed or front portion of capillary column is removed.
Check inlets, septa. Clean injector port.	Replace septa.
Check baseline level.	Perform gas purity check (if high baseline indicates that impure carrier gas may be in use).
Inspect chromatogram to verify symmetrical peak shape and adequate resolution between closely eluting peaks.	Repair or replace flow controller if constant gas flow cannot be maintained.
	Reactivate flow controller filter dryers when the presence of moisture is suspected.
	Autosampler: Replace syringe, fill wash bottle, dispose of waste bottle contents.

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Title: Mercury in Solids by Cold Vapor Atomic Absorption

[Methods 7471A and 7471B]

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1.0 Scope and Application

1.1 This procedure describes the preparation and analysis of mercury (Hg, CAS # 7439-97-6) by Cold Vapor Atomic Absorption Spectroscopy (CVAA) using SW-846 Method 7471A.

1.2 Method 7471A and 7471B are applicable to the preparation and analysis of mercury in soils, sediments, bottom deposits, and sludge-type materials. All matrices require sample preparation prior to analysis. This is not an appropriate procedure for the digestion of tissues or other organic matrices, which require the use of EPA 245.6 instead.

1.3 If sample preparation utilizing the Incremental Sampling Method is required, see SOP DV-OP-0013 for the procedure required prior to acid digestion for metals incorporating this procedure.

1.4 The routine reporting limit for mercury in solid matrices is 17 µg/kg.

2.0 Summary of Method

A representative portion of the sample is digested in aqua regia in the first digestion cycle and potassium permanganate in the second cycle. Mercury is reduced to its elemental state with stannous chloride and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorption of light at 253.7 nm is calibrated as a function of mercury concentration.

3.0 Definitions

3.1 Total Mercury: Inorganic forms of mercury are effectively dissolved by the acids used in the digestion. The potassium permanganate reagent breaks down organo-mercury compounds to inorganic forms that are detected by this procedure.

3.2 Aqua Regia: A 3:1 mixture of hydrochloric and nitric acids. This mixture is effective at dissolving metals in the solid form.

3.3 General Analytical Terms: Refer to the Glossary of the TestAmerica Denver Quality Assurance Manual (QAM) and policy DV-QA-003P, *Quality Control Program*, for definitions of general analytical and QA/QC terms.

4.0 Interferences

Chemical and physical interferences may be encountered when analyzing samples using this method.

4.1 Potassium permanganate “suitable for mercury determination” is specified because of the potential for mercury contamination in the reagent. In addition, potassium permanganate crystals will absorb mercury vapors from the air. Reagent bottles must be kept tightly closed to avoid contamination.

4.2 Potassium permanganate, in addition to breaking down organic compounds, also eliminates possible interferences from sulfide. Concentrations as high as 20 ppm of sulfide as sodium sulfide do not interfere with the recovery of inorganic mercury from reagent water.

4.3 Copper has also been reported to interfere; however, copper concentrations as high as 10 ppm had no effect on the recovery of mercury from spiked samples.

4.4 Chlorides can cause a positive interference. 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 at 253.7 nm. Care must be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This is accomplished by adding excess hydroxylamine reagent (25 mL) before stannous chloride is added. Both inorganic and organic mercury spikes have been quantitatively recovered from seawater using this technique.

NOTE: Sufficient addition of permanganate is apparent when the purple color persists at least 15 minutes. Some samples may require dilution prior to digestion due to extremely high concentrations of chloride.

4.5 Interference from certain volatile organic materials that absorb at the wavelength used for the method may also occur. If suspected, a preliminary run without stannous chloride can determine if this type of interference is present. While the possibility of absorption from certain organic substances present in the sample does exist, this problem is not routinely encountered. This is mentioned only to caution the analyst of the possibility. If this condition is found to exist, the mercury concentration in the sample can be determined by subtracting the result of the sample run without the reducing reagent (stannous chloride) from that obtained with the reducing reagent.

4.6 Samples containing high concentrations of oxidizable organic materials, as evidenced by high COD levels, may not be completely oxidized by this procedure. When this occurs, the recovery of mercury will be low. The problem can be lessened by reducing the volume of original sample used.

4.7 The most common interference is laboratory contamination which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual, Radiation Safety Manual and this document.

5.2 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.

5.3 Specific Safety Concerns or Requirements

5.3.1 Eye protection that satisfies ANSI Z87.1, laboratory coat, and nitrile or latex gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated must be removed and discarded; non-disposable gloves must be cleaned immediately. A disposable face shield should be used when making up aqua regia.

5.3.2 Potassium permanganate is a strong oxidizing agent. It is incompatible and must be stored separately from hydroxylamine hydrochloride and stannous chloride, the reducing agents used in this procedure, and from acids.

5.4 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 (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Mercury Nitrate Solutions	Corrosive Poison	0.1 mg/m^3 Ceiling (Mercury Compounds)	Extremely toxic. Causes irritation to the respiratory tract. Causes irritation. Symptoms include redness and pain. May cause burns. May cause sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. May affect the central nervous system. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage.
Hydrochloric Acid	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause permanent eye damage.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Hydroxylamine Hydrochloride	Corrosive Poison	No OSHA PEL listed for this compound	Direct contact with skin or eyes causes irritation. May cause skin sensitization, an allergic reaction. Inhalation or ingestion may cause methemoglobinemia and resulting cyanosis (bluish discoloration of skin due to deficient oxygenation of the blood), and labored breathing.
Potassium Permanganate	Oxidizer	5 mg/m^3 for Mn compounds	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Dry crystals and concentrated solutions are caustic causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin. Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, and blurred vision and can cause severe damage, possibly permanent.
1 – Always add acid to water to prevent violent reactions. 2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Instrumentation

6.1.1 Digestion Block, with adjustable heating, capable of maintaining a sample temperature of 90-95°C.

6.1.2 Mercury Autoanalyzers:

CETAC Mercury Analyzer with Autosampler and Auto-Diluter

6.2 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on R:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

6.3 Supplies

6.3.1 Disposable digestion tubes with caps, volume accuracy verified to +-3% gravimetrically prior to use.

6.3.2 Disposable glass autosampler tubes, 16 mm x 100 mm

6.3.3 Argon, 99.999% purity

6.3.4 Calibrated automatic pipettes or Class A glass volumetric pipettes (see SOP DV-QA-0008 for details on calibrating mechanical pipettes).

6.3.5 Class A volumetric flasks.

6.3.6 Thermometer, non-mercury column, accurate to ±1°C at 95 °C (see SOP DV-QA-0001 for calibration details).

6.3.7 Glass beads, <1 mm diameter, acid washed.

7.0 Reagents and Standards

Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. Primary and secondary standards used for data production are recorded in the Reagent Module of the TestAmerica LIMS (TALS).

7.1 **Reagent water:** Reagent water must be produced by a Millipore DI system or equivalent. Reagent water must be free of the analytes of interest as demonstrated through the analysis of method blanks.

7.2 **Nitric acid (HNO_3):** concentrated, trace metal grade or better.

7.3 **Hydrochloric acid (HCl):** concentrated, trace metal grade or better.

7.4 **Aqua Regia:** Add 600ml concentrated HCL and 200ml concentrated HNO3 to a 1L container. Aqua Regia will be prepared immediately before use.

7.5 **Calibration Blank, Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB), and Method Blank (MB), 1% HNO_3:**

7.5.1 Add 0.5 L of concentrated HNO_3 to a 50-L carboy partially filled with reagent water.

7.5.2 Dilute to 50 L with reagent water.

7.5.3 Record the acid lot number and other required information in the Blank Reagent Logbook stored in the metals prep area.

7.6 **Stannous chloride solution ($SnCl_2$), Hg grade, 10% (w/v) per manufacturer's instructions:**

7.6.1 Place approximately 100 mL of reagent water into a 2-L volumetric flask.

7.6.2 Slowly add 200 mL of concentrated HCl to the flask and swirl to mix.

7.6.3 Add 200 grams of $SnCl_2$ to the flask.

7.6.4 Mix the contents of the flask until the reagent is completely dissolved.

7.6.5 Bring solution to a final volume of 2 L with reagent water.

7.7 **Sodium chloride-hydroxylamine hydrochloride solution (Hg grade):**

Add 12 g of sodium chloride and 12 g of hydroxylamine hydrochloride (Hg grade) to every 100 mL of reagent water.

NOTE: Hydroxylamine sulfate may be used in place of hydroxylamine hydrochloride.

7.8 Potassium permanganate, 5% solution (w/v):

Dissolve 5 g of potassium permanganate (reagent grade, "suitable for mercury determination") for every 100 mL of reagent water.

7.9 Purchased Mercury Stock Solutions

7.9.1 Second source initial calibration verification (ICV) stock solution 100 mg/L (Hg ICV Stock).

7.9.2 Primary Mercury Calibration Standard Solution, 1,000 mg/L (Hg Ultra Prim).

7.10 Monthly Calibration Working Standard Solution, 10 mg/L (Hg Mnth Spike)

7.10.1 Add approximately 90 mL of 1% HNO_3 to a 100 mL Class A volumetric flask.

7.10.2 Pipet 1.00 mL of the 1,000 mg/L primary mercury calibration standard solution into the flask.

7.10.3 Dilute to the mark on the flask with 1% HNO_3.

7.10.4 Stopper the flask and shake to mix.

7.10.5 Transfer the solution to a 125-mL Nalgene bottle.

7.10.6 Document the preparation of the solution in the Reagent Module in TALS.

7.10.7 Prepare this solution fresh monthly or more often if necessary.

7.11 Daily Calibration Working Spike, 100 μg/L (Hg Daily Spk)

7.11.1 Add approximately 90 mL of 1% HNO_3 to a 100-mL volumetric flask.

7.11.2 Add 1.00 mL of the 10 mg/L Calibration Working Standard (see section 7.10).

7.11.3 Bring the solution to a final volume of 100.0 mL.

7.11.4 Stopper and mix thoroughly.

7.11.5 Document the preparation in the reagent module of the LIMS.

7.11.6 Prepare this solution each day prior to calibration.

7.12 Initial Calibration (ICAL) Standards

The initial calibration standards are prepared directly in the digestion tubes as follow:

ICAL	Daily Calibration Working Spike (mL)	1% HNO_3 (mL)	Final Conc. (µg/L)
Blank	0.0	5.0	0.0
Std 1	0.1	4.9	0.20
Std 2	0.25	4.75	0.50
Std 3	0.5	4.5	1.0
Std 4	1.0	4.0	2.0
Std 5	2.5	2.5	5.0
Std 6	5.0	0.0	10.

7.13 Second-Source Initial Calibration Verification Intermediate Standard, 400 µg/L (Hg Biwk ICV)

Add 400 uL of the 100 mg/L ICV Standard to a 100-mL volumetric flask partially filled with 1% HNO_3 and dilute to the mark. Record this information in the Reagent Module in TALS.

7.14 Second-Source Initial Calibration Verification (ICV) Daily Working Standard, 4.00 µg/L (Hg Soil ICV)

Add 0.5 mL of the 400 µg/L ICV Intermediate Standard (see section 7.13) to a soil digestion tube and add 4.5 mL of 1% HNO_3. Record this information in the Reagent Module in TALS.

7.15 Continuing Calibration Verification (CCV) Standards, 5 µg/L (Hg Soil CCV)

7.15.1 The CCVs are prepared exactly as the 5.0 µg/L ICAL standard shown above (see section 7.12).

7.15.2 Prepare sufficient volume of the standard for analysis of a CCV after every 10 samples.

7.16 Laboratory Control Sample (LCS), 417 µg/kg

7.16.1 The LCS is prepared in an empty digestion tube or 0.6 g of glass beads (<1mm) are used if required.

7.16.2 Add 2.5 mL of the 100 µg/L Daily Calibration Working Spike (see Section 7.11) to a digestion tube. See Section 9.4 for additional detail.

7.16.3 This is equivalent to a 5.0 µg/L ICAL standard, which is the concentration that appears on the raw data printout from the instruments.

7.17 Matrix Spike and Matrix Spike Duplicate (MS/MSD), 417 µg/kg

MS/MSD pairs are spiked in the same manner as the LCS (see section 7.16) and prepared in the same manner as the samples, using 0.6 g of sample.

7.18 Reporting Limit (CRA) Check Standard, 0.2 µg/L (Hg Soil RL)

7.18.1 Add 0.1 mL of 100 µg/L Daily Calibration Working Spike (see section 7.11) and 4.9 mL of reagent water to a digestion tube.

7.18.2 This is equivalent to a 0.2 µg/L ICAL standard, which is the concentration that appears on the raw data printout from the instruments.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time	Reference
Soil	Glass	10 grams	Cool, $\leq$ 6°C	28 Days	N/A

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the TALS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver Policy DV-QA-003P, *Quality Control Program*.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver Policy DV-QA-024P, *QA/QC Requirements for Federal Programs*. This procedure meets all criteria for DOD QSM 5 unless otherwise stated.

9.1.3 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 Method Comments in TALS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Preparation Batch

A group of up to 20 samples that are of the same matrix and are processed together using the same procedures and reagents. The preparation batch must contain a method blank, an LCS, and a matrix spike/matrix spike duplicate pair (MS/MSD). As discussed in the following sections, special program or project requirements can include additional requirements. Always refer to special project instructions for details before proceeding with the analysis.

9.3 Method Blank (MB)

The MB consists of an empty vessel or <1-mm glass beads (for DoD and AFCEE projects) containing all reagents specific to the method that is carried through the entire analytical procedure, including preparation and analysis. At least one method blank (MB) must be processed with each preparation batch.

Acceptance Criteria: The result for the method blank must be less than the project-specific data quality objectives. In the absence of project-specific data quality objectives, the blank must be less than ½ RL or less than 10% of the mercury concentration found in the associated samples, whichever is higher.

Corrective Action: All samples associated with an unacceptable method blank must be re-prepared and reanalyzed. If mercury was not detected in the samples, the data may be reported with qualifiers (check project requirements to be sure this is allowed) and it must be addressed in the project narrative.

NOTE: DOD QSM 5 does not allow this exception. Results may not be reported without a valid method blank unless sample cannot be re-prepared or re-analyzed.

9.4 Laboratory Control Sample (LCS), 417 µg/kg

The preparation of the LCS is described in Section 7.16. At least one LCS must be processed with each preparation batch. The LCS must be carried through the entire analytical procedure.

Acceptance Criteria: Maximum control limits for LCS recoveries are 80-120%. In-house control limits based on three standard deviations of the mean of historical results are used as long as they are at least as tight as 80-120% (see Policy DV-QA-003P for further details on establishing control limits).

NOTE: DOD QSM 5 Solid matrix LCS Limits are 80-124%**.**

Corrective Action: If LCS recoveries are outside established control limits, the system is out of control and corrective action must occur. If recoveries are above control limits and mercury is not detected in samples, the data may be reported with qualifiers (check project requirements to be sure this is allowed) and it must be addressed in the project narrative. In other circumstances, the entire batch must be re-prepared and reanalyzed.

NOTE: Reporting sample results with failing LCS recoveries is not acceptable for DOD QSM 5 unless samples cannot be re-prepared or reanalyzed.

9.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD), 417µg/kg

One MS/MSD pair must be processed for each preparation batch. Some programs may require the use of sample duplicates in place of or in addition to MS/MSDs. In addition, some programs will allow spikes to be reported only for project-related samples. Samples identified as field blanks cannot be used for MS/MSD analysis.

Acceptance Criteria: Control limits are statistically determined based on three standard deviations of the mean of the laboratory’s historical data. The MS/MSD recovery must fall within 75-125%; the relative percent difference (RPD) between the MS and MSD cannot exceed 20%.

NOTE: DOD QSM 5 Solid matrix MS/MSD Limits are 80-124%**.**

Corrective Action: If analyte recovery or RPD fails acceptance criteria, the LCS recovery must be in control for the data to be reported. If there is no evidence of analytical problems and all other QC criteria are met, then qualified results may be reported and the situation must be described in the final report case narrative. In other circumstances, the batch must be re-prepared and reanalyzed.

If the native analyte concentration in the MS/MSD exceeds 4 times the spike level for that analyte, the recovery data are reported as NC (i.e., not calculated). If the reporting software does not have the ability to report NC, then the actual recovery must be reported and narrated as follows: "Results outside of limits do not necessarily reflect poor method performance in the matrix due to high analyte concentrations in the sample relative to the spike level."

NOTE: DOD QSM 5 results outside control limits need to be evaluated to assess matrix effect or analytical error.

9.6 Method of Standard Addition (MSA)

The method of standard additions is an option for the analysis of samples shown to have significant matrix effects, e.g., unacceptably low MS/MSD recoveries or under certain conditions for TCLP analysis (see Attachment 2 for details).

NOTE: DOD QSM 5: Performed only when required by the project and the SD or PDS fails. Must be documented with an NCM and included in the case narrative.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 Sample Preparation

10.3.1 All calibration and calibration verification standards (ICV, ICB, CCV, CCB), as well as the field samples, are processed through the digestion procedure. Prepare digestion tubes containing volumes of standards required for each tube as listed in Section 7.

10.3.2 Weigh 0.5 – 0.6 g of each well-homogenized sample into a sample digestion tube. See SOP DV-QA-0023 for additional information on subsampling.

10.3.3 If preparing Incremental Samples a 3 g sample aliquot is required. This aliquot will be prepared by utilizing the procedure described in *Incremental Sampling Methodology for Soils and Sediments* (DV-OP-0013). Divide the 3 g aliquot into five 0.6 g samples. Digest the five individual aliquots and combine them back into one after adding the sodium chloride-hydroxylamine hydrochloride reagent. All batch QC samples must also be processed in this fashion.

10.3.4 Prepare a MB, LCS, MS, and MSD for each batch. The MB is either an empty digestion tube or is prepared by placing 0.6 g of glass beads in a digestion tube, depending on client requirements. The LCS is prepared by adding 2.5 mL of the 100 µg/L Daily Calibration Working Spike to a digestion tube. The MS is prepared by adding 2.5 mL of the 100 µg/L Daily Calibration Working Spike to a digestion tube containing a second aliquot of the chosen matrix sample. The MSD is prepared in the same manner as the MS using a third aliquot of the chosen sample.

NOTE: The spike must be added after the sample aliquot but before the addition of reagents.

10.3.5 Add 5.0 mL of reagent water to all un-spiked field samples and the method blanks. Add 2.5 mL of reagent water to the LCS, MS and MSD.

10.3.6 Add 5.0 ml of Aqua regia to each tube.

10.3.7 Heat for 2 minutes at 95 ± 3 °C. Record the start and stop times and the temperature on the bench sheet in TALS.

10.3.8 Allow the samples and standards to cool at room temperature.

10.3.9 Add 19 mL of reagent water.

10.3.10 Add 15 mL of 5% potassium permanganate solution. A purple color must persist for at least 15 minutes. If the color does not persist, the sample must be re-prepared using a smaller sample aliquot.

NOTE: It is important that equal volumes of the potassium permanganate solution are added to all solutions in the batch. Unequal volumes used with the automated method will result in dilution errors.

10.3.11 Cap the samples and standards and heat for 30 minutes at 95 ± 3 °C. Record the start and stop times and the temperature on the bench sheet in TALS. The analyst will verify that a purple color persists or a black precipitate is present after the thirty minutes of heating. If this is not true, the digestion must be repeated using a smaller sample aliquot.

10.3.12 Allow the samples and standards to cool at room temperature.

10.3.13 Add 6 mL of sodium chloride-hydroxylamine hydrochloride solution to reduce the excess permanganate. Verify that the volume is at 50 mL.

10.3.14 For samples aliquoted using the Incremental Sampling Method combine the 5 individual sample cups for each sample and QC into one marked 250 mL container.

10.4 Calibration

10.4.1 All calibration standards are digested together with samples, as described in Section 10.3, prior to analysis. Preparation of calibration standards is described in Section 7.12.

10.4.2 Set up the instrument with the operating parameters recommended by the manufacturer. Allow the instrument to become thermally stable before beginning calibration (approximately 30 minutes of warm-up is required).

10.4.3 Detailed information regarding calibration models and calculations can be found in Corporate Policy CA-Q-P-003, *Calibration Curves and the Selection of Calibration Points*, and under the public folder, *Arizona Calibration Training*.

10.4.4 Initial Calibration (ICAL)

10.4.4.1 Calibration must be performed daily (every 24 hours) and each time the instrument is set up. The instrument calibration date and time must be included in the raw data.

10.4.4.2 Calibrate using six standards and a blank (see section 7.12).

NOTE: It is not acceptable to reject calibration points for this method.

10.4.4.3 The calibration curve must have a correlation coefficient (r^2) ≥ 0.995 or the instrument shall be stopped and recalibrated prior to running samples. Sample results cannot be reported from a curve with an unacceptable correlation coefficient. The calibration curve is processed with an unweighted linear regression.

10.4.4.4 Record the microAbsorbance (µAbs.) for the 10 ppb standard in the instrument maintenance log.

10.4.5 Initial and Continuing Calibration Blanks

10.4.5.1 An initial calibration blank (ICB) is tested immediately after the daily ICAL standards.

Acceptance Criteria: Absolute values for the calibration blanks must be less than ½ the standard RL. Client specific requirements take precedence. For example, DOD QSM 5 requires control of blanks to a concentration less than or equal to the LOD.

Corrective Action: If the blank acceptance limit is exceeded, the analysis should be terminated, the source of contamination identified, and the instrument recalibrated.

10.4.5.2 Continuing calibration blanks (CCBs) are run after every 10 samples and at the end of the run.

Acceptance Criteria: The absolute value of the blank result must be less than ½ the reporting limit. As just noted, DOD QSM 5 requires that results for blanks must be less than the LOD (refer to special project requirements).

Corrective Action: If the blank acceptance limit is exceeded, the analysis should be terminated, the source of contamination identified, and the instrument recalibrated.

10.4.6 Initial Calibration Verification (ICV), 4.0 µg/L (Hg Soil ICV)

The accuracy of the calibration standards is verified by testing a second source standard (ICV).

Acceptance Criteria: The ICV recovery must be within 90-110%.

Corrective Action: If the ICV acceptance limit is exceeded, the analysis should be terminated, the accuracy of the calibration standards checked, and the instrument recalibrated.

10.4.7 Reporting Limit Check Standard (CRA), 0.2 µg/L (Hg Soil RL)

The accuracy of results at the reporting limit is verified by testing a standard in every analytical run that is prepared at the reporting limit concentration.

Acceptance Criteria: The results for this standard must be within 50% of the expected value (20% for some programs).

Corrective Action: If the RL check acceptance limit is exceeded, the analysis should be terminated, the instrument operation checked, the instrument recalibrated, and associated samples reanalyzed.

10.4.8 Continuing Calibration Verification (CCV), 5.0 µg/L (Hg Soil CCV)

Calibration accuracy is monitored during the analytical run through the analysis of a known standard after every 10 samples and at the end of the run.

Acceptance Criteria: The CCV recovery must be within 80-120% except for QSM 5.0 where the CCV recovery limits are 90-110%.

Correction Action: Sample results may be reported only when bracketed by valid CCV pairs. If a mid-run CCV fails, the CCV may be reanalyzed once without modification to the instrument‘s operating conditions. If the reanalyzed CCV is found to be in control, the CCV analysis must be repeated with successful results or the analysis must be terminated, the problem corrected, the instrument recalibrated, the calibration verified and the affected samples reanalyzed. If the cause of the CCV failure was not directly instrument related, the associated samples must be re-prepared and reanalyzed.

10.4.9 CCV Acceptance Criteria for sample run under a DOD QSM program

CCVs must have a percent recovery of 90-110%. If the CCV fails the following options are available: Recalibrate and reanalyze all affected samples since the last acceptable CCV or immediately (within an hour) analyzed 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.

10.5 Sample Analysis

10.5.1 Set up the instrument and autosampler according to the manufacturer’s instructions.

10.5.2 Allow the samples to cool to room temperature prior to analysis or a decrease in the response signal can occur.

10.5.3 Pipet 10 mL of each sample and calibration standard into a disposable test tube for analysis

10.5.4 Analyze the standards and samples according to the manufacturer’s instructions.

10.5.5 All measurements must fall within the defined calibration range to be valid. Dilute and reanalyze all samples with mercury concentrations that exceed the highest calibration standard.

NOTE: The instrument auto-dilutes samples. Any samples that require greater than a 10x dilution MUST be diluted manually.

10.5.6 If the sample results are negative and the absolute value is greater than the reporting limit, the sample must be reanalyzed.

10.5.7 Baseline correction is acceptable as long as it is performed after every sample or after the CCV and CCB.

10.5.8 The analytical sequence listed below must be followed. Refer to Quality Control Section 9.0 and for quality control limits.

Instrument Calibration
ICV
ICB
CRA
CCV
CCB
Maximum of 10 samples
CCV
CCB
Repeat sequence of 10 samples between CCV/CCB pairs as required to complete run
CCV
CCB

NOTE: Samples included in the count between CCVs include the method blank, LCS, MS, MSD, and field samples.

10.5.9 Guidelines are provided in the appendices on procedures to minimize contamination of samples and standards, preventive maintenance and troubleshooting.

11.0 Calculations / Data Reduction

Detailed calibration equations can be found in the corporate Policy CA-Q-P-003, *Calibration Curves and Selection of Calibration Points* and under the public folder, *Arizona Calibration Training*.

11.1 Accuracy

$$\text{ICV / CCV, LCS \% Recovery} = \frac{\text{observed concentration}}{\text{spike concentration}} \times 100$$

$$\text{MS \% Recovery} = \frac{(\text{spiked sample}) - (\text{unspiked sample})}{\text{spike concentration}} \times 100$$

11.2 Precision (RPD)

$$\text{Matrix Duplicate (MD)} = \frac{|\text{orig. sample value} - \text{dup. sample value}|}{[(\text{orig. sample value} + \text{dup. sample value})/2]} \times 100$$

11.3 Concentration = mg/kg or L

$$= \frac{C \times V \times D}{W}$$

Where:

C = sample concentration in extract (ppm)
V = Volume of extract (mL)
D = Dilution Factor
W = Weight/Volume of sample aliquot extracted (grams or mLs)

NOTE: All dry weight corrections are made in TALS at the time the final report is prepared.

11.4 Documentation and Record Management

The following documentation comprises a complete CVAA raw data package:

11.4.1 Sample data entered into the preparation batch in TALS, which includes the batch number, list of samples, preparation analyst and date, identification of reagents and standards used, and identification of all measuring equipment used (e.g., balances, thermometers, pipettes).

11.4.2 Raw data (direct instrument printout as a PDF) with the analyst name and all required calibration information.

11.4.3 Data review checklist - See SOP DV-QA-0020.

11.5 Reporting

11.5.1 Standard units for reporting solid sample results are mg/kg.

11.5.2 If dilutions are required due to insufficient sample, interferences, or other problems, the reporting limit and MDL are multiplied by the dilution factor, and the data may require flagging.

11.5.3 Solid samples are reported on a dry-weight basis unless otherwise requested by the client. Reporting limits are adjusted for both sample size and percent solids.

11.5.4 All associated data are entered or uploaded into TALS as required.

11.5.5 Unless special instructions indicate otherwise, samples less than the reporting limit are reported as ND.

11.5.6 The initial data review is performed by the analyst while the second-level data review is performed by the area supervisor or designee. Both reviews are documented on a Data Review Checklist. See SOP DV-QA-0020 for a copy of the checklist and for more detail on the review process.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. An initial method detection limit study is performed in accordance with Policy DV-QA-005P. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method or program requirements require a greater frequency. For Texas TRRP, DoD, AFCEE, and DOE projects, an MDL verification (MDLV) is performed quarterly.

12.2 Demonstration of Capabilities

All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows.

12.2.1 Four aliquots of the QC check sample are analyzed using the same procedures used to analyze samples, including sample preparation. The concentration of the QC check sample should be equivalent to a mid- level calibration.

12.2.2 Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

12.2.3 If any analyte does not meet the acceptance criteria, the test must be repeated. Only those analytes that did not meet criteria in the first test need to be evaluated. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

12.2.4 Further details concerning demonstrations of proficiency are described in SOP DV-QA-0024.

12.3 Training Requirements

The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. See requirements for demonstration of analyst proficiency in SOP DV-QA-0024.

13.0 Pollution Control

It is TestAmerica’s policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, order chemicals based on quantity needed, and prepare reagents based on anticipated usage and reagent stability).

14.0 Waste Management

All waste will be disposed of in accordance with Federal, State, and local regulations.

Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in Section 13, *Waste Management and Pollution Prevention*, of the Corporate Environmental Health and Safety Manual, and Policy DV-HS-001P, *Waste Management Program*.

14.1 The following waste streams are produced when this method is carried out:

14.1.1 Aqueous Acidic (Metals) - Corrosive - (J)

14.1.2 Expired reagents and standards – Contact the Waste Coordinator.

NOTE: Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of these materials.

15.0 References / Cross-References

15.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Final Update II, Revision I, September 1994, Method 7471A (Mercury).

15.2 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Update IV, February 2007, Method 7471B (Mercury).

15.3 Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 4.2, 10/25/2010.

15.4 Department of Defense Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013.

15.5 U.S.EPA Statement of Work for Inorganic Analysis, ILMO3.0

16.0 Method Modifications:

Item	Method	Modification
1	7471A	An additional QC analysis, RL verification, is added
2	7471A	Methods 7470A and 7471A state that working standards "should be prepared fresh daily." The laboratory frequently prepares up to three batches of mercury samples, including digested calibration standards, each day. The third batch is typically prepared and digested late in the day, and then is analyzed the morning of the next day. The laboratory had developed the following information demonstrating that analysis within 24 hours, but on the second calendar day from preparation produces reliable results and is acceptable to the EPA: • Successful proficiency testing (PT) results for samples that were prepared and analyzed within 24 hours, but on successive days • Successful analysis of true NIST mercury

Item	Method	Modification
		standards within every analytical batch; and • A written comment from the EPA MICE Hotline stating that, with the supporting lab data, their opinion was that the laboratory's practice is "within the letter of the method as written."
3	7471A	Chapter 1 of SW-846 specifies the use of reagent water with a purity equivalent of ASTM Type II water. This SOP specifies the use of a Millipore DI system or equivalent to produce reagent water. This SOP requires that reagent water must be free of the analytes of interest as demonstrated through the analysis of method blanks.
4	7471A	Chapter 1 of SW-846 states that the method blank should not contain any analyte of interest at or above the MDL. This SOP states that the method blank must not contain any analyte of interest at or above ½ the reporting limit.
5	7471B	Method 7471B uses reagent water for the method blank. TestAmerica Denver is currently using glass beads when required.
6	7471B	Section 11.1 requires 50 mL of reagent water to be added to the sample with 15 mL of Potassium permanganate. TestAmerica Denver utilizes digestion tubes which do not allow for 50 mL of reagent water. 19 mL of reagent water is currently being added.
7	7471A	Section 7.1 specifies triplicate 0.2-g portions of sample for solids analysis. TestAmerica Denver instead utilizes a 0.5-0.6 g weight range in order to avoid targeting of specific weights and to comply with the requirements of the most recent method revision.

17.0 Attachments

Attachment 1: Summary of Quality Control Requirements
Attachment 2: MSA Guidance
Attachment 3: Instrument Maintenance
Attachment 4: Troubleshooting Guide

18.0 Revision History

- Revision 7 dated 28 Feb 2015
    - Annual Technical Review
    - Removed reference to purging sample headspace from Section 4.4, outdated.
    - Section 4.6 – Removed reference to method 245.6
    - Changed MSDS to SDS
    - Removed references to "Cetac Only"
    - Added Section 7.5.3 regarding recording of data in TALS
    - Added TALS reagent IDs to standard names
    - Corrected concentrations of Cal Stds
    - Corrected Section references
    - Changed units of RL std to water units
    - Changed minimum sample volume to 10 g to accord with corporate policy

  - Added DoD V5 references
  - Changed sample aliquot to 0.5 – 0.6 g
  - Deleted references to adjust volume with 1% HNO3
  - Updated temperature of digestion to 95 ± 3 ^{o}C
  - Deleted Section 10.4.4.3 (Redundant)
  - Changed “counts” in Section 10.4.4.4 to microAbsorbance
  - Removed “Approximately” from ICV true values
  - Removed GC references from Section 10.4.9
  - Removed references to “resloping”
  - Added initial CCV/CCB pair to sequence
- Revision 6 dated 28 Feb 2014
  - Annual Technical Review
  - Removed references to Serial Dilutions and Post Digestion Spikes
  - Section 10.4 for incremental sampling was merged into Section 10.3
  - Updated Section 10.4.4.1 and 10.4.4.2 to note DOD QSM 5 criteria
  - Updated Section 10.4.7 to note DOD QSM 5 CCV criteria is 90-110.
  - Updated Attachment 2 for ICB,CCB and CCV criteria to DOD QSM 5
  - Added Attachment 5 for Troubleshooting
- Changed Revision 5 dated 15 July 2013
  - Annual Technical Review
  - Correction to formatting
  - Changed reference to Standards Log to Reagent Module in the LIMS
  - Added General Analytical Terms information to definition section
  - Edited section 7.6, 10.4.8, 12.1 & 12.2 to reflect current practices.
  - Changed RL reference in sections 7.18, 10.5.6, 10.6.8 and Attachment 2 to CRA
  - Removed bullet point 5 under 11.5
  - Removed Attachment 3 and renumbered the subsequent attachments
  - Corrected references date for section 15.2
  - Added Texas TRRP to section 12.1
- Revision 4 dated 30 September 2012
  - Clarified the language in Section 9.4 to be one LCS per batch.
  - Modified Section 7.16.2 to refer to Section 10.4.4 for additional detail.

- Revision 3.2 dated 13 July 2012
  - Updated Sections 7.6 and 7.7 to state Hg grade reagents are used
  - Updated Sections 10.4.11 to include a note about bringing samples to a final volume before the sample is mixed
  - Updated Section 10.5.4 and Attachment 2 to control calibrations blanks to ½ the RL.
  - Added Sections 10.5.3.5 to record the number of counts for the 10 ppb standard
  - Formatting and grammatical changes throughout

- Revision 3.1 dated 03 February 2012
  - Changed references of Multi-Incremental Sampling to Incremental Sampling throughout document
  - Annual Technical Review
  - Section 1.3 Added Incremental Sampling Method statement to SOP
  - Added introductory statement to section 7.0 regarding reagent purity
  - Updated section 9.5 and Attachment 2 for method blank control criteria
  - Section 10.2 Added Incremental Sampling Method preparation amount
  - Section 10.2.12 Added Incremental Sampling Method combination procedure

  - Section 10.2.13 Added Incremental Sampling Method final volume
  - Added dilution note to Section 10.3.5
  - Updated section 12.0 to reflect current laboratory practices

- Revision 3 dated 23 August 2011
  - Updated Section 5.1.1 to include using a face shield when making up aqua regia
  - Added Section 7.4 for how to make aqua regia
  - Removed previous Section 7.6 (FIMS information)
  - Updated Section 7.14 ICV daily intermediate standard level to 400ug/l
  - Updated Section 7.15 ICV daily working standard level to 4ug/l
  - Updated Section 10.2.3 ICV level to 4ug/l
  - Changed run order for ICV and ICB in section 10.3.8
  - Added a note to section 10.1.3 for the addition of the LCS/MS spike before the reagents.

- Revision 2.5, dated 25 April 2011
  - Removed all references to the FIMS Hg Analyzer
  - Sections 6.1 and 6.3 were updated to reflect the use of digestion blocks from water baths

- Revision 2.4, dated 07 February 2011
  - Updated supplies list for implementation of calibrated tube
  - Updated Section 10 for implementation of calibrated tube
  - Updated section 6 to include reference to the Master List of Documents, Software and Hardware
  - Added section 11.1 to reference corporate SOP CA-Q-S-005 “Calibration Curves”

- Revision 2.3, dated 01 September 2010
  - Annual Technical Review
  - Removed comment about Standards Log program in Section 7
  - Updated Section 11.4 for new LIMS
  - Removed Example prep sheet (Attachment 3)

- Revision 2.2, dated 07 August 2009
  - Removed Reagent Blank from Section 7.4
  - Changed table header name in section 7.12 to say 1%HNO_3 from Reagent Water
  - Changed sections 7.13 and 7.14 to use 1% HNO_3 from reagent blank

- Revision 2.1, dated 16 February 2009
  - Section 10.2.5: Update the corrective action to match the other Hg SOPs
  - Deleted Section 12.3 for IDL requirement

- Revision 2, dated 28 December 2007
  - Integration for TestAmerica and STL operations.
  - Changed aliquot size from 0.3g to 0.6g.
  - Made changes to concentration to reflect the aliquot change throughout the SOP.
  - Reformatted the SOP.

- Revision 1, dated 11 October 2005
  - The method summary has been updated to reflect the actual procedure performed.
  - The definition of aqua regia was corrected to indicate three parts HCl to one part

HNO_3.

- In section 10.4.6, changed the true value for the ICV to “approximately 2.0 µg/L,” since the value can change slightly each time the standard is prepared.
- Corrected section 10.3.11 to add verification that the permanganate color persists during the thirty minute digestion.
- Corrected 10.3.13 to reflect the laboratory’s preference for using hydroxylamine hydrochloride to reduce the excess permanganate.
- Added recipe for 1.3 % $SnCl_2$ for the PE FIMS analyzer.
- Corrected sections 7.10 and 7.11 to reflect a volumetric preparation rather than gravimetric.
- Added instructions to prepare reagent blank in section 7.5.
- Added detailed preparation information for the ICV.
- Added instructions for preparing the MB, LCS, MS, and MSD to section 10.3.3.
- Added instructions add 2.5 ml of reagent water to the MB and field samples to compensate for the volume of the spikes added to the samples and the LCS in section 0.

Attachment 1

Summary of Quality Control Requirements

QC PARAMETER	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
ICB	Immediately following ICAL	Absolute value < ½ RL (<LOD for QSM 5.0)	Terminate analysis; correct the problem; recalibrate or re-prepare and reanalyze batch.
ICV	Following ICB	90- 110% recovery	Terminate analysis; correct the problem; recalibrate or re-prepare and reanalyze batch.
RL Check Standard (CRA)	Following the ICV	50-150% recovery	Terminate analysis; correct the problem; recalibrate or re-prepare and reanalyze batch.
CCV	Every 10 samples and at the end of the run	80 - 120 % recovery. 90-110% for QSM 5.0	Terminate analysis; correct the problem; recalibrate and rerun all samples not bracketed by acceptable CCVs or re-prepare and reanalyze batch.
CCB	Immediately following each CCV	Absolute value < ½ RL (<LOD for QSM 5.0)	Terminate analysis; correct the problem; recalibrate and rerun all samples not bracketed by acceptable CCVs or re-prepare and reanalyze batch.
Method Blank	One per sample preparation batch of up to 20 samples.	Project specific or ≤ ½ RL Sample results greater than 10% the blank concentration are acceptable.	Redigest and reanalyze samples. Note exceptions under criteria section.
Laboratory Control Sample (LCS)	One per sample preparation batch of up to 20 samples.	Recovery must be within statistical control limits, not to exceed 80 - 120%	Terminate analysis; correct the problem; redigest and reanalyze all samples associated with the failed LCS.
Matrix Spike	One per sample preparation batch of up to 20 samples.	Recovery must be within statistical control limits, not to exceed 75-125%	In the absence of client specific requirements, flag the data; no flag required if the sample level is > 4x the spike added.
Matrix Spike Duplicate	See Matrix Spike	Recovery within statistical control limits, not to exceed 75-125 % recovery or in-house control limits; RPD ≤ 20%	See Corrective Action for Matrix Spike.

Attachment 2

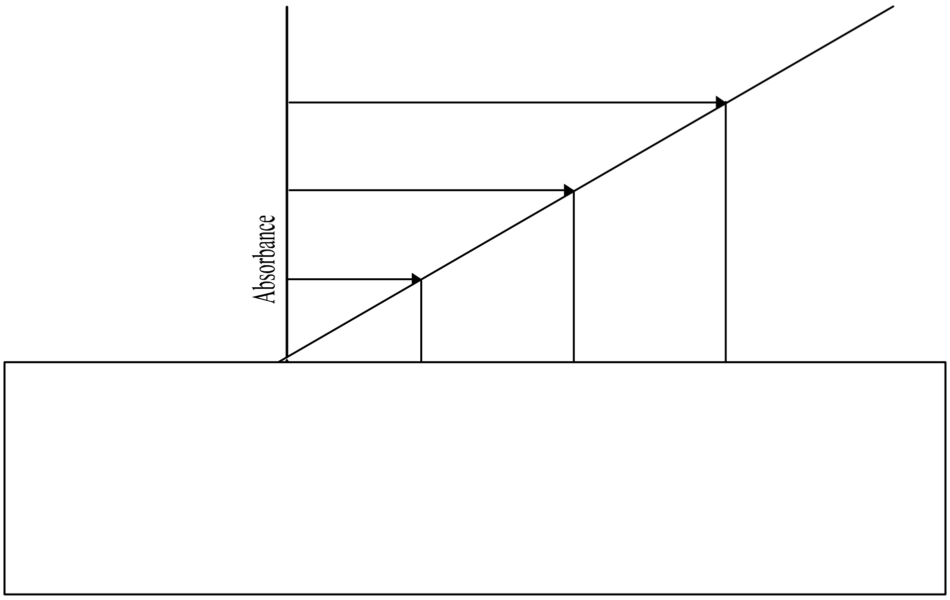
MSA Guidance

Method of Standard Addition

Four equal volume aliquots of sample are measured and known amounts of standards are added to three aliquots. The fourth aliquot is the unknown and no standard is added to it. The concentration of standard added to the first aliquot should be 50% of the expected concentration. The concentration of standard added to the second aliquot should be 100% of the expected concentration and the concentration of standard added to the third aliquot should be 150% of the expected concentration. The volume of the unspiked and spiked aliquots should be the same (i.e., the volume of the spike added should be negligible in relation to the volume of sample).

To determine the concentration of analyte in the sample, the absorbance (or response) of each solution is determined and a linear regression performed. On the vertical axis the absorbance (or response) is plotted versus the concentrations of the standards on the horizontal axis using 0 as the concentration of the unspiked aliquot. An example plot is shown in Figure 1. When the resulting line is extrapolated back to zero absorbance, the point of interception of the horizontal axis is the concentration of the unknown. Calculate the correlation coefficient (r) and the x-intercept (where y=0) of the curve. The concentration in the digestate is equal to the negative x-intercept.

Figure 1



For the method of standard additions to be correctly applied, the following limitations must be taken into consideration.

- The plot of the sample and standards must be linear over the concentration range of concern. For best results, the slope of the curve should be similar to that of a plot of the aqueous standard curve.
- The effect of the interference should not vary as the ratio of the standard added to the sample matrix changes.

Attachment 3

Instrument Maintenance

A maintenance log is used to record when maintenance is performed on instruments. When an instrument problem occurs, record the date, time and instrument number, then identify the problem and corrective action in the maintenance log. When the instrument is returned to service, record the return to service, the date, and any tests performed to verify proper operation.

The following preventative maintenance procedures are required to ensure that that the instrument is fully operational.

Cold Vapor Atomic Absorption

Daily	Monthly	Annually
Change rinse solution.	Check Hg lamp intensity.	Change Hg lamp.
Optimize light path.		Check liquid/gas separator.
Check argon flow.		
Check tubing. Replace as needed.		
Check drain.		
Check condition of dryer		

Attachment 4

Troubleshooting Guide

Problem	Possible Cause
Poor or No Absorbance or Sensitivity Check failed	Incorrect wavelength Dirty windows Window loose Etched or dirty optics Bad lamp Not enough or no sample introduced Empty sample cup Incorrectly made standards Gas leak
Erratic Readings	Source lamp not aligned properly Lamp not pre-warmed Injection tip partially clogged Contaminated reagents Contaminated glassware Drying tube saturated Bad lamp Injection tip hitting outside of tube Injection tip coated or not set properly Leak in sample tubing Power fluctuations Air bubbles in tubing
Standards reading twice or half normal absorbance or concentration	Incorrect standard used Incorrect dilution performed Dirty cell

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THE LEADER IN ENVIRONMENTAL TESTING

Title: Mercury in Water by Cold Vapor Atomic Absorption (CVAA) [SW 7470A]

Approvals (Signature/Date):

Doug Gomer 8/10/15
Doug Gomer Date
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Adam W Alban 11 Aug 15
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Margaret S. Sleevi Date
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Facility Distribution No. ________ **Distributed To:** ________________

1.0 Scope and Application

1.1 This procedure describes the preparation and analysis of mercury (Hg, CAS # 7439-97-6) by Cold Vapor Atomic Absorption Spectroscopy (CVAA) using SW-846 Method 7470A.

1.2 Method 7470 is applicable to the preparation and analysis of mercury in ground water, aqueous samples, wastes, wipes, TCLP, EP and other leachates/extracts.

1.3 All matrices require sample preparation prior to analysis.

1.4 The final reporting limit is 0.0002 mg/L (0.2 μg/L), except for TCLP leachates that have a 0.002 mg/L (2 μg/L) reporting limit.

2.0 Summary of Method

This SOP describes a technique for the determination of mercury in solution. The procedure is a physical method based on the absorption of radiation at 253.7 nm by mercury vapor. A representative portion of the sample is digested in sulfuric and nitric acids. Organic mercury compounds are oxidized with potassium permanganate and potassium persulfate and the mercury reduced to its elemental state with stannous chloride and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance is measured as a function of mercury concentration. Concentration of the analyte in the sample is determined by comparison of the sample absorbance to the calibration curve (absorbance vs. concentration). All sample data are uploaded to the TestAmerica LIMS (TALS).

3.0 Definitions

3.1 Dissolved Metals: Those elements that pass through a 0.45-μm membrane. (Sample is acidified after filtration).

3.2 Total Metals: The concentration determined on an unfiltered sample following digestion.

3.3 Refer to the Glossary of the TestAmerica Denver Quality Assurance Manual (QAM) and Policy DV-QA-003P, *Quality Assurance Program*, for definitions of general analytical and QA/QC terms.

4.0 Interferences

4.1 Chemical and physical interferences may be encountered when analyzing samples using this method.

4.2 Potassium permanganate, which is used to breakdown organic mercury compounds, also eliminates possible interferences from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of inorganic mercury from reagent water.

4.3 Copper also has been reported to interfere; however, copper concentrations as high as 10 mg/L had no effect on the recovery of mercury from spiked samples.

4.4 Chlorides can cause a positive interference. Seawaters, brines, and industrial effluents high in chlorides will require dilution. During the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation at 253.7 nm. Care must be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. Both inorganic and organic mercury spikes have been quantitatively recovered from seawater using this technique.

4.5 Interference from certain volatile organic materials that absorb at the wavelength used for the method may also occur. If suspected, a preliminary run without stannous chloride can determine if this type of interference is present. While the possibility of absorption from certain organic substances present in the sample does exist, this problem is not routinely encountered. This is mentioned only to caution the analyst of the possibility. If this condition is found to exist, the mercury concentration in the sample can be determined by subtracting the result of the sample run without the reducing reagent (stannous chloride) from that obtained with the reducing reagent.

4.6 Samples containing high concentrations of oxidizable organic materials, as evidenced by high COD levels, may not be completely oxidized by this procedure. When this occurs, the recovery of mercury will be low. The problem can be eliminated by reducing the volume of original sample used.

4.7 The most common interference is laboratory contamination, which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual, Radiation Safety Manual and this document.

5.2 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, nitrile or latex gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.3 Specific Safety Concerns or Requirements

5.3.1 Samples that contain high concentrations of carbonates or organic material or samples that are at elevated pH can react violently when acids are added.

5.3.2 Eye protection that satisfies ANSI Z87.1, laboratory coat, and nitrile or latex gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated must be removed and discarded; non-disposable gloves must be cleaned immediately.

5.3.3 Potassium permanganate is a strong oxidizing agent. It is incompatible with and must be stored separately from hydroxylamine hydrochloride and stannous chloride, the reducing agents used in this procedure, and from acids.

5.4 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 (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Mercury (1,000 ppm in Reagent)	Oxidizer Corrosive Poison	0.1 mg/m^3 Ceiling (Mercury Compounds)	Extremely toxic. Causes irritation to the respiratory tract. Causes irritation. Symptoms include redness and pain. May cause burns. May cause sensitization. Can be absorbed through the skin with symptoms to parallel ingestion. May affect the central nervous system. Causes irritation and burns to eyes. Symptoms include redness, pain, and blurred vision; may cause serious and permanent eye damage.
Sulfuric Acid	Corrosive Oxidizer Dehydrator Poison Carcinogen	1 mg/m^3-TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Hydrochloric Acid	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Potassium Permanganate	Oxidizer	5 mg/m^3 for Mn Compounds	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Dry crystals and concentrated solutions are caustic causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin. Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, and blurred vision and can cause severe damage, possibly permanent.

Potassium Persulfate	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.
1 – Always add acid to water to prevent violent reactions. 2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Instrumentation

6.1.1 Digestion Block, with adjustable heating, capable of maintaining a sample temperature of 90-95°C.

6.1.2 Mercury Auto-analyzers: The laboratory currently uses two CETAC QuickTrace^{TM} Mercury Analyzer M-7500s with Autosamplers and Auto-Diluters.

6.2 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on R:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

6.3 Supplies

6.3.1 Disposable 50 mL digestion tubes with caps. Accuracy at 30 mL verified to ±3% gravimetrically prior to use (by lot). See DV-QA-0008 for more information regarding volume verifications.

6.3.2 Disposable glass test tubes, 16 mm x 100 mm

6.3.3 Argon, 99.999% purity

6.3.4 Calibrated automatic pipettes or Class A glass volumetric pipettes (see SOP DV-QA-0008 for details on calibrating mechanical pipettes).

6.3.5 Class A volumetric flasks.

6.3.6 Thermometer, non-mercury column, accurate to ±1 °C at 95 °C (see SOP DV-QA-0001 for calibration details).

7.0 Reagents and Standards

Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. Suggested reagent and standard recipes are listed below. Alternate weights and volumes may be used as long as the final concentrations are maintained as listed and the details are recorded in the Reagent module in TALS. All standard concentrations listed below refer to the on-instrument concentration except where otherwise noted.

7.1 **Reagent water:** Must be produced by a Millipore DI system or equivalent. Reagent water must be free of the analytes of interest as demonstrated through the analysis of method blanks.

7.2 **Nitric acid (HNO_3):** concentrated, trace metal grade or better.

7.3 **Hydrochloric acid (HCl):** concentrated, trace metal grade or better.

7.4 **Sulfuric acid (H_2SO_4):** concentrated, trace metal grade or better.

7.5 **Reagent Blank:** This blank solution is used as the Calibration Blank (STD0), Initial Calibration Blank (ICB), Continuing Calibration Blank (CCB), and as the starting solution for the Method Blanks (MBs). It is made as follows:

Add 0.5 L of concentrated HNO_3 to a 50-liter carboy partially filled with reagent water. Dilute to 50 L with reagent water. Mix carefully. Record the acid lot numbers and other required information in the Blank Reagent Logbook stored in the metals prep area.

7.6 **Stannous Chloride Solution, Hg grade, 10% (w/v) per manufacturer's (CETAC) instructions**

7.6.1 Place approximately 1000 g of deionized water in a tared 2-L HDPE jar on a top-loading balance.

7.6.2 Add 200 g of $SnCl_2$ to the flask.

7.6.3 Add deionized water until the total weight is 2000 g.

7.6.4 Place the jar in a fume hood and slowly add 200 mL of concentrated HCl to the flask and swirl to mix.

7.6.5 Close the jar and agitate until the reagent is dissolved.

7.7 **Sodium chloride-hydroxylamine hydrochloride solution (Hg grade):**

7.7.1 Place approximately 1000 g of deionized water in a tared 2-L HDPE jar on a top-loading balance.

7.7.2 Add 240 g of NaCl and 240 g of hydroxylamine hydrochloride (Hg grade) to the jar.

7.7.3 Add deionized water until the total weight is 2480 g.

7.7.4 Close the jar and agitate until the reagent is dissolved.

NOTE: Hydroxylamine sulfate may be used in place of hydroxylamine hydrochloride.

7.8 Potassium permanganate ($KMnO_4$), 5% solution (w/v):

7.8.1 Place approximately 1000 g of deionized water in a tared 2-L HDPE jar on a top-loading balance.

7.8.2 Add 100 g of $KMnO_4$ (Hg grade) to the jar.

7.8.3 Add deionized water until the total weight is 2100 g.

7.8.4 Close the jar and agitate until the reagent is dissolved.

7.9 Potassium persulfate ($K_2S_2O_8$), 5% solution (w/v):

7.9.1 Place approximately 1000 g of deionized water in a tared 2-L HDPE jar on a top-loading balance.

7.9.2 Add 100 g of $K_2S_2O_8$ (Hg grade) to the jar.

7.9.3 Add deionized water until the total weight is 2100 g.

7.9.4 Close the jar and agitate until the reagent is dissolved.

7.10 Purchased Mercury Stock Solutions

7.10.1 Primary Mercury Calibration Standard Solution (Hg Ultra Prim), 1,000 mg/L

7.10.2 Second-source Mercury Standard (Hg ICV Stock), 100 mg/L. This standard is obtained from a different vendor than the Primary Mercury Calibration Standard.

7.11 Calibration Working Standard Solution (Hg Month Spike), 10 mg/L.

7.11.1 Add approximately 90 mL of 1% HNO_3 to a 100 mL Class A volumetric flask.

7.11.2 Pipet 1.00 mL of the 1000 mg/L primary mercury calibration standard solution (see Section 7.10.1) into the flask.

7.11.3 Dilute to the mark on the flask with Reagent Blank.

7.11.4 Stopper the flask and shake to mix.

7.11.5 Transfer the solution to a 125 mL Nalgene bottle.

7.11.6 Document the preparation of the solution in the Reagent Module in TALS.

7.11.7 Prepare this solution fresh monthly or more often if necessary.

7.12 Daily Calibration Working Solution (Hg Daily Spk), 100 µg/L

7.12.1 Add approximately 90 mL of 1% HNO_3 to a 100 mL Class A volumetric flask.

7.12.2 Pipet 1.00 mL of the 10 mg/L Calibration Working Standard solution (see Section 7.11) into the flask.

7.12.3 Dilute to the mark on the flask with the Reagent Blank solution (final volume of 100.0 mL).

7.12.4 Stopper the flask and shake to mix.

7.12.5 Transfer the solution to a 125 mL Nalgene bottle.

7.12.6 Document the preparation of the solution in the Reagent Module in TALS.

7.13 Daily Initial Calibration (ICAL) Standards.

7.13.1 To each of seven 50 mL digestion tubes, add approximately 30 mL of the Reagent Blank solution.

7.13.2 For each calibration level, add the appropriate amount of Daily Calibration Working Solution to the tube as indicated in the following table. The final concentration for each calibration level is listed in the following table:

Daily ICAL Standards

Calibration Level	Volume of Daily Calibration Working Solution (100 µg/L) Added (mL)	Final Hg Concentration (µg/L)
1 (Hg STD1 0.1)	0.03	0.06
2 (Hg STD2 0.2)	0.06	0.12
3 (Hg STD3 0.5)	0.15	0.3
4 (Hg STD4 1.0)	0.3	0.6
5 (Hg STD5 2.0)	0.6	1.2
6 (Hg STD6 5.0)	1.5	3.0
7 (Hg STD7 10.0)	3.0	6.0

7.13.3 Close each tube and swirl to mix.

7.13.4 Prepare the calibration standards as samples.

7.13.5 Document the preparation of the solutions in the Reagent Module in TALS.

7.13.6 Prepare the calibration solutions each day prior to calibration.

7.13.7 The calibration blank is titled STD0 in TALS.

7.14 Continuing Calibration Verification Standard (Hg H20 CCV), 3.0 µg/L.

7.14.1 The CCV is prepared exactly as the 3.0 µg/L calibration standard, and from the same source. Refer to Section 7.13.

7.14.2 Prepare sufficient volume of the standard for analysis of a CCV after every 10 samples.

7.15 Second-Source Initial Calibration Verification Intermediate Standard (Hg Biwk ICV), 400 µg/L.

Add 0.4 mL of the 100 mg/L ICV stock standard (see Section 7.10.2) to a 100 mL volumetric flask partially filled with the Reagent Blank solution and dilute to the mark. Record this information in the Reagent Module in TALS.

7.16 Second-Source Initial Calibration Verification Daily Working Standard (Hg H20 ICV), 2.4 µg /L.

Add 0.3 mL of the 400 µg/L ICV intermediate standard (see Section 7.15) to a 50 mL digestion tube filled with 30 mL of Reagent Blank. Prepare as a sample. Record this information in the Reagent Module in TALS.

7.17 Laboratory Control Sample (LCS), 3 µg/L

The LCS is prepared by adding 1.5 mL of the 100 µg/L Daily Calibration Working Standard (Section 7.12) to 30 mL of Reagent Blank in a digestion tube. The LCS goes through the same digestion process as the samples.

7.18 Matrix Spike and Matrix Spike Duplicate (MS/MSD), 3 µg/L

7.18.1 The MS is prepared by adding 1.5 mL of the 100 µg/L Daily Calibration Working Solution (Section 7.12) to a digestion tube containing a second 30-mL aliquot of the selected sample.

7.18.2 The MSD is prepared in the same manner as the MS using a third aliquot of the selected sample.

7.18.3 The MS and MSD go through the same digestion process as the samples.

7.19 Reporting Limit (CRA) Check Standard (Hg H20 RL), 0.12 µg/L

The 0.12 µg/L calibration standard is analyzed as a sample to verify the reporting limit. Denoted as CRA in the run sequence.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Water	HDPE	50 mL	HNO_3, pH < 2	28 Days	40 CFR Part 136.3

[1] Inclusive of digestion and analysis.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the TALS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver Policy DV-QA-003P, *Quality Control Program*.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver Policy DV-QA-024P, *QA/QC Requirements for Federal Programs*. See Table 1 for a summary of these requirements. This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated. Any deviations or exceptions from QSM 5.0 requirements must have prior approval in the project requirements.

9.1.3 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 Method Comments in TALS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Sample QC

9.2.1 Preparation Batch

A group of up to 20 samples that are of the same matrix and are processed together using the same procedures and reagents. The preparation batch must contain a method blank (MB), a laboratory control sample (LCS), and a matrix spike/matrix spike duplicate (MS/MSD) pair. As discussed in the following sections, special program or project requirements can include additional requirements. Always refer to special project instructions for details before proceeding with the analysis.

9.2.2 Method Blank (MB)

The method blank consists of Reagent Blank containing all reagents specific to the method that is carried through the entire analytical procedure, including preparation and analysis. At least one method blank must be processed with each preparation batch.

Acceptance Criteria: The result for the method blank must be less than the project-specific data quality objectives. In the absence of project-specific data quality objectives, the blank must be less than ½ the reporting limit or less than 10% of the mercury concentration found in the associated samples, whichever is higher***.***

For DoD V5 the method blank is controlled to < ½ LOQ or 10% of the amount measured in any sample or 10% of the regulatory limit, whichever is greater.

Corrective Action: All samples associated with an unacceptable method blank must be re-prepared and reanalyzed. If mercury was not detected in the samples, the data may be reported with qualifiers (check project requirements to be sure this is allowed) and it must be addressed in the project narrative.

9.2.3 Laboratory Control Sample (LCS)

The LCS is a blank to which a known concentration of the target analyte has been added. At least one aqueous LCS must be processed with each preparation batch. The LCS must be carried through the entire analytical procedure.

Acceptance Criteria: Maximum control limits for LCS recoveries for Method 7470A are 80-120%. In-house control limits based on three standard deviations of the mean of past results are used as long as they are at least as tight as the limits in the methods (see TestAmerica Denver Policy DV-QA-003P for further details on establishing control limits).

For DoD V5 the QSM Appendix C limits are required.

Corrective Action: If LCS recoveries are outside established control limits, the system is out of control and corrective action must occur. If recoveries are above the upper control limit and mercury is not detected in samples, the data may be reported with qualifiers (check project requirements to be sure this is allowed) and it must be addressed in the project narrative. In other circumstances, the entire batch must be re-prepared and reanalyzed.

9.2.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

A matrix spike (MS) is a second aliquot of a selected field sample to which known concentrations of target analytes have been added. A matrix spike duplicate (MSD) is a third aliquot of the same sample (spiked exactly as the MS) prepared and analyzed along with the sample and matrix spike. One MS/MSD pair must be processed for each preparation batch. Some programs may require the use of sample duplicates in place of or in addition to MS/MSDs. In addition, some programs will allow spikes to be reported for project-related samples only. Spiking levels are provided in Attachment 1. When the MS/MSD concentration is above the linear range; the MS/MSD and parent sample **MUST** be re-analyzed at a dilution.

Acceptance Criteria: Control limits are statistically determined based on three standard deviations of the mean of the laboratory's historical data. The recoveries for the MS and MSD must fall within 75-125%. The relative percent difference between the MS and MSD cannot exceed 20%.

For DoD V5 the QSM appendix C limits are required

Corrective Action: MS and MSD data are sample/matrix specific and are not normally used to determine the validity of the entire batch. If analyte recoveries or the RPD between duplicates fall outside the acceptance range, the LCS recovery must be in control for the data to be reported. If there is no evidence of analytical problems and all other QC criteria are met, then qualified results may be reported and the situation must be described in the final report case narrative. If laboratory error is suspected, the batch must be re-prepared and reanalyzed. The following corrective actions are required for MS/MSD recovery failures to rule out lab error:

- Check calculation and instrument performance;
- Verify, if possible, that the MS and MSD were spiked correctly;

- Consider objective evidence of matrix interference (e.g., heterogeneous sample or interference demonstrated by prior analyses);

- Flag the data for any results outside of acceptance limits and note it on the final report.

- For any single RPD failure, check calculations; verify, if possible, that the MS and MSD were spiked correctly; check instrument performance; consider objective evidence of matrix interference or sample inhomogeneity; and flag the data.

- When the MS/MSD concentration is above the linear range; the MS/MSD and parent sample **MUST** be re-analyzed at a dilution.

NOTE: Some client programs require reanalysis to confirm matrix interferences. Check special project requirements for this corrective action.

If the native analyte concentration in the MS/MSD sample exceeds 4 times the spike level for that analyte, the recovery data are reported as NC (i.e., not calculated).

For DoD V5 if the MS, MSD or RPD are outside of the control limits the parent sample is flagged “J”. For all DoD projects a serial dilution and post digestion spike (PDS) are required if the MS or MSD fail.

9.2.5 Serial Dilution

Some programs require that a fivefold (1+4) dilution must be included in each analytical batch for each sample matrix.

Acceptance Criteria: The results must be within 10% of the expected value, assuming that the initial sample concentration is at least 25x the MDL concentration (or 50x the LOQ for DoD).

Corrective Action: If the control limit is not met, all associated sample results must be qualified and the failure addressed in the narrative.

9.2.6 Post-Digestion Spike

Some programs require the inclusion of a post-digestion spike in each analytical batch. The post-digestion spike is prepared by adding 0.3 mL of the 100 μg/L Daily Calibration Working Solution to 10 mL of sample digestate. Post-digestion spikes are performed as an additional check for matrix interference.

Acceptance Criteria: The percent recovery limits for the post-digestion spike are 80 to 120%.

Corrective Action: If the acceptance criteria are not met, all associated sample results must be qualified.

9.2.7 Method of Standard Addition (MSA)

The method of standard additions is an option for the analysis of samples shown to have significant matrix effects, e.g., unacceptably low MS/MSD recoveries or under certain conditions for TCLP analysis (see Attachment 3)

9.3 Instrument QC

9.3.1 Initial Calibration (ICAL)

9.3.1.1 Detailed information regarding calibration models and calculations can be found in Corporate Policy CA-Q-P-003, *Calibration Curves & Selection of Calibration Points*.

9.3.1.2 Calibration must be performed daily (every 24 hours) and each time the instrument is set up. All calibration standards and calibration QC samples will be recorded in prep batches and prepared as samples. The instrument calibration date and time must be included in the raw data.

9.3.1.3 Calibrate using seven standards and a blank. The concentration levels are listed in Attachment 1.

NOTE: It is generally not acceptable to reject calibration points for this method.

9.3.1.4 The calibration curve must have a correlation coefficient of ≥ 0.995 for an unweighted linear regression or the instrument shall be stopped and recalibrated prior to running samples. Sample results cannot be reported from a curve with an unacceptable correlation coefficient.

9.3.1.5 Record the microabsorbance for the 10 ppb standard in the instrument maintenance logbook.

9.3.2 Initial and Continuing Calibration Blank (ICB/CCB)

9.3.2.1 An initial calibration blank is tested immediately after the daily ICAL standards.

Acceptance Criteria: Absolute values for the calibration blanks must be less than ½ the standard RL. Client specific requirements take precedence. For example, DoD QSM 5 requires control of blanks to a concentration less than or equal to the LOD.

Corrective Action: If the blank acceptance limit is exceeded, the analysis should be terminated, the source of contamination identified, and the instrument recalibrated.

9.3.2.2 Continuing calibration blanks are run after every 10 samples and at the end of the run.

Acceptance Criteria: The absolute value of the blank result must be less than ½ the reporting limit. Some programs require that blanks be less than 2x the MDL or less than the LOD (refer to special project requirements).

Corrective Action: If the blank acceptance limit is exceeded, the analysis should be terminated, the source of contamination identified, and the instrument recalibrated.

9.3.3 Initial Calibration Verification (ICV), 2.4 μg/L

The accuracy of the calibration standards is verified by testing a second source standard (ICV).

Acceptance Criteria: The ICV result must be within 10% of the true value.

Corrective Action: If the ICV acceptance limit is exceeded, the analysis should be terminated, the accuracy of the calibration standards checked, and the instrument recalibrated.

9.3.4 Reporting Limit Check Standard (CRA), 0.12 μg/L

The accuracy of results at the reporting limit is verified by testing a standard in every analytical run that is prepared at the reporting limit concentration.

Acceptance Criteria: The results for this standard must be within 50% of the expected value

Corrective Action:	If the RL check acceptance limit is exceeded, the analysis should be terminated, the instrument operation checked, and the instrument recalibrated.

9.3.5 Continuing Calibration Verification (CCV), 3.0 μg/L

Calibration accuracy is monitored throughout the analytical run through the analysis of a known standard after every 10 samples and at the end of the run. The CCV must be a mid-range standard at a concentration other than that of the ICV.

Acceptance Criteria:	The CCV result must fall within 20% of the true value. For DoD V5 the CCV result must be within 10%.
Correction Action:	Sample results may be reported only when bracketed by valid CCV pairs. If a mid-run CCV fails, the CCV may be re-analyzed once without modification to the instrument‘s operating conditions. If the re-analyzed CCV is found to be in control, the CCV analysis must be repeated with successful results or the analysis must be terminated, the problem corrected, the instrument recalibrated, the calibration verified and the affected samples reanalyzed. If the cause of the CCV failure was not directly instrument related, the associated samples must be re-prepared and reanalyzed.

9.3.6 Linear Range

TAL Denver does not report values greater than the highest standard (10 µg/L) used for calibration. Any sample concentration greater than 90% of the highest standard will be diluted. The calibration curve is validated by running 3 check standards, 0.12 µg/L (CRA) , 3 ug/L (CCV), and 2.4 µg/L (ICV), during the analytical run. No further linear range study is warranted.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 Sample Preparation

10.3.1 All calibration and calibration verification standards (ICV, ICB, CCV, CCB), as well as the field samples, are processed through the digestion procedure.

10.3.2 Transfer 30.0 mL of well mixed sample to a clean sample digestion tube. The calibration standards may be prepared in duplicate to ensure sufficient volume to complete the analytical sequence. Additional aliquots of CCV and CCB solution may have to be prepared for larger sample runs to ensure that CCV and CCB samples bracket every 10 samples in the analytical sequence.

10.3.3 Prepare an MB, LCS, MS, and MSD for each batch.

10.3.3.1 The MB consists of 30.0 mL of Reagent Blank.

10.3.3.2 The LCS is prepared by adding 1.5 mL of the 100 μg/L Daily Calibration Working Solution to 30 mL of Reagent Blank in a digestion tube.

10.3.3.3 The MS is prepared by adding 1.5 mL of the 100 μg/L Daily Calibration Working Solution to a digestion tube containing a second 30-mL aliquot of the selected sample.

10.3.3.4 The MSD is prepared in the same manner as the MS using a third aliquot of the selected sample.

10.3.4 Add 1.5 mL of concentrated H_2SO_4 and 0.75 mL of concentrated HNO_3 to the samples in the digestion tubes, mixing after each addition.

10.3.5 Add 4.5 mL of 5% potassium permanganate solution to each sample. For samples high in organic materials or chlorides, dilute the sample until the purple color persists for at least 15 minutes.

10.3.6 Add 2.4 mL of potassium persulfate solution, cap the vial, and heat for two hours at 90 - 95°C. Record the start and stop times and the initial and final temperatures on the bench sheet. Verify that a purple color persists or a black precipitate is present after the two hours of heating. If this is not true, repeat the digestion using a smaller aliquot of sample.

10.3.7 Allow the samples and standards to cool at room temperature.

10.4 Calibration

10.4.1 All calibration standards are digested together with samples, as described in Section 10.3, prior to analysis.

10.4.2 Set up the instrument with the operating parameters recommended by the manufacturer. Allow the instrument to become thermally stable before beginning calibration by starting the gas, lamp, heater, and sample pump (approximately 30 minutes of warm-up is required).

10.4.3 The mercury analyzer method uses external standard calibration. Use of an internal standard for this method is not appropriate.

10.5 Sample Analysis

NOTE: Because of differences between various makes and models of CVAA instrumentation, detailed push-button operating instructions are not provided here. Refer to the specific instrument-operating manual for detailed autosampler setup and operation protocols.

NOTE: The injection of samples and the addition of stannous chloride are done automatically by the instrument. Refer to the specific instrument manual for details.

10.5.1 When ready to begin analysis, add 1.8 mL of sodium chloride-hydroxylamine hydrochloride solution to the samples to reduce the excess permanganate (the permanganate has been reduced when no purple color remains).

10.5.2 Add additional Reagent Blank to the samples, QC samples and calibration standards to bring the final volume of each sample to 50 mL.

10.5.3 Aliquot each sample and calibration standard into a disposable test tube for analysis.

10.5.4 All measurements must fall within the defined calibration range to be valid. Dilute and reanalyze all samples that are within 10% of the highest calibration standard.

NOTE: The instrument can auto-dilute samples. Any sample that requires greater than a 10x dilution MUST be diluted manually.

10.5.5 If the sample results are negative and the absolute value is greater than the reporting limit, the sample must be diluted and reanalyzed.

10.5.6 The samples must be allowed to cool to room temperature prior to analysis or a decrease in the response signal can occur.

10.5.7 Baseline correction is acceptable as long as it is performed after every sample or after the CCV and CCB.

10.5.8 The following analytical sequence must be used for Method 7470A. Refer to Quality Control Section 9.0 and Attachment 2 for quality control criteria to apply to Method 7470A.

Instrument Calibration

ICV
ICB
CRA
Maximum of 10 samples
CCV
CCB
Repeat sequence of 10 samples between CCV/CCB pairs as required to complete the run.
CCV
CCB

NOTE: Samples included in the count between CCVs include the method blank, LCS, MS, MSD, and field samples.

10.5.9 For TCLP samples, full four-point MSA will be required if all of the following conditions are met:

- Recovery of the analyte in the matrix spike is <50%;
- The concentration of the analyte does not exceed the regulatory level; and
- The concentration of the analyte is within 20% of the regulatory level.
- The reporting and matrix spike levels for TCLP analyses are detailed in Attachment 1. Attachment 3 provides guidance on performing MSA analyses. For TCLP mercury determinations, MSA spikes must be added prior to sample preparation.

10.5.10 To facilitate the early identification of QC failures and samples requiring rerun, it is strongly recommended that sample data be reviewed periodically throughout the run.

10.5.11 See Attachment 5 for guidelines for minimizing contamination of samples and standards. See Attachments 4 and 6 for guidance on troubleshooting and preventive maintenance.

11.0 Calculations / Data Reduction

11.1 Detailed calibration equations can be found in the corporate Policy CA-Q-P-003, *Calibration Curves & Selection of Calibration Points* and under the public folder, *Arizona Calibration Training*.

11.2 Accuracy

$$\textbf{ICV / CCV, LCS \% Recovery} = \frac{\text{observed concentration}}{\text{known concentration}} \times 100$$

$$\textbf{MS \% Recovery} = \frac{\text{(spiked sample) - (unspiked sample)}}{\text{spike concentration}} \times 100$$

11.3 Precision (RPD)

$$\textbf{Matrix Duplicate (MD)} = \frac{|\text{orig. sample value - dup. sample value}|}{[(\text{orig. sample value + dup. sample value})/2]} \times 100$$

11.4 Concentration = $\text{Hg concentration } (\mu g/L) = \frac{C \times V_1 \times D}{V_2}$

Where:

C = Concentration (μg/L) from instrument readout
D = Instrument dilution factor
V_1 = Final volume in liters after sample preparation
V_2 = Initial volume of sample digested in liters

11.5 Appropriate factors must be applied to sample values if dilutions are performed.

11.6 Sample results should be reported with up to three significant figures in accordance with the TestAmerica significant figure policy (DV-QA-004P).

11.7 Documentation and Record Management

11.7.1 All sample data is uploaded to TALS. All sample preparation and analytical batch information, including the batch number(s), list of samples, preparation analyst and date, instrument analyst and date, identification of reagents and standards used, and identification of all measuring equipment used (e.g., balances, thermometers, pipettes) is recorded in TALS.

11.7.2 Raw data is scanned or saved directly as a PDF and is attached to the analytical batch in TALS.

11.7.3 The initial data review is performed by the analyst and a second-level review is performed by the area supervisor or designee. Both reviews are documented on a Data Review Checklist. See SOP DV-QA-0020 for more detail on the review process.

11.7.4 If dilutions are required due to insufficient sample, interferences, or other problems, the reporting limit and MDL are multiplied by the dilution factor and the data may require flagging.

NOTE: Unless special instructions indicate otherwise, sample results less than the reporting limit are reported as ND.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. An initial method detection limit study is performed in accordance with Policy DV-QA-005P. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method or program requirements require a greater frequency. For Texas TRRP, DoD, AFCEE, and DOE projects, an MDL verification is performed quarterly. DoD V5 requires the MDLV to be spiked at 2 - 4x the MDL.

12.2 Demonstration of Capabilities

All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows.

12.2.1 Four LCSs are analyzed using the same procedures used to analyze samples, including sample preparation.

12.2.2 Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

12.2.3 If any analyte does not meet the acceptance criteria, the test must be repeated. Only those analytes that did not meet criteria in the first test need to be evaluated. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

12.2.4 Further details concerning demonstrations of proficiency are described in SOP DV-QA-0024.

12.3 Training Requirements

The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. See requirements for demonstration of analyst proficiency in SOP DV-QA-0024.

13.0 Pollution Control

It is TestAmerica’s policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, order chemicals based on quantity needed, and prepare reagents based on anticipated usage and reagent stability).

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in Section 13, *Waste Management and*

Pollution Prevention, of the Corporate Environmental Health and Safety Manual, and DV-HS-001P, *Waste Management Program*.

14.2 The following waste streams are produced when this method is carried out:

14.2.1 Aqueous Acidic (Metals) - Corrosive - Waste Stream J

14.2.2 Expired reagents and standards – Contact the Waste Coordinator.

NOTE: Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Waste Coordinator for proper management of these materials.

15.0 References / Cross-References

15.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Final Update II, Revision I, September 1994, Method 7470A (Mercury).

15.2 Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 4.2, 10/25/2010.

15.3 U.S.EPA Statement of Work for Inorganics Analysis, ILMO3.0.

15.4 Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 5.0, 7/2013

16.0 Method Modifications:

Item	Method	Modification
1	EPA 7470A	Chapter 1 of SW846 specifies the use of reagent water with a purity equivalent to ASTM Type II water. This SOP specifies the use of a Millipore DI system or equivalent to produce reagent water. This SOP requires that reagent water must be free of the analytes of interest as demonstrated through the analysis of method blanks.
2	EPA 7470A	This SOP allows for the use of reduced sample volumes to decrease waste generation. Reagent levels are adjusted to maintain the same ratios as stated in the source methods. According to a letter from Robert Booth of EPA EMSL-Cinn to David Payne of EPA Region V, “Reduction in sample size and appropriate corresponding reduction in sample volume is not considered a significant change in the methodology.”
3	EPA 7470A	Methods 7470A and 7471A state that working mercury standards “should be prepared fresh daily.” The laboratory frequently prepares up to three batches of mercury samples, including digested calibration standards, each day. The third batch is typically prepared and digested late in the day, and then is analyzed the morning of the next day. The laboratory has developed the following information demonstrating that analysis within 24 hours, but on the second calendar day from preparation produces reliable results and is acceptable to the EPA: • Successful proficiency testing PT results for samples that were

Item	Method	Modification
		prepared and analyzed within 24 hours, but on successive days (e.g., ERA WP-66); • Successful analysis of true NIST mercury standards within every analytical batch; and • A written comment from the EPA MICE Hotline stating that, with the supporting lab data, their opinion was that the laboratory's practice is "within the letter of the method as written."
4	EPA 7470A	Chapter 1 of SW-846 states that the method blank should not contain any analyte of interest at or above the MDL. This SOP states that the method blank must not contain any analyte of interest at or above ½ the reporting limit.

17.0 Attachments

Attachment 1: Mercury Reporting Limits, Calibration Levels, QC Standard and Spiking Levels
Attachment 2: Summary of Quality Control Requirements
Attachment 3: MSA Guidance
Attachment 4: Troubleshooting Guide
Attachment 5: Contamination Control Guidelines
Attachment 6: Preventative Maintenance
Table 1: DOD QSM 5.0 QC Criteria for CVAA/Mercury

18.0 Revision History

- Revision 4 dated July 31, 2015
  - Annual review
  - Added 0.1 standard to Section 7.13.2
  - Updated MB control limit to ½ LOQ for DoD
  - Removed 20% DoD control for CRI from Section 9.3.4
  - Added DoD V5 spiking requirement for MDLV to Section 12.1
  - Updated Section 12.2 DOC to use LCS's
  - Added 0.1 standard to Attachment 1
  - Added TALS reference to Section 2.0
  - Added instructions to Section 7.5 regarding making reagent blank
  - Added TALS reagent IDs
  - Change LIMS to TALS throughout
  - Added Linear range section 9.3.6
  - Corrected Section 11.7 to match current practice
  - Removed figures one and two
  - Revised reagent Sections 7.6-7.9 to match current practice
  - Changed Sections 7.13-7.19 to reflect new procedure
  - Updated procedures in Section 10 to better meet traceability requirements

- Revision 3 dated July 31, 2014
  - Annual review
  - Added DoD V5 requirements to Sections 9.2.2, 9.2,3, 9.2.4, 9.3.2.1 and 9.3.5.
  - Added table 1 - DOD QSM 5.0 QC Criteria for CVAA/Mercury

- Revision 2 dated July 15, 2013
    - Annual review
    - Changes section 7.6 and 12 to reflect current practices
    - Remove reference to Standards Log to Reagent Module in the LIMS in section 7.11.6, 7.12.6, 7.13.4, 7.15 & 7.16.
    - Changed “RL” to “CRA” in sections 7.19, 9.3.4, 10.5.8
    - Added CRA (RL Standard) to Attachment 2
    - Removed Attachment 3 and re-number subsequent attachments
    - Clarified first bullet point under 10.5.9
    - Corrected references date for section 15.2
    - Added Texas TRRP to section 12.1

- Revision 1.2 dated July 13, 2012
    - Updated Sections 7.6 and 7.7 to state Hg reagents are used
    - Updated Sections 9.3.2.1 and 9.3.2.2 to control calibration blanks to ½ RL
    - Added Section 9.3.1.5 to record the counts for the 10 ppb high standard
    - Updated Sections 10.5.2 to bring samples to a final volume of 45 mL with 1% HNO_3
    - Formatting and grammatical changes

- Revision 1.1 dated February 03, 2012
    - Annual technical review
    - Added introductory statement to section 7.0 regarding reagent purity
    - Updated Section 9.1.2 and Attachment 2 for Method Blank acceptance criteria
    - Added dilution note to Section 10.3.4
    - Updated section 12.0 to reflect current laboratory practice
    - Removed Leeman instrument and replaced Nitrogen with Argon for Attachment 7

- Revision 1.0 dated 23 August 2011
    - Updated Section 7.15 ICV Intermediate Standard to 400ug/l
    - Updated Section 7.16 ICV Working Standard level to 4ug/l
    - Updated Section 9.2.3 ICV true value to 4ug/l
    - Updated Section 10.3.8 ICV and ICB run order

- Revision 0.5 dated 25 April 2011
    - Removed all references to the FIMS Analyzer
    - Sections 6.1 and 6.3 were updated to reflect the use of digestion blocks from water baths.
    - The reagent amounts were updated to reflect using a 30ml aliquot from 10ml.
    - Section 10.3.2 was updated to show a final volume of 40ml.

- Revision 0.4 dated 07 February 2011
    - Revised section 10 to reflect use of calibrated digestion tubes and calibration standard volumes
    - Revised supplies list
    - Revised section 6.2 to include reference to Master List of Documents, Software and Hardware
    - Added section 11.1 to reference corporate SOP CA-Q-S-005 “Calibration Curves”

- Revision 0.3 dated 01 September 2010
    - Section 7.0: Removed note about standards log with the change in LIMS systems

  - Section 12.2 added section about MDLV verifications
  - Updated Section 11.6 for new LIMS
  - Removed Attachments 3a and 3b
  - Annual Technical Review

- Revision 0.2 dated 07 August 2009
  - Sections 7.17 and 7.18 were updated to use 1% HNO3 from reagent blank.
  - Sections 10.1.3.1 and 10.1.3.2 were updated to use 1% HNO3 from reagent blank.
  - Changed SOP name DV-QA-003P from QC Policy to Quality Assurance Program.

- Revision 0.1, dated 16 February 2008
  - Section 9.1.2: Changed control limit to 10% to match soil SOP
  - Section 9.2.2: Changed the stated control limits for special projects from ½ the RL to 2x the MDL
  - Deleted section 12.2 for IDL requirements
  - Section 12.3: Noted that LCSs will be used for verification

Attachment 1

Mercury Reporting Limits, Calibration Levels, QC Standard and Spiking Levels (µg/L)

	Value at Instrument	Final Value
Standard Aqueous RL	0.12	0.2
Std 0	0	0
Std 1	0.06	0.1
Std 2	0.12	0.2
Std 3	0.3	0.5
Std 4	0.6	1.0
Std 5	1.5	2.0
Std 6	3.0	5.0
Std 7	6.0	10.0
ICV	2.4	4.0
CCV	3.0	5.0
LCS	3.0	5.0
Aqueous MS	3.0	5.0

Attachment 2

Summary of Quality Control Requirements

QC Parameter	Frequency *	Acceptance Criteria	Corrective Action
ICV	Beginning of every analytical run.	90 - 110% recovery	Terminate analysis; Correct the problem; Recalibrate or reprep batch (see Section 9.3.3).
RL Check Standard (CRA)	Following the ICV	50-150% recovery	Terminate analysis; correct the problem; recalibrate or re-prepare and reanalyze batch.
ICB	Beginning of every analytical run, immediately following the ICAL.	Absolute value must be < ½ RL, 2x the MDL for DoD	Terminate analysis; Correct the problem; Recalibrate or reprep batch (see Section 9.3.2).
CCV	Every 10 samples and at the end of the run.	80 - 120% recovery	Terminate analysis; Correct the problem; Recalibrate and rerun all samples not bracketed by acceptable CCV or reprep batch (see Section 9.3.5).
CCB	Immediately following each CCV.	Absolute value must be < ½ RL, 2x the MDL for DoD	Terminate analysis; Correct the problem; Recalibrate and rerun all samples not bracketed by acceptable CCB or reprep batch (see Section 9.3.2).
Method Blank	One per sample preparation batch of up to 20 samples.	Project specific or ½ RL Sample results greater than 10x the blank concentration are acceptable.	Re-digest and reanalyze samples. Note exceptions under criteria section. See Section 9.2.2 for additional requirements.
Laboratory Control Sample (LCS)	One per sample preparation batch of up to 20 samples.	In-house 3 standard deviation control limits, not to exceed 80-120% recovery.	Terminate analysis; Correct the problem; Re-digest and reanalyze all samples associated with the LCS (see Section 9.2.3).
Matrix Spike	One per 10 samples preparation batch of up to 20 samples.	In-house 3 standard deviation control limits, not to exceed 75-125% recovery	In the absence of client-specific requirements, flag the data (see Section 9.2.4).
Matrix Spike Duplicate	See Matrix Spike	In-house 3 standard deviation control limits, not to exceed 20% RPD	See Corrective Action for Matrix Spike.

Attachment 3

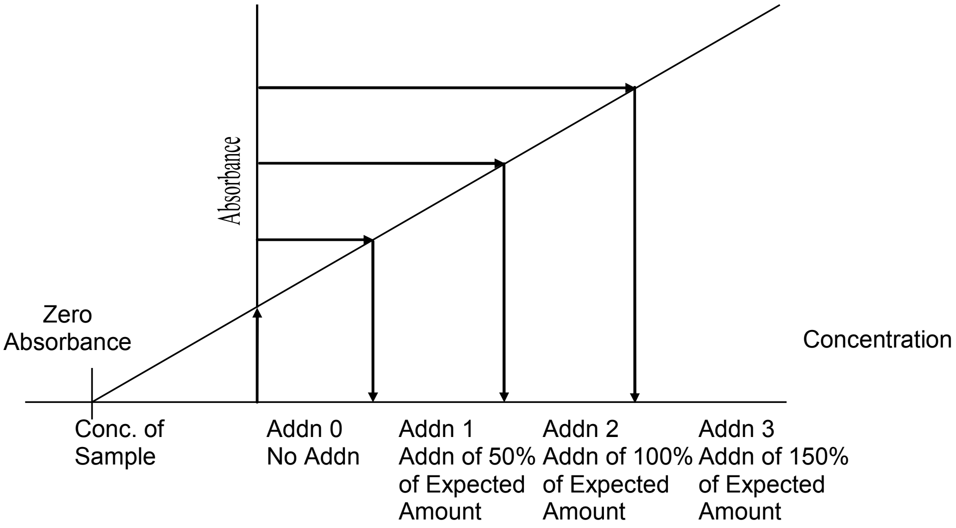
MSA Guidance

Method of Standard Addition (MSA)

Four equal volume aliquots of sample are measured and known amounts of standards are added to three of the aliquots. The fourth aliquot is the unknown and no standard is added to it. The concentration of standard added to the first aliquot should be 50% of the expected concentration. The concentration of standard added to the second aliquot should be 100% of the expected concentration, and the concentration of standard added to the third aliquot should be 150% of the expected concentration. The volume of the unspiked and spiked aliquots should be the same (i.e., the volume of the spike added should be negligible in relation to the volume of sample).

To determine the concentration of an analyte in the sample, the absorbance (or response) of each solution is determined and a linear regression performed. The absorbance (or response) is plotted on the vertical axis versus the concentrations of the standards on the horizontal axis using 0 as the concentration of the unspiked aliquot. An example plot is shown in Figure 1. When the resulting line is extrapolated back to zero absorbance, the point of interception of the horizontal axis is the concentration of the unknown. The correlation coefficient (r) and the x-intercept (where y=0) of the curve are calculated. The concentration in the digestate is equal to the negative x-intercept.

Figure 1



For the method of standard additions to be correctly applied, the following limitations must be taken into consideration.

- The plot of the sample and standards must be linear over the concentration range of concern. For best results, the slope of the curve should be similar to that of a plot of the aqueous standard curve.

- The effect of the interference should not vary as the ratio of the standard added to the sample matrix changes.

Attachment 4

Troubleshooting Guide

Problem	Possible Cause
Poor or No Absorbance or Sensitivity Check failed	Incorrect wavelength Dirty windows Window loose Etched or dirty optics Bad lamp Not enough or no sample introduced Empty sample cup Incorrectly made standards Gas leak
Erratic Readings	Source lamp not aligned properly Lamp not pre-warmed Injection tip partially clogged Contaminated reagents Contaminated glassware Drying tube saturated Bad lamp Injection tip hitting outside of tube Injection tip coated or not set properly Leak in sample tubing Power fluctuations Air bubbles in tubing
Standards reading twice or half normal absorbance or concentration	Incorrect standard used Incorrect dilution performed Dirty cell
Background Correction Light Blinking	Background screen or attenuator faulty

Attachment 5

Contamination Control Guidelines

The following procedures are strongly recommended to prevent contamination:

- All work areas used to prepare standards and spikes should be cleaned before and after each use.
- All glassware should be washed with detergent and tap water and rinsed with 1:1 nitric acid followed by deionized water.
- Proper laboratory housekeeping is essential in the reduction of contamination in the metals laboratory. All work areas must be kept scrupulously clean.
- Powdered gloves should not be used in the metals laboratory since the powder contains silica and zinc, as well as other metallic analytes.
- Glassware should be periodically checked for cracks and etches and discarded if found. Etched glassware can cause cross contamination of any metallic analytes.
- Autosampler trays should be covered to reduce the possibility of contamination. Trace levels of elements being analyzed in the samples can be easily contaminated by dust particles in the laboratory.

The following are helpful hints in the identification of the source of contaminants:

- Reagents or standards can contain contaminants or be contaminated with the improper use of a pipette.
- Improper cleaning of glassware can cause contamination.
- If an unusually high sample is analyzed, segregate the glassware and soak with sulfuric acid prior to routine cleaning.

Attachment 6

Preventative Maintenance

A maintenance logbook is used to record when maintenance is performed on instruments. When an instrument problem occurs, record the date, time, and instrument number; describe the problem; and explain the corrective action in the maintenance log.

The following procedures are required to ensure that that the instrument is fully operational:

Cold Vapor Atomic Absorption (CETAC Analyzers)

Daily	Monthly	Annually
Change rinse solution.	Check Hg lamp intensity.	Change Hg lamp.
Optimize light path.		Check liquid/gas separator.
Check argon flow.		
Check tubing. Replace as needed.		
Check drain.		
Check condition of dryer		

Table 1
DOD QSM 5.0 QC Criteria for CVAA/Mercury

QSM 5.0 Table 7. Inorganic Analysis by CVAA/Mercury	
Requirement	**DoD QSM 5.0 and DOE QSAS 3.0**
Initial Calibration (ICAL)	Measure a minimum of 5 standards and a calibration blank daily and $r^2 \geq 0.99$ No samples shall be analyzed until ICAL has passed.
Initial Calibration Verification (ICV)	Run second-source standard once after each ICAL and prior to sample analysis. Must be within ± 10% of expected value. Correct any problems, verify standard, and rerun ICV. If that fails, correct problem and rerun ICAL. Verification must pass before running any samples.
Continuing Calibration Verification (CCV)	Run CCV after every 10 samples, and at the end of the analysis sequence: Reported analyte within ± 10% of expected value If the CCV is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project (3HR). Correct any problems, then rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since last successful CCV. Results cannot be reported without a valid CCV. Or Immediately (within one hour) 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. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analytes(s) in all samples since the last acceptable CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Initial and Continuing Calibration Blank	Analyze calibration blank before analyzing samples, after every 10 field samples, and at the end of the analysis sequence. No analytes detected > LOD. Correct any problems, then re-prep and reanalyze the calibration blank and analyze all samples since the last acceptable calibration blank. Failures due to carryover may not require an ICAL.
Method Blank	One per prep batch. No analytes detected > ½ LOQ (RL) or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater If criteria not met, correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank. If reanalysis is not possible, apply B-flag to all results for the specific analyte(s) in all samples processed with the contaminated blank. Must be explained in the case narrative. Flagging is only appropriate when samples cannot be reanalyzed.

Table 1
DOD QSM 5.0 QC Criteria for CVAA/Mercury
(Continued)

QSM 5.0 Table 7. Inorganic Analysis by CVAA/Mercury	
DoD QSM 5.0 and DOE QSAS 3.0	
LCS	One per prep batch. Recovery must meet DoD QSM limits. If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project (3HR). Correct any problems, then re-prep and reanalyze LCS and associated samples for failed analytes in all samples in the associated batch. If corrective action fails, apply Q-flag to specific analyte(s) in all samples in associated batch.
Matrix Spike (MS)	One MS per prep batch. Use DoD acceptance criteria for LCS. If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.
MSD or Sample Duplicate	Analyze one MSD or sample duplicate per prep batch per matrix. RPD between duplicates must be ≤ 20%. For failures, consult project-specific DQOs and contact client for additional measures to be taken. If acceptance criteria are not met, apply J-flag. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.

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ICP Analysis for Trace Elements by SW-846 Method 6010C

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1.0 Scope and Application

1.1 This procedure describes the analysis of trace elements including metals in solution by Inductively Coupled Plasma -Atomic Emission Spectroscopy (ICPAES). This procedure references Method 6010C for hazardous waste (RCRA) testing.

1.2 The elements that can be determined by this procedure are listed in Attachment 1, together with the routine reporting limits. Additional elements may be analyzed under Method 6010C provided that the method performance criteria presented in Section 12.0 are met.

1.3 The laboratory digests all water samples according to SOP DV-IP-0010.

1.4 Silver concentrations must be below 1.0 mg/L in aqueous sample digestates and 100 mg/kg in solid matrix sample digestates. Precipitation may occur in samples where silver concentrations exceed these levels and lead to the generation of erroneous data. Samples with silver concentrations exceeding these levels must be re-prepared and reanalyzed using a smaller sample amount.

1.5 The digestion procedure for soil samples is described in SOP DV-IP-0015.

1.6 State or client specific requirements may take precedence over this SOP for water analyses. Review special instructions for each project before starting work.

2.0 Summary of Method

2.1 The laboratory uses simultaneous ICPAES instruments, with both axial and radial viewing configurations. Samples are nebulized and the aerosol that is produced is transported to the plasma torch where excitation occurs.

2.2 Characteristic atomic-line emission spectra are produced by a radio frequency inductively coupled plasma (ICP). The spectra are dispersed by a grating spectrometer and the intensities of the emission lines are monitored by a charge injection device (CID). The photo-currents from the charge injection device (CID) are processed and controlled by a computer system.

2.3 A background correction technique is required to compensate for variable background contribution to the determination of trace elements. Background must be measured adjacent to analyte lines during analysis. The position selected for the background intensity measurement, on either or both sides of the analytical line, will be determined by the complexity of the spectrum adjacent to the analyte line. The position used must be free of spectral interferences and reflect the same change in background intensity as occurs at the analyte wavelength measured. Background correction is not required in cases of line broadening where a background correction measurement would actually degrade the analytical result.

2.4 Refer to the appropriate SOPs for details on sample preparation methods: DV-IP-0010 for aqueous samples and DV-IP-0015 for soil samples.

3.0 Definitions

3.1 **Dual View ICP** – an ICP equipped with both radial and axial viewing capabilities.

3.2 **Dissolved Metals -** Those elements which pass through a 0.45-µm membrane. (The sample is acidified after filtration).

3.3 **Potentially Dissolved Metals -** Potentially dissolved metals is the concentration of metals in solution after acidifying the sample with nitric acid to pH <2, holding at room temperature for 8 to 96 hours, and then filtering through a 0.45-µm membrane filter. This definition is based on the Colorado surface water regulations.

3.4 **Suspended Metals -** Those elements which are retained by a 0.45-µm membrane.

3.5 **Total Metals -** The concentration determined on an unfiltered sample following vigorous digestion.

3.6 **Total Recoverable Metals -** The concentration determined on an unfiltered sample following treatment with hot, dilute mineral acid.

3.7 **Reporting Limit (RL) -** The lowest concentration to which results are reported without qualification. Details concerning RLs are presented in Policy DV-QA-009P.

3.8 Refer to the Glossary of the TestAmerica Denver Quality Assurance Manual (QAM) and Policy DV-QA-003P, *Quality Control Program*, for definitions of general analytical and QA/QC terms.

4.0 Interferences

4.1 Spectral, physical, and chemical interference effects may contribute to inaccuracies in the determinations of trace elements by ICP. Spectral interferences are caused by the following:

4.1.1 Overlap of a spectral line from another element.

4.1.2 Unresolved overlap of molecular band spectra.

4.1.3 Background contribution from continuous or recombination phenomena.

4.1.4 Stray light from the line emission of high concentration elements.

4.2 A background correction technique is used to compensate for variable background contribution to the determination of trace elements. Background correction is not required in cases where a background corrective measurement would actually degrade the analytical result.

4.3 Spectral Interferences

Inter-element correction factors (IECs) are necessary to compensate for spectral overlap. Inter-element interferences occur when elements in the sample emit radiation at wavelengths so close to that of the analyte that they contribute significant intensity to the analyte signal. If such conditions exist, the intensity contributed by the matrix elements will cause an excessively high (or sometimes low) concentration to be reported for the analyte. Inter-element corrections must be applied to the analyte to compensate for the effects of these unwanted emissions.

4.4 Physical Interferences

An internal standard (IS), yttrium or other suitable element, is added to all solutions to correct and monitor physical interferences. Use of a peristaltic pump and the mass flow controller also help to overcome physical interferences. Physical interferences are generally considered to be effects associated with sample transport, nebulization, and conversion within the plasma. These interferences may result in differences between instrument responses for the sample and the calibration standards. Physical interferences may occur in the transfer of solution to the nebulizer (e.g., viscosity effects), at the point of aerosol formation and transport to the plasma (e.g., surface tension), or during excitation and ionization processes within the plasma itself. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high dissolved solids or high acid concentrations. If internal standard recoveries are not acceptable (see Section 9.11), then dilution of the sample may be necessary to overcome the interferences.

4.5 Chemical Interferences

Chemical interferences are characterized by molecular compound formation, ionization effects, and solute vaporization effects. Normally these effects are not significant with the ICP technique, but if observed, can be minimized by buffering the sample, matrix matching, or standard addition procedures.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Safety Manual, Radiation Safety Manual and this document.

5.2 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, nitrile or latex gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.3 Specific Safety Concerns or Requirements

5.3.1 Eye protection that satisfies ANSI Z87.1, laboratory coat, and nitrile or latex gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated must be removed and discarded; non-disposable gloves must be cleaned immediately.

5.3.2 The ICP plasma emits strong UV light and is harmful to vision. All analysts must avoid looking directly at the plasma. The RF Generator produces strong radio frequency waves, most of which are unshielded. People with pacemakers should not go near the instrument while in operation.

5.4 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 (1)	Hazards	Exposure Limit(2)	Signs and Symptoms of Exposure
Nitric Acid	Corrosive Oxidizer Poison	2 ppm-TWA 4 ppm-STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Hydrochloric Acid	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

1 – Always add acid to water to prevent violent reactions.
2 – Exposure limit refers to the OSHA regulatory exposure limit.

6.0 Equipment and Supplies

6.1 Instrumentation

6.1.1 Thermo Fischer ICP 6500E Trace Analyzers are currently used. Instruments with demonstrated equivalent performance can also be used

6.1.2 Radio Frequency Generator.

6.1.3 Argon gas supply, 99.99%

6.1.4 Coolflow or appropriate water-cooling device.

6.1.5 Peristaltic Pump.

6.1.6 Autosampler.

6.2 Supplies

6.2.1 Calibrated automatic pipettes or Class A glass volumetric pipettes.

6.2.2 Class A volumetric flasks.

6.2.3 Autosampler tubes.

6.3 Computer Software and Hardware

Please refer to the master list of documents and software located on R:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

7.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. All standards used in calculations shall be entered into the TALS Reagent Module with all applicable information (e.g., components, concentrations, expiration, etc.).

7.2 Shelf-Life

7.2.1 Stock standards, standards as received from the vendor, expire on the date assigned by the vendor. If no date is assigned by the vendor, a one-year expiration will be assigned by the laboratory.

7.2.2 The expiration date of intermediate concentration standards or working standards cannot be later than the date assigned to any of the stock standards used to prepare the intermediate solution.

7.2.3 If visible deterioration is noted for any standard, it must be re-verified against a second-source. Any standard that does not verify must be replaced immediately.

7.3 Standards

7.3.1 Standards used for calibration and quality control purposes must be NIST traceable, where available. Multi-component custom blend standards must be verified against a second-source standard before they are put into use (the only exception is standards purchased directly from NIST), as described in SOP DV-QA-0015.

7.3.2 Stock standards are purchased as custom multi-element mixes or as single-element solutions. All standards must be stored in FEP fluorocarbon, polyethylene, or polypropylene bottles. Silver standards must be protected from light. The preparation frequency is governed by the parent standard with the earliest expiration date unless specified otherwise in this SOP. Detailed instructions regarding the preparation of standards and reagents are given in this section. Alternate procedures are allowed as necessary to accommodate volume requirements as long as final concentrations are maintained and an accurate description of the standard or reagent used is entered into the Reagent Module in TALS.

7.3.3 Intermediate calibration and QC standards are prepared in water with hydrochloric and nitric acids in order to approximate the acidic matrix of the various digests analyzed. This is an important point. Even with the use of yttrium as an internal standard, deviations from these concentrations can cause physical effects, as discussed in Section 4.4 of this procedure.

7.4 Reagent Blank / Initial Calibration Blank (ICB) / Continuing Calibration Blank (CCB)

Fill a 20-liter carboy with about 18 liters of reagent water. Slowly add 1L of concentrated nitric acid and 1L concentrated hydrochloric acid. Adjust the total volume to 20L. Mix carefully. Record the acid lot number and other required information in the Blank Reagent Logbook stored in the metals prep area.

7.5 Stock ICSA and ICSAB Standards

The following standards are purchased from commercial sources:

Stock ICSA & ICSAB Standard	Elements	Concentration (mg/L)
Icp stk ICSA	Fe Al, Ca, Mg	2,000 5,000
ANALYTES B	Ba, Be, Co, Cr, Cu, Mn, V Ag, Cd, Ni, Pb, Zn	50 100
ICP ISAB STD1	Li, Mo, Sb, Sr As, B, P Se K, Na	100 200 500 5000

Stock ICSA & ICSAB Standard	Elements	Concentration (mg/L)
ICP ISAB STD2	Ti Sn	100 1,000
10000 Si	Si	10,000
10000 Th	Th	10,000
1000 Tl	Tl	1,000
1000 Zr	Zr	1,000
1000 S	S	1,000
1000 Bi	Bi	1,000

7.6 ICSA Working Standard (ICP ICSA)

A combined working ICSA standard is made in a 250-mL volumetric flask using the following volumes of the Stock ICSA and ICSAB Standards:

Stock Standard	Volume of Stock Added (mL)
ICSA Std	25

Adjust to volume (250 mL) using the reagent blank solution. This produces the final ICSA standard concentrations shown in Attachment 4.

7.7 ICSAB Working Standard

A combined working ICSAB standard is made in a 250-mL volumetric flask using the following volumes of the Stock ICSAB Standards:

Stock Standard	Volume of Stock Added (mL)
Icp stk ICSA	25
ANALYTES B	2.5
ICP ISAB STD1	2.5
ICP ISAB STD2	2.5
10000 Si	0.25
10000 Th	0.05
1000 Tl	2.5
1000 Zr	0.25
1000 S	0.25
1000 Bi	0.25

Adjust to volume (250 mL) using the reagent blank solution. This produces the final ICSAB standard concentrations shown in Attachment 4.

7.8 Calibration Check Standard (S1, S2)

The two calibration check standards are the same as the working ICAL standards (ICP ICAL1A and ICP ICAL2A) described in Section 7.12.

7.9 Laboratory Control Sample (LCS) Stock Standards

The LCS stock standards are purchased from commercial sources. The stocks are custom-made standards purchased at ready-to-use concentrations as follows:

LCS Stock Standards	Elements	Concentration (mg/L)
ICP SPK 3A	Ca, K, Mg, Na P Al, Ba, Bi, Se, Tl, U, As, Fe, Li, Sr, Th Co, Mn, Ni, Pb, V, Zn Cu Cr Cd Ag, Be	5,000 1,000 200 100 50 25 20 10 5
ICP SPK 2B	Sb, Zr B, Mo, Ti Sn Si (SiO_2) S	50 100 200 1,000 (2,140) 200

The soil and water LCSs are prepared according to the instructions in SOPs DV-IP-10 and DV-IP-0015. Final concentrations are shown in Attachment 2.

7.10 Matrix Spike / Matrix Spike Duplicate (MS/MSD)

The same LCS stock standards described in Section 7.8 are also used to prepare matrix spikes and matrix spike duplicates. Final concentrations are shown in Attachment 2.

7.11 Post Digestion Spike (PDS) Standards (Analyte Addition Spike Standards)

The custom standards tabulated below are purchased from a commercial source. Add 0.06 mL of each to 6 mL (100X) of digestate or dilution of digestate.

PDS Stock	Elements	Conc. (mg/L)
ICP PDS 1	Ag, Be, Cd, Co, Cr, Cu, Mn, Ni, Sr, V	5.0
	Ba, Li, Pb,	10
	As, Se, Th, Tl, Zn	20
	U	50
	Al, Fe	100
	P	200
	Ca, K, Mg, Na,	2,000
ICP PDS 2	Mo, Ti, Zr	5.0
	B, Sb, Sn	10
	Si	500
	(SiO_2)	(1,070)

7.12 Initial Calibration (ICAL) Standards

7.12.1 Stock Calibration Standards

The following stock solutions are purchased from commercial sources.

Stock Standard	Elements	Conc. (mg/L)
Icp cal std 2	Mo, Ti, Zr	100
	Sn	200
	Si	1,000
	(SiO_2)	(2,140)
Icp cal std 3	Ag, Al, B, Ba, Be, Cd, Co, Cr, Cu, Mn,	100
	Ni, Sr, V, Zn	100
	Li, P	200
	Fe	500
	Ca, Na	1,000
	Mg	4,000
	K	10,000
Al, Ca, Fe, Na, S, Th Stocks	Al, Ca, Fe, Na, S, Th	10,000
As, Pb, Sb, Se, Tl, U, Bi Stocks	As, Pb, Sb, Se, Tl, U, Bi	1,000

7.12.2 Working Initial Calibration Standard (ICP ICAL1A)

Add 5.0 mL each of Icp cal std 2 and Icp cal std 3 to a 500-mL volumetric flask partially filled with reagent blank solution. Add 1 mL of the As, Pb, Sb, Se, and Tl stocks. Dilute to the mark with reagent blank solution.

7.12.3 Working Initial Calibration Standard (ICP ICAL2A)

Add 10 mL of the Al and Fe and 50 mL of the Na 10,000 mg/L stock solutions; 1 mL of the Th and 20 mL of the U 1,000 mg/L stock solutions; 2ml of the 1,000 mg/l Bi solution and 1 mL of the 10,000 mg/L S solution to a 1,000-mL volumetric flask partially filled with reagent blank and dilute to the mark with reagent blank.

7.13 Initial Calibration Verification (ICV)

7.13.1 ICV Stock Standards

The following stock solutions are purchased from commercial sources:

Stock Standard	Elements	Conc. (mg/L)
Icp ICVL A	Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Ni, Pb, Sr, V, Zn Se, Tl Ca, Na Mg K	25 25 50 200 1,000 2,000
Icp ICVL B	Ag, Mo, Sb, Ti, Zr Sn P, Si (SiO_2)	25 50 200 (428)
Icp ICVH	Al, Na Fe U Th	4,000 8,000 500 300
Bi, S Stocks	Bi, S	1,000

7.13.2 Working High Initial Calibration Verification (ICP ICVH)

Add 1.0 mL of the ICVH Stock, 0.05 ml Bi and 0.4 mL of the Sulfur to a 100 mL volumetric flask partially filled with reagent blank solution and dilute to the mark.

7.13.3 Working Initial Calibration Verification (ICP ICV)

Add 1.0 mL of each of the Icp ICVL A and Icp ICVL B stock solutions to a 100-mL volumetric flask partially filled with reagent blank solution and dilute to the mark.

7.14 Reporting Limit Standard (RLSTD)

7.14.1 RL Stock Standard

The following stock solutions are purchased from commercial sources:

Standard	Elements	Conc. (mg/L)
ICP RLSTD 1A	As, Sb, Se, Tl Pb	10 3.0
ICP RL STD 2A	Mo, Ti, Zr Sn Si (SiO2)	10 20 500 1,070
ICP RL STD3A	Ag, Cr, Cu, Li, Ni, Th, V, Zn, Al, B Ba, Cd, Co, Sr Be Ca, Mg Fe K, Na, P Mn U	10 100 5.0 1.0 200 30 1,000 3.0 60
100 mg/L S	S	100
100 mg/L Bi	Bi	100

7.14.2 Daily Reporting Limit Standard (ICP CRI)

Add 0.1 mL of each of ICP RLSTD 1A, ICP RL STD 2A, ICP RL STD 2A, 100 mg/L Bi and 100 mg/L S to a 100-mL volumetric flask partially filled with reagent blank and dilute to the mark. The Working RL standard must be prepared fresh each day.

7.15 High Continuing Calibration Verification (ICP CCVH)

Perform a 2x dilution of the working ICP ICAL2A solution (Section 7.11.3) with reagent blank solution.

7.16 Continuing Calibration Verification (ICP CCV)

Perform a 2x dilution of the working ICP ICAL1A solution (Section 7.11.2) with reagent blank solution.

7.17 Low Level ICV/Low Level CCV (ICP LLCCV)

The low level ICV/CCV verification stock standards are custom-made commercial standards as follows:

LLICV/LLCCV Stock Standard	Elements	Conc. (mg/L)
ICP LLCCV-1	K	300
	Na	100
	Ca, Mg	20
	Al, Bi, Fe	10
	U	6
	Ni	4
	Zn	2
	As, Cu, Se, Tl, Th	1.5
	Ba, Cr, Co, Li, Mn, Ag, Sr,	1
	V	1
	Pb	0.9
	Cd	0.5
	Be	0.1
ICP LLCCV-2	P	300
	Si	50
	B	10
	Sn	10
	Mo	2
	Zr	1.5
	Sb	1
	Ti	1

7.17.1 Low Level ICV \ Low Level CCV, Working Standards

RL Standard	Vol. of Stock Added (mL)
ICP-LLCCV-1	1
ICP-LLCCV-2	1

Adjust to volume (100 mL) using the reagent blank solution.

7.18 Reagents

7.18.1 Concentrated nitric acid (HNO3), trace metals grade or better.

7.18.2 Concentrated hydrochloric acid (HCl), trace metals grade or better.

7.18.3 Reagent water must be produced by a Millipore DI system or equivalent, with a minimum resistivity of 1.0 Mohm/cm at 25˚C.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation [1]	Holding Time [2]	Reference
Waters	HDPE	50 mLs	HNO_3, pH < 2; Cool $\leq 6^{o}C$	180 Days	40 CFR Part 136.3
Soils	Glass	3 grams	Cool $\leq 6\ ^{o}C$ [3]	180 Days	N/A

[1] Aqueous samples are preserved with nitric acid to a pH of <2 and may be stored in either plastic or glass. If boron or silica are to be determined, plastic containers are preferred. Refrigeration is not required for most programs. Preservation must be verified prior to analysis.

[2] Inclusive of digestion and analysis.

[3] Although ICP analysis of soil does not require refrigeration of the samples, mercury analysis does require refrigeration. Samples which will be used to aliquot volume for both analyses must be refrigerated.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the TALS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver Policy DV-QA-003P, *Quality Control Program*.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver Policy DV-QA-024P, *QA/QC Requirements for Federal Programs*. DoD QSM 5.0 QC Acceptance Criteria for ICP analyses are presented in Attachment 11. The criteria must be met unless otherwise documented in the project documents.

9.1.3 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 Method Comments in TALS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 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. See Policy DV-QA-003P for further details.

9.3 Method Blank

The blank is de-ionized water taken through the procedure as if it were a sample. For soil samples analyzed under the AFCEE and DoD QAPPs, the method blank consists of <1 mm glass beads that have been processed in the same manner as the samples. A method blank is required with every batch of 20 or less samples.

Acceptance Criteria: The method blank must not contain any analyte of interest above ½ the reporting limit or above one-tenth of the concentration found in the associated samples (for samples with concentrations above the RL).

Corrective Action: If the method blank exceeds allowable levels, all associated samples must be redigested and reanalyzed. A possible exception is the situation in which the analyte is not detected in any of the associated samples, but this can only be done with client approval and it must be addressed in the final report case narrative.

9.4 Laboratory Control Sample (LCS)

The LCS is prepared as described in Section 7.8. One LCS is required with each analytical batch.

Acceptance Criteria: The recovery of the LCS must be within historical control limits. Historical control limits are based on three standard deviations of past results, and must be 80-120% or tighter. In the instance where the LCS recovery is greater than 120% and the sample results are < RL, the data may be reported with qualifiers. Such action must be taken in consultation with the client and must be addressed in the report narrative. The process of establishing control limits is described in more detail in the Policy DV-QA-003P. The control limits are stored in TALS.

Corrective Action: If the LCS recovery falls outside of the established limits, all associated samples must be redigested and reanalyzed

9.5 Matrix Spike / Matrix Spike Duplicate (MS/MSD)

MS/MSDs are prepared as described in Section 0. One MS/MSD pair is required with each analytical batch. Note that some programs (e.g., North Carolina and South Carolina) require the MS/MSDs to be run at a 10% frequency. Some client specific data quality objectives (DQOs) may require the use of sample duplicates in place of or in addition to MS/MSDs. The MS/MSD results are used to determine the effect of a matrix on the precision and accuracy of the analytical process. Due to the potential variability of the matrix of each sample, these results may have immediate bearing on only the specific sample spiked. Samples identified as field blanks cannot be used for MS/MSD analysis. Note that if client instructions on the chain of custody form tell the lab to use a field blank for the MS/MSD, this should be double-checked with the laboratory PM.

Acceptance Criteria: The recoveries for the MS and MSD must be within the historical control limits or the project-required control limits, whichever are appropriate. Historical control limits are based on three standard deviations of past results, and should be within the established project-specific method control limits, if they exist. The process of establishing control limits is described in more detail in Policy DV-QA-003P. The control limits are stored in the laboratory's LIMS system. Acceptance limits derived from historical data should be no wider than +/-25%.

Corrective Action: If MS/MSD recoveries fall outside of the established limits and the LCS is in control, the data will be flagged as outside of control limits. The failure will be documented by the PM in the case narrative to alert the client that a matrix affect may be present.

Acceptance Criteria: The relative percent difference (RPD) between the MS and MSD is evaluated to measure precision and must be less than or equal to the historical RPD control limit. Historical control limits are based on three standard deviations of past results, and must be no greater than 20%.

Corrective Action: If the RPD fails to meet precision limit and the recoveries pass, the control limits should be checked as this would be a very rare occurrence if the limits are set properly. If the LCS is in control, it indicates long-term precision, and precision failures within the batch may be due to sample non-homogeneity. MS/MSD results which fall established control limits must be addressed in the narrative.

NOTE: This method does not require a sample duplicate. Precision is measured using the MS/MSD. Use of the MS/MSD is preferred as not all samples will contain measurable concentrations of the target analytes. Samples that have target analytes at low concentrations or non-detectable levels do not provide useful precision data. When an MS/MSD is not available, an LCS and LCSD will be used to measure precision.

9.6 Serial Dilution Test

A dilution test is performed for each batch of samples. The purpose of this test is to ensure that neither positive nor negative interferences are biasing the analytical results. The serial dilution test should be performed on the same sample used to perform the MS/MSD.

Acceptance Criteria:	If the analyte concentration is sufficiently high (minimally, a factor of 50 times the MDL), an analysis of a 1:5 dilution (e.g., 1 mL of sample diluted to 5 mL with reagent blank solution) must agree within ± 10% of the original determination. For DoD QSM 5.0 the serial dilution is required if the MS or MSD fails and the parent concentration is greater than 50x the LOQ prior to dilution.
Corrective Action:	If the two results do not agree within ± 10%, then a chemical or physical interference is suspected A qualifier flag is assigned to the data and the failure is addressed in the case narrative to alert the client that a matrix affect may be present. For DoD V 5 a J-flag is added to the parent sample for the specific analyte if the acceptance criteria are not met.

9.7 Post Digestion Spike (PDS)

Whenever the MS/MSD recoveries are unacceptable, a PDS spike must be performed. The PDS spike is prepared as described in Section 7.10. Some programs, e.g., AFCEE, require a PDS analysis whenever the serial dilution test fails. Other programs, e.g., DoD QSM, require a PDS to be included in every batch. Check project requirements. For these programs, the same sample that was used for the serial dilution test should be used for the PDS.

Acceptance Criteria:	An analyte spike added to a portion of a prepared sample, or its dilution, should be recovered to within 80-120% for Method 6010C. The spike addition should produce a minimum level of 10 times to a maximum of 100 times the lower limit of quantitation.
Corrective Action:	If the spike is not recovered within the specified limits, a matrix effect is confirmed. For DoD QSM 5.0 a J-flag is added to the parent sample if the sample concentration is less than 50x the LOQ prior to dilution. Any failures are flagged and should be described in the report case narrative.

9.8 Method of Standard Additions (MSA)

This technique involves constructing a calibration curve in the sample matrix itself to compensate for a sample interferent that may enhance or depress the analyte signal, thus producing a different slope from that of the calibration standards. It will not correct for additive interferences that cause a baseline shift. Attachment 8 provides more guidance on performing MSA analyses.

9.9 Interference Check Analysis (ICSA / ICSAB)

The ICSA contains only interfering elements, the ICSAB contains analytes and interferents. Refer to Sections 7.4, 7.5, and 7.6 for the preparation of the ICSA and ICSAB solutions. Attachment 4 lists the final concentrations. All analytes are spiked into the ICSAB solution. The ICSA and ICSAB solutions are analyzed at the beginning of the run.

Acceptance Criteria: The ICSAB results for the all analytes must fall within 80-120% of the true value. If any ICSAB analyte result fails criteria, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the samples rerun.

The absolute value of ICSA results for the non-interfering elements must be ≤ 2 x RL. The DoD and AFCEE programs have their own criteria based on the version used. For DoD QSM 5.0 the non-spiked analytes must be less than the absolute value of the LOD unless they are verified impurities.

Corrective action: If the ICSA results for the non-interfering elements do not meet these limits, the field sample data must be evaluated as follows: If the non-interfering element concentration in the ICSA is the result of contamination versus a spectral interference, and this reason is documented, the field sample data can be accepted. If the affected element was not required, then the sample data can be accepted. If the interfering elements are not present in the field sample at a concentration which would result in an absolute value > 2x RL, then the field sample data can be accepted. If the interfering element is present in the field sample at a level which would result in a false analyte signal > 2x RL, the data can be accepted only if the concentration of the affected analyte in the field sample is more than 10x the analyte signal in the ICSA. If the data do not meet the above conditions, then the IECs must be re-evaluated and corrected if necessary and the affected samples reanalyzed.

9.10 Monitoring Internal Standard Results

Yttrium is automatically added as an internal standard (IS) to every solution tested through use of a third pump channel and mixing coil. The analyst must monitor the response of the internal standard throughout the sample analysis run. This information is used to detect potential problems and identify possible background contributions from the sample (i.e., natural occurrence of IS analyte).

Acceptance Criteria:	If the internal standard counts fall within ±30% of the counts observed in the ICAL blank, then the data are acceptable.
Corrective Action:	If the internal standard counts in the field samples are outside of the control limits, the field samples must be diluted and reanalyzed;

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any unauthorized deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 Sample Preparation

Solid and aqueous samples must be digested prior to analysis by the appropriate method (see SOPs DV-IP-0010, DV-IP-0015, and DV-IP-0017).

10.4 Calibration

10.4.1 Instrument Start Up

Set up the instrument with the operating parameters recommended by the manufacturer. Complete any required preventative maintenance and record in the ICPAES Preventative Maintenance Log. Preventive maintenance recommendations a list in the TestAmerica Denver Quality Assurance Manual. Allow the instrument to become thermally stable before beginning calibration (approximately 30 minutes of warm-up is required)

10.4.2 Initial Calibration (ICAL)

The calibration curve is established on each day of operation using a blank and one standard. The preparation of the ICAL standards is described in Section 7. The final concentrations of the ICAL standards are presented in Attachment 6. The validity of the calibration curve is confirmed by analysis of the ICV, CCV, ICB, RL Check standard and Low Level ICV/CCV) which are run immediately after the ICAL. Some programs require a high-level verification check as well.

10.4.3 Initial Calibration Verification (ICV)

Calibration accuracy is verified using a second-source standard (ICV) that is at or below a concentration near the mid-point of the working range. The ICV is analyzed immediately after the ICAL. The preparation of this standard is described in Section 7. The concentrations of the ICV standard are presented in Attachment 6.

Acceptance Criteria: For Method 6010C, the ICV result must fall within 10% of the true value for that solution. The standard deviation must be < 5% (the laboratory is using at least two exposures for all ICP analyses).

Corrective Action: If the ICV fails to meet acceptance limits, the standard may be reanalyzed without modification to the instrument operating conditions. <u>Two consecutive, acceptable analyses are required before the analytical run may continue.</u> Otherwise, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

10.4.4 Mid Level Continuing Calibration Verification (CCV)

The preparation of the CCV solution is described in Section 7. The final concentrations of the CCVs are presented in Attachment 6. Note that the CCV is made at a different concentration than the ICV to meet NELAC requirements. CCVs are analyzed after the ICV, after every ten samples, and at the end of the analytical run.

Acceptance Criteria: The CCV must be within 10% of the expected value to meet Method 6010C requirements. The relative standard deviation must be <5%.

Corrective Action: If the CCV fails to meet any of these criteria, the standard may be reanalyzed without modification to the instrument operating conditions. *<u>Two consecutive, acceptable analyses are required before the analytical run may continue.</u>* Otherwise, the instrument must be recalibrated and the samples reanalyzed since the last successful CCV must be reanalyzed.

10.4.5 Low Level Initial Calibration (LLICV) and Continuing Calibration Verification (LLCCV)

The preparation of the LLCCV solution is described in Section 7. The low-level CCV needs to be analyzed at the beginning and end of every run sequence. If low level samples are expected then the low-level CCV should also be run every ten samples.

Acceptance Criteria: The LLCCV must be within +/-30% of the expected value to meet Method 6010C requirements.

Corrective Action: If the LLCCV fails to meet any of these criteria, the standard may be reanalyzed without modification to the instrument operating conditions. *Two consecutive, acceptable analyses are required before the analytical run may continue.* If the calibration cannot be verified within theses specified limits, the analysis of samples containing the affected analytes at similar concentrations cannot continue until the cause is determined and the LLCCV standard successfully analyzed. Otherwise, the instrument must be recalibrated and the samples reanalyzed since the last successful CCV must be reanalyzed. TestAmerica will not hold samples with concentrations greater than 10x the reporting limit to the 30% acceptance criteria.

10.4.6 Initial Calibration Blank (ICB)

System cleanliness is verified by analyzing an ICB after the first CCV. The preparation of the ICB is described in Section 7.

Acceptance Criteria: Absolute values for the calibration blanks must be less than ½ the standard RL. Common lab contaminants such as sodium must be less than the RL. Client specific requirements take precedence. For example, DoD requires control of blanks to a concentration less than or equal to the LOD.

Corrective Action: If the ICB fails to meet acceptance limits, a single reanalysis may be attempted without modification to the instrument operating conditions. Otherwise, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

10.4.7 RL Calibration Check Standard (ICP CRI)

Calibration accuracy at the RL is verified by analyzing a standard prepared at a concentration at or below the laboratory's standard reporting limit. The preparation of this standard is described in Section 7. Alternate RLSTD concentrations may be used as necessary to meet client requirements as long as an accurate description of the standard used is entered into the Reagents Module in TALS.

Acceptance Criteria: For routine work and for programs that allow the RL to be as low as 2 x MDL (e.g., AFCEE), the acceptance limits are ± 50% of the expected value.

For some programs (e.g., DoD QSM), the acceptance limit is ± 20%.

Corrective Action: If the RL Check standard fails to meet acceptance limits, a single reanalysis may be attempted without modification to the instrument operating conditions. Otherwise, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

10.4.8 Lower Limit of Quantitation Check (LLQC)

The lower limit of quantitation check (LLQC) sample should be analyzed after establishing the lower laboratory reporting limits and on an as needed basis to demonstrate the desired detection capability. The difference between the LLQC and the LLICV/CCV is that this standard is carried through the entire preparation and analytical procedure.

Acceptance Criteria: LLQC is verified when all analytes are detected within ± 30% of their true value.

Corrective Action: If the LLQC fails to meet acceptance limits, a single reanalysis may be attempted without modification to the instrument operating conditions. Otherwise, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

10.4.9 High-Level Calibration Check Standard

The method 6010 defines the linear working range used for daily analysis based on the LDR studies performed every six months, in which case this standard is not required. However, some programs require verification of the high end of the linear range at different frequencies. For example, the AFCEE QAPP, version 4.0, requires evaluation of a high check standard every three months.

Acceptance Criteria: The result for this standard must be within 10% of the expected value.

Corrective Action: If the High-Level Calibration Check standard fails to meet acceptance limits, a single reanalysis may be attempted without modification to the instrument operating conditions. Otherwise, the analysis should be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified. Alternately, results that do not exceed the level of the highest calibration standard may be accepted and reported.

10.4.10 Continuing Calibration Blank (CCB)

CCBs, prepared as in Section 7.3, are analyzed after each CCV.

Acceptance Criteria:	Absolute values for the calibration blanks must be less than ½ the standard RL. Common lab contaminants such as sodium must be less than the RL. Client specific requirements take precedence. For example, DoD requires control of blanks to a concentration less than or equal to the LOD.
Corrective Action:	If the CCB is greater than these limits, a single reanalysis may be attempted without modification to the instrument operating conditions. Otherwise, instrument maintenance should be considered, the calibration re-verified, and all samples analyzed since the last successful CCB must be reanalyzed.

10.5 Sample Analysis

10.5.1 Replicate Readings

The laboratory averages the results from two exposures for Axial and Dual View ICP for each standard, field sample, and QC sample due to sample volume limitations of the autosampler tube.

10.5.2 Rinse Time Between Samples

Prior to calibration and between each sample/standard, the system is rinsed with the calibration blank solution. The minimum rinse time between analytical samples is 60 seconds unless following the protocol outlined in 12.7 it can be demonstrated that a shorter rinse time may be used.

10.5.3 The following analytical sequence is used:

Instrument Calibration
High Standard Verification
ICV
LLICV
CCV
ICB
RL Verification Standard
LLQC (as needed)
ICSA
ICSAB
LRA
CCV
CCB
LLCCV
10 samples

CCV
CCB
LLCCV
10 samples
CCV
CCB
LLCCV
Repeat sequence with 10 samples between CCV/CCB pairs
CCV
CCB
LLCCV

10.5.4 Full method-required QC must be available for each wavelength used in determining reported analyte results. Guidelines are provided in the appendices for minimizing contamination of samples and standards (Attachment 10) and troubleshooting (Attachment 9).

10.5.5 Dilutions for High Levels of Elements of Interest

For 6010, results must fall within the linear range. Dilute and reanalyze all samples for required analytes that exceed the linear range or use an alternate wavelength for which QC data are established. Dilutions must be prepared using the reagent blank solution to maintain the correct acid strength.

10.5.6 Dilutions for High Levels of Interfering Elements

Dilutions are also required for an element that is included in an IEC calculation if it exceeds the linear range. If a dilution is not performed, the IEC may be inaccurately applied. Therefore, even if an over-range analyte may not be required to be reported for a sample, if that analyte is an interferent for any requested analyte in that sample, the sample must be diluted to a level at or below the working range. An NCM will be written in these instances.

10.6 Instrument Maintenance

See Section 20 in the QAM.

10.7 Troubleshooting

See Attachment 9.

11.0 Calculations / Data Reduction

11.1 Detailed calibration equations can be found in the corporate Policy CA-Q-P-003 *Calibration Curves & Selection of Calibration Points* and under the public folder, *Arizona Calibration Training*.

11.2 ICV percent recoveries are calculated according to the following equation:

$$\%\text{R} = \left(\frac{\text{ICV Found Value}}{\text{ICV True Value}}\right) \times 100\%$$

11.3 CCV percent recoveries are calculated according to the following equation:

$$\%\text{R} = \left(\frac{\text{CCV Found Value}}{\text{CCV True Value}}\right) \times 100\%$$

11.4 Matrix Spike Recoveries are calculated according to the following equation:

$$\%R = \left(\frac{SSR - SR}{SA}\right) \times 100\%$$

Where:

SSR = Spike Sample Result
SR = Sample Result
SA = Spike Added

The relative percent difference (RPD) of matrix spike/matrix spike duplicates are calculated according to the following equation:

$$RPD = \left[\frac{|MSD - MS|}{\left(\frac{MSD + MS}{2}\right)}\right] \times 100$$

Where:

MS = determined spiked sample concentration
MSD = determined matrix spike duplicate concentration

11.5 The final concentration for a digested aqueous sample is calculated as follows:

$$\text{Final Concentration (mg/L)} = \frac{C \times V1 \times D}{V2}$$

Where:

C = Concentration (mg/L) from instrument readout
D = Instrument dilution factor
V1 = Final volume in liters after sample preparation
V2 = Initial volume of sample digested in liters

11.6 The final concentration determined in digested solid samples when reported on a dry weight basis is calculated as follows:

$$\text{Final Concentration (mg/kg), dry weight} = \frac{C \times V \times D}{W \times S}$$

Where:

C = Concentration (mg/L) from instrument readout
D = Instrument dilution factor
V = Final volume in liters after sample preparation

W = Weight in Kg of wet sample digested
S = Percent solids/100

NOTE: A Percent Solids determination must be performed on a separate aliquot when dry weight concentrations are to be reported. If the results are to be reported on wet weight basis the "S" factor should be omitted from the above equation.

11.7 The LCS percent recovery is calculated according to the following equation:

$$\%R = \left(\frac{\text{LCS Found Value}}{\text{LCS True Value}} \right) \times 100\%$$

11.8 The IEC's are calculated according to the following equation:

$$IEC = \left(\frac{\text{observed concentration}}{\text{observed concentration of the interfering element}} \right)$$

11.9 The dilution test percent difference for each component is calculated as follows:

$$\%\,Difference = \frac{|I - S|}{I} \times 100$$

Where:

I = Sample result (Instrument reading)
S = Dilution test result (Instrument reading × 5)

Appropriate factors must be applied to sample values if dilutions are performed.

11.10 Documentation and Record Management

11.10.1 All sample data is uploaded to TALS. All sample preparation and analytical batch information, including the batch number(s), list of samples, preparation analyst and date, instrument analyst and date, identification of reagents and standards used, and identification of all measuring equipment used (e.g., balances, thermometers, pipettes) is recorded in TALS.

11.10.2 Raw data is scanned or saved directly as a PDF and is attached to the analytical batch in TALS.

11.10.3 The initial data review is performed by the analyst and a second-level review is performed by the area supervisor or designee. Both reviews are documented on a Data Review Checklist. See SOP DV-QA-0020 for more detail on the review process.

11.10.4 If dilutions are required due to insufficient sample, interferences, or other problems, the reporting limit and MDL are multiplied by the dilution factor and the data may require flagging.

NOTE: Unless special instructions indicate otherwise, sample results less than the reporting limit are reported as ND.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. An initial method detection limit study is performed in accordance with Policy DV-QA-005P. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method or program requirements require a greater frequency. For DoD, AFCEE, and DOE projects, an MDL verification is performed quarterly. DOD QSM 5.0 requires the MDLV spike level to be 2-4 times the calculated MDL.

12.2 Instrument Detection Limit Study

12.2.1 Instrument detection limit (IDL) studies are conducted quarterly for each instrument and each wavelength used for analysis.

12.2.2 Run seven blanks on three non-consecutive days.

12.2.3 Calculate the standard deviation for each day. The final IDL concentration is the average of the three daily standard deviation values.

12.2.4 See Policy DV-QA-014P for a discussion of IDL studies and evaluation of IDL results.

12.3 Linear Dynamic Range (LDR)

12.3.1 The LDR must be determined initially (i.e., at initial setup) and then every three months for each analyte wavelength used on each instrument. The linear range is the concentration above which results cannot be reported without dilution of the sample.

12.3.2 The LDR must be determined from a linear calibration prepared in the normal manner using the normal operating procedures described in Sections 10 and 11.

12.3.3 The LDR is determined by analyzing successively higher standard concentrations of the analyte. A minimum of three standards is required for the initial and on-going studies, and one of the levels must be close to the upper end of the range. The highest concentration must be within 10% of the stated concentration.

12.3.4 The highest standard that meets this criterion defines the maximum concentration that can be reported for sample analysis without dilutions.

12.3.5 If the instrument is adjusted in any way that may affect the LDRs, new dynamic ranges must be determined. The LDR data must be documented and kept on file.

12.4 Background Correction Points

12.4.1 To determine the appropriate location for off-line background correction when establishing methods, the user must scan the area on either side adjacent to the wavelength of interest and record the apparent emission intensity from all other method analytes. The location selected for background correction must be either free of off-line interelement spectral interference or a computer routine must be used for automatic correction on all determinations.

12.4.2 Tests to determine spectral interference must be done using analyte concentrations that will adequately describe the interference. Background correction points must be set prior to determining IECs. Refer to the ICP instrument manual for specific procedures to be used in setting background correction points.

12.5 Interelement Corrections (IECs)

12.5.1 ICP interelement correction (IEC) factors must be determined prior to the analysis of samples and every six months thereafter. If the instrument is adjusted in any way that may affect the IECs, the IECs must be re-determined.

12.5.2 When initially determining IECs for an instrument, wavelength scans must be performed to ensure that solutions in use are free from contaminants. If an IEC varies significantly from the previously determined IEC, then the possibility of contamination should be investigated. The purity of the IEC check solution can be verified by using a standard from a second source or an alternate method (i.e., GFAA or ICP-MS). Published wavelength tables (e.g., MIT tables, Inductively Coupled Plasma-Atomic Spectroscopy: Prominent Lines) can also be consulted to evaluate the validity of the IECs.

12.5.3 Refer to the facility-specific instrument operation SOP and instrument manufacturer's recommendations for specific procedures to be used in setting IECs. An IEC must be established to compensate for any interelement interference which produces a false analytical result with an absolute value greater than the RLs shown in Attachment 1. Note that the USACE program requires a control limit of 2x |MDL|, which is feasible when verified MDLs are used.

12.5.4 To determine IECs, run a single element standard at the established linear range. To calculate an IEC, divide the observed concentration of the analyte by the observed concentration of the "interfering element."

12.5.5 Dual-View ICP IECs are more sensitive to small changes in the plasma and instrument setup conditions. Adjustments in the IECs will be required on a more frequent basis for the CID detector instruments as reflected by the ICSA response.

12.6 Rinse Time Determination

12.6.1 Rinse times must be determined annually.

12.6.2 To determine the appropriate rinse time for a particular ICP system, a standard containing the highest concentration level that would be reported for samples is aspirated as a regular sample followed by the analysis of a series of rinse blanks. The length of time required to reduce the analyte signals to < RL will define the rinse time for a particular ICP system.

12.6.3 For some analytes it may be impractical to set the rinse time based on the linear range standard result (i.e., analyte not typically detected in environmental samples at that level and an excessive rinse time would be required at the linear range level).

12.6.4 Rinse time studies can be conducted at additional concentration levels. These additional studies must be documented and kept on file if a concentration other than the linear range level is used to set the rinse time. The concentration levels used to establish the rinse time must be taken into consideration when reviewing the data.

12.6.5 The ICP instruments use an intelligent rinse program. The intelligent rinse lengthens the rinse time whenever a sample result for a known problem analyte is above a set concentration.

12.7 Demonstration of Capabilities

12.7.1 All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows:

12.7.2 Four LCS's are run using the same instrumental conditions and procedures used to analyze samples. Using these four LCS's demonstrates the analyst's ability to optimize and calibrate the instrument and to prepare analytical solutions. Calculate the mean recovery and standard deviation of the mean recovery for each analyte of interest.

12.7.3 If any analyte does not meet the acceptance criteria, the test must be repeated. Only those analytes that did not meet criteria in the first test need to be evaluated. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

12.7.4 Further details concerning demonstrations of proficiency are described in SOP DV-QA-0024.

12.7.5 The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

12.8 Training Requirements

The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

13.0 Pollution Control

13.1 It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, order chemicals based on quantity needed, and prepare reagents based on anticipated usage and reagent stability).

13.2 Standards and reagents should be prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in Section 13, *Waste Management and Pollution Prevention*, of the Corporate Safety Manual, and DV-HS-001P, *Waste Management Plan*.

14.2 The following waste streams are produced when this method is carried out:

14.2.1 Acid solutions from ICP drain - Waste Stream J

14.2.2 Metals waste potentially contaminated with Cat 1 radioactive materials – Waste Stream RJ

Note: Radioactive, mixed waste and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of radioactive or potentially radioactive waste generated by this procedure.

15.0 References / Cross-References

15.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition and all promulgated updates, EPA Office of Solid Waste, through January 2008.

15.1.1 Method 6010C, Revision 3, Update IV, February 2007.

15.1.2 Method 3005A, Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, Revision 1,July 1992

15.1.3 Method 3010A, Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy, Revision 1, July 1992.

15.1.4 Method 3050B, Acid Digestion of Sediments, Sludges and Soils, Revision 2, December 1996.

15.2 Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 4.2, 10/25/2010.

15.3 Department of Defense Quality Systems Manual for Environmental Laboratories Version 5.0, July 2013.

16.0 Method Modifications:

Item	Method	Modification
1	EPA 6010C	This procedure uses mixed calibration standard solutions purchased from approved vendors instead of using individual mixes prepared in house as recommended by the subject methods.
2	EPA 6010C	The alternate run sequence presented in Section 10.5.3 is consistent with method requirements. Additional QC (i.e., ICSA) analyses were added to accommodate the CLP protocol requirements.
3	EPA 6010C	Method 6010 states that if the correction routine is operating properly, the determined apparent analyte(s) concentration from analysis of each interference solution should fall within a specific “concentration range around the calibration blank.” Because of the lack of definition for “concentration range around the calibration blank,” the laboratory has adopted the procedure in EPA CLP ILMO4.0 for determining IECs,
4	EPA 6010C	Section 9.9 of Method 6010C states: “If less than acceptable accuracy and precision data are generated, additional quality control tests are recommended prior to reporting concentration data for the elements in this method.” The dilution test helps determine if a chemical or physical interference exists. Because the laboratory sometimes does not have prior knowledge if the MS/MSD will be within criteria, the analyst may select to perform a dilution test on one sample in each preparation batch. According to the method, the post digestion spike (PDS) determines any potential matrix interferences. In this procedure, matrix interference is determined by evaluating data for the LCS, MS/MSD, and serial dilutions. The laboratory must request documented, clear guidance when a unusual matrix will be received for a project and a request to perform the dilution test or PDS on a client-identified sample.

17.0 Attachments

Attachment 1	Metals Analyzed by ICP and Reporting Limits
Attachment 2	Matrix Spike and Aqueous Laboratory Control Sample Levels
Attachment 3	Low Level ICV and CCV Spiking Levels

Attachment 4	Interference Check Sample Concentrations
Attachment 5	TCLP Reporting Limits, Regulatory Limits and Matrix Spike Levels
Attachment 6	6500 Initial Calibration &Continuing Calibration Verification Standards
Attachment 7	Summary of Quality Control Requirements
Attachment 8	MSA Guidance
Attachment 9	Troubleshooting Guide
Attachment 10	Contamination Controls
Attachment 11	DoD QSM 5.0 QC Acceptance Criteria

18.0 **Revision History**

Revision 3, dated 31 July 2015

- Annual review
- Updated Section 7.4 for how to make the 5% HNO_3/5% HCl solution
- Updated Section 12.2 for MDLV spike level to 2-4x MDL
- Updated Section 12.8.2 to use LCSs instead of ICVs for the DOC
- Reformatting throughout
- Removed reference to silica holding time
- Added Maintenance and troubleshooting sections
- Replaced Section 11.10 to match current practice
- Removed Section 12.2
- Removed Sections 1.3.1 and 1.3.2
- Added new Section 1.6
- Removed reference to glass beads in Section 6.2
- Corrected Reagent and Standard formulae throughout to agree with current practice

Revision 2, dated 31 July 31 2014

- Annual review
- Updated Section 6.1.3 to specify purity of argon gas
- Added statement to section 9.1.2 to reference DoD QSM 5.0 criteria in Attachment 11
- Removed references to preparation of oil/oily samples throughout the document as the lab no longer supports this digestion method
- Added references for prep methods to section 15
- Added DOD QSM 5.0 QC acceptance criteria as Attachment 11

Revision 1, dated 15 July 2013

- Annual review
- Removed section 1.7
- Added section 3.8
- Corrected formatting
- Added section 11.12
- Removed Attachment 8, renumbered attachments and fixed references to attachments throughout the document

Revision 0.3, dated 13 July 2012

- Annual Review
- Clarified soil preservation for ICP only analysis, Section 8
- Updated section 9.1, 10.1, 10.2, and 12.1 to reflect current practice
- Updated sections 10.4.6 and 10.4.10 to control calibration blanks to ½ the RL

Revision 0.2, dated 30 June 2011

- Added reference to DV-IP-0017 “Microwave Digestion” throughout document

- Added section 6.3 “Computer Software and Hardware”
- Removed Uranium from the ICSA/ICSAB tables in sections 7.4, 7.5, and 7.6
- Updated sections 7.14 and 7.15 to reflect current practices
- Updated the Acceptance Criteria in sections 9.4, 9.6, and 9.10
- Referenced the TestAmerica Denver Quality Assurance Manual in section 10.4.1
- Updated section 11 to reference corporate SOP CA-Q-S-005, “Calibration Curves” and Arizona Calibration Training spreadsheet
- Added IEC calculation to section 11

Revision 0.1, dated 18 June 2010
- Basic Annual Review

Revision 0, dated 19 June 2009

Attachment 1

Metals Analyzed by ICP and Reporting Limits

ELEMENT	Symbol	CAS #	6010 Analyte	Reporting Limit (μg/L) Water	Reporting Limit (mg/kg) Soil
Aluminum	Al	7429-90-5	X	100	10
Antimony^{trace}	Sb	7440-36-0	X	10	1
Arsenic^{trace}	As	7440-38-2	X	15	1
Barium	Ba	7440-39-3	X	10	1
Beryllium	Be	7440-41-7	X	1	0.1
Bismuth	Bi	7440-69-9		100	10
Boron	B	7440-42-8	X	100	10
Cadmium^{trace}	Cd	7440-43-9	X	5	0.5
Calcium	Ca	7440-70-2	X	200	20
Chromium	Cr	7440-47-3	X	10	1
Cobalt	Co	7440-48-4	X	10	1
Copper	Cu	7440-50-8	X	15	2
Iron	Fe	7439-89-6	X	100	10
Lead^{trace}	Pb	7439-92-1	X	9	0.8
Lithium	Li	7439-93-2	X	10	5
Magnesium	Mg	7439-95-4	X	200	20
Manganese	Mn	7439-96-5	X	10	1
Molybdenum	Mo	7439-98-7	X	20	2
Nickel	Ni	7440-02-0	X	40	4
Phosphorus	P	7723-14-0	X	3,000	300
Potassium	K	7440-09-7	X	3,000	300
Selenium^{trace}	Se	7782-49-2	X	15	1.3
Silicon	Si	7631-86-9		500	50
Silver^{trace}	Ag	7440-22-4	X	10	1
Sodium	Na	7440-23-5	X	1	100
Strontium	Sr	7440-24-6	X	10	1
Sulfur	S	7704-34-9	X	200	2
Thallium^{trace}	Tl	7440-28-0	X	15	1.2
Thorium	Th	7440-29-1		15	15
Tin	Sn	7440-31-5	X	100	10
Titanium	Ti	7440-32-6	X	10	1
Uranium	U	7440-61-1		60	20
Vanadium	V	7440-62-2	X	10	2
Zinc	Zn	7440-66-6	X	20	2
Zirconium	Zr	7440-67-7		15	1

Attachment 2

Matrix Spike and Aqueous Laboratory Control Sample Levels

ELEMENT	LCS Level (μg/L)	Matrix Spike Level (μg/L)
Aluminum	2,000	2,000
Antimony	500	500
Arsenic	2,000	2,000
Barium	2,000	2,000
Beryllium	50	50
Bismuth	2,000	2,000
Boron	1,000	1,000
Cadmium	50	50
Calcium	50,000	50,000
Chromium	200	200
Cobalt	500	500
Copper	250	250
Iron	1,000	1,000
Lead	500	500
Lithium	1,000	1,000
Magnesium	50,000	50,000
Manganese	500	500
Molybdenum	1,000	1,000
Nickel	500	500
Phosphorous	10,000	10,000
Potassium	50,000	50,000
Selenium	2,000	2,000
Silicon	10,000	10,000
Si (as SiO_2)	21,400	21,400
Silver	50	50
Sodium	50,000	50,000
Strontium	1,000	1,000
Sulfur	2,000	2,000
Thallium	2,000	2,000
Thorium	2,000	2,000
Tin	2,000	2,000
Titanium	1,000	1,000
Uranium	2,000	2,000
Vanadium	500	500
Zinc	500	500
Zirconium	500	500

Attachment 3

Low Level ICV/CCV

ELEMENT	LCS Level (μg/L)
Aluminum	100
Antimony	10
Arsenic	15
Barium	10
Beryllium	1
Bismuth	100
Boron	100
Cadmium	5
Calcium	200
Chromium	10
Cobalt	10
Copper	15
Iron	100
Lead	9
Lithium	10
Magnesium	200
Manganese	10
Molybdenum	20
Nickel	40
Phosphorous	3,000
Potassium	3,000
Selenium	15
Silicon	500
Si (as SiO_2)	1070
Silver	10
Sodium	1,000
Strontium	10
Thallium	15
Thorium	15
Tin	10
Titanium	10
Uranium	60
Vanadium	10
Zinc	20
Zirconium	15

Attachment 4

Interference Check Sample Concentrations

Element	ICSA (μg/L)	ICSAB (μg/L)
Aluminum	500,000	500,000
Antimony	-	1,000
Arsenic	-	2,000
Barium	-	500
Beryllium	-	500
Bismuth	-	1,000
Boron	-	2,000
Cadmium	-	1,000
Calcium	500,000	500,000
Chromium	-	500
Cobalt	-	500
Copper	-	500
Iron	200,000	200,000
Lead	-	1,000
Lithium	-	1,000
Magnesium	500,000	500,000
Manganese	-	500
Molybdenum	-	1,000
Nickel	-	1,000
Phosphorous	-	2,000
Potassium	-	50,000
Selenium	-	5,000
Silicon	-	10,000
Silica	-	21,400
Silver	-	1,000
Sodium	-	50,000
Strontium	-	1,000
Sulfur	-	1,000
Thallium	-	10,000
Titanium	-	1,000
Vanadium	-	500

Attachment 4

Interference Check Sample Concentrations (cont'd)

Element	ICSA (µg/L)	ICSAB (µg/L)
Zinc	-	1,000
Tin	-	10,000
Thorium	-	10,000
Uranium	2,000	2,000
Zirconium	-	1,000

Attachment 5

TCLP Reporting Limits, Regulatory Limits and Matrix Spike Levels

ELEMENT	Reporting Level (µg/L)	Regulatory Limit (µg/L)	Spike Level (µg/L)
Arsenic	500	5000	4000
Barium	10000	100000	12000
Cadmium	100	1000	1100
Chromium	500	5000	5200
Lead	500	5000	5500
Selenium	250	1000	3000
Silver	500	5000	1050
Copper	100	N/A	2250
Zinc	200	N/A	2500

Attachment 6

6000 Dual View Calibration, ICV & CCV Standards

Element	Calibration Level	ICV (µg/L)	CCV (µg/L)
Aluminum Lo	1,000	250	500
Aluminum Hi	100,000	40,000	50,000
Antimony	2,000	250	1,000
Arsenic	2,000	250	1,000
Barium	1,000	250	500
Beryllium	1,000	250	500
Bismuth	2,000	500	1000
Cadmium	1,000	250	500
Calcium	10,000	2,000	5,000
Chromium	1,000	250	500
Cobalt	1,000	250	500
Copper	1,000	250	500
Iron Lo	5,000	250	2,500
Iron Hi	100,000	80,000	50,000
Lead	2,000	250	1000
Magnesium	40,000	10,000	20,000
Manganese	1,000	250	500
Molybdenum	1,000	250	500
Nickel	1,000	250	500
Phosphorous	2,000	2,000	1,000
Potassium	100,000	20,000	50,000
Selenium	2,000	500	1,000
Silver	1,000	250	500
Sodium Lo	10,000	2000	5,000
Sodium Hi	500,000	40,000	250,000
Strontium	1,000	250	500
Sulfur	10,000	4,000	5,000
Thallium	2,000	500	1,000
Thorium	10,000	3,000	5,000
Tin	2,000	500	1,000
Vanadium	1,000	250	500
Uranium	20,000	5,000	10,000
Zinc	1,000	250	500
Zirconium	1,000	250	500

Attachment 7
Summary Of Quality Control Requirements

QC Parameter	Frequency	Acceptance Criteria	Corrective Action
Two-point Initial Calibration	Beginning of every analytical run, every 24 hours, whenever instrument is modified, or CCV criterion is not met	RSD between multiple exposures ≤5%	Terminate analysis; Correct the problem; Prepare new standards; Recalibrate following system performance.
ICV	Beginning of every analytical run.	90 - 110 % recovery.	Terminate analysis; Correct the problem; Recalibrate.
CCV	After the ICV, after every 10 samples and at the end of the run.	90-110% recovery	Terminate analysis; Correct the problem; Recalibrate and rerun all samples not bracketed by acceptable CCV.
RL Standard	At the beginning of the run	Results must within 50%	Terminate analysis; Correct the problem; Recalibrate.
LLICV/CCV	At the beginning of the run and after every 10 samples	Recovery must be within 30%	Terminate analysis; Correct the problem; Recalibrate and rerun all samples not bracketed by acceptable LLCCV.
ICB	Beginning of every analytical run, immediately following the initial CCV.	The result must be within +/- ½ RL from zero.	Terminate analysis; Correct the problem; Recalibrate.
CCB	Immediately following each CCV (except for the CCV following the ICV).	The result must be within +/- ½ RL from zero.	Terminate analysis; Correct the problem; Recalibrate and rerun all samples not bracketed by acceptable CCB.
ICSA	Beginning of every run	See Section 9.10	See Section 9.10
ICSAB	Immediately following each ICSA.	Results must be within 80 - 120% recovery.	See Section 9.10
Dilution Test	One per prep batch.	For samples > 10x LOD (after dilution)' dilutions must agree within 10%.	Narrate the possibility of physical or chemical interference per client request.

See Section 10.5.3 for run sequence to be followed.

Attachment 7

Summary of Quality Control Requirements (Continued)

QC Parameter	Frequency	Acceptance Criteria	Corrective Action
Method Blank (MB)	One per sample preparation batch of up to 20 samples.	The result must be less than or equal to ½ the RL.	Re-run once in a clean tube. If > ½ RL, re-digest and reanalyze samples.
		Sample results greater than 10x the blank concentration are acceptable.	Note exceptions under criteria section.
		Samples for which the contaminant is < ½ RL may not require redigestion or reanalysis (see Section 9.3)	See Section 9.4 for additional requirements.
Laboratory Control Sample (LCS)	One per sample preparation batch of up to 20 samples.	LCS must be within 80 - 120% recovery or in-house control limits. Samples for which the contaminant is < RL and the LCS results are > 120% may not require redigestion or reanalysis (see Section 9.4)	Terminate analysis; Correct the problem; Redigest and reanalyze all samples associated with the LCS.
Matrix Spike (MS)	One per sample preparation batch of up to 20 samples.	75 – 125% recovery or tighter in-house control limits.	In the absence of client specific requirements, flag the data; no flag required if the sample level is > 4x the spike added.
Matrix Spike Duplicate (MSD)	One per sample preparation batch of up to 20 samples. 10% frequency for some programs (see 9.5)	75 – 125 % recovery; RPD ≤ 20% or tighter in-house control limits.	See Corrective Action for Matrix Spike.

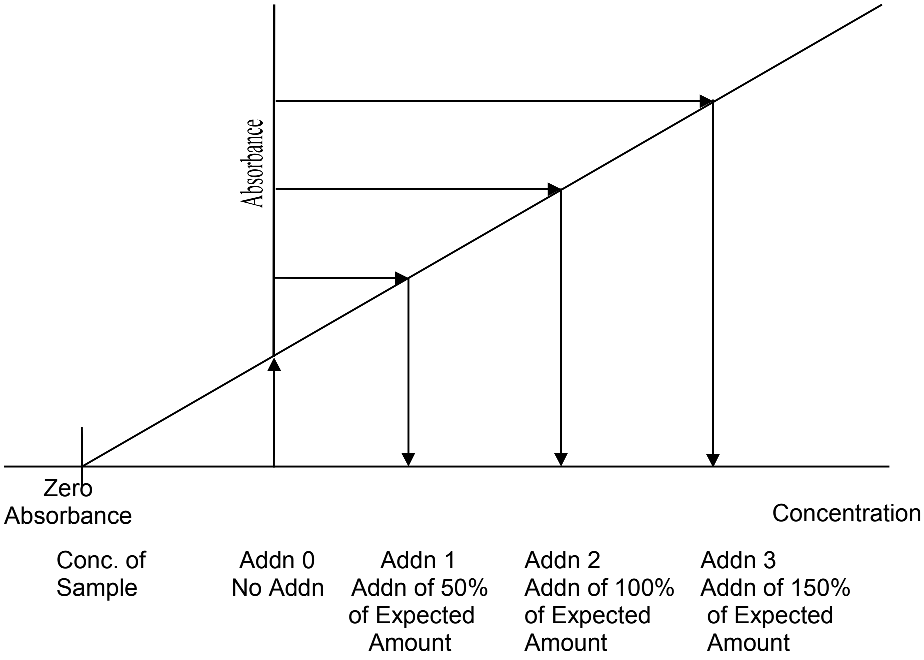
Attachment 8

MSA Guidance

Method of Standard Addition

Four equal volume aliquots of sample are measured and known amounts of standards are added to three aliquots. The fourth aliquot is the unknown and no standard is added to it. The concentration of standard added to the first aliquot should be 50% of the expected concentration. The concentration of standard added to the second aliquot should be 100% of the expected concentration and the concentration of standard added to the third aliquot should be 150% of the expected concentration. The volume of the unspiked and spiked standard should be the same.

In order to determine the concentration of analyte in the sample, the analytical value of each solution is determined and a plot or linear regression performed. On the vertical axis the analytical value is plotted versus the concentrations of the standards on the horizontal axis. An example plot is shown in Figure 1. When the resulting line is extrapolated back to zero absorbance, the absolute value of the point of interception of the horizontal axis is the concentration of the unknown.



For the method of standard additions to be correctly applied, the following limitations must be taken into consideration:

- The plot of the sample and standards must be linear (r=0.995 or greater) over the concentration range of concern. For best results, the slope of the curve should be similar to that of a plot of the aqueous standard curve.
- The effect of the interference should not vary as the ratio of the standard added to the sample matrix changes.

Attachment 9

Troubleshooting Guide

Problem	**Possible Cause/ Solution**
High Blanks	Increase rinse time Clean or replace tip Clean or replace torch Clean or replace sample tubing Clean or replace nebulizer
Instrument Drift	RF not cooling properly Vacuum level is too low Replace torch (Crack) Clean or replace nebulizer (blockage) Check room temperature (changing) Replace pump tubing Room humidity too high Clean torch tip (salt buildup) Check for argon leaks Adjust sample carrier gas Replace RF generator
Erratic Readings, Flickering Torch or High RSD	Check for argon leaks Adjust sample carrier gas Replace tubing (clogged) Check drainage(back pressure changing) Increase uptake time (too short) Increase flush time (too short) Clean nebulizer, torch or spray chamber Increase sample volume introduced Check that autosampler tubes are full Sample or dilution of sample not mixed Increase integration time (too short) Realign torch Reduce amount of tubing connectors
Standards reading twice normal absorbance or concentration	Incorrect standard used Incorrect dilution performed

Attachment 10

Contamination Control Guidelines

The following procedures are strongly recommended to prevent contamination:

All work areas used to prepare standards and spikes should be cleaned before and after each use.

All glassware should be washed with detergent and tap water and rinsed with 1:1 nitric acid followed by deionized water.

Proper laboratory housekeeping is essential in the reduction of contamination in the metals laboratory. All work areas must be kept scrupulously clean.

Powdered gloves should not be used in the metals laboratory because the powder contains silica and zinc as well as other metallic analytes.

Glassware should be periodically checked for cracks and etches and discarded if found. Etched glassware can cause cross contamination of any metallic analytes.

The following are helpful hints in the identification of the source of contaminants:

Yellow pipette tips and volumetric caps can sometimes contain cadmium.

Some sample cups have been found to contain lead.

The markings on glass beakers have been found to contain lead. If acid baths are in use for glassware cleaning, they should be periodically checked for contaminants since contaminant concentrations will increase over time.

New glassware especially beakers can be a source of silica and boron.

Reagents or standards can contain contaminants or be contaminated with the improper use of a pipette.

Improper cleaning of glassware can cause contamination.

Latex gloves contain over 500 ppb of zinc.

Attachment 11
DoD QSM 5.0 QC Criteria for Analysis by ICP

QSM 5.0 Table 8. Inorganic Analysis by ICP

Requirement	**DoD QSM 5.0 and DOE QSAS 3.0**
Linear Dynamic Range (LDR) or high-level standard check	Run an LDR or high-level check standard at least once every 6 months. When calibrating with a single standard and a blank, the daily LDR standard must be analyzed at a concentration greater than any samples analyzed that day. Data cannot be reported above the high calibration range without an established/passing high-level check standard. Must be within ± 10% of expected value. Dilute samples within the calibration range or re-establish/verify the LDR.
Initial Calibration (ICAL)	Measure a minimum of one high standard and a calibration blank, daily. If more than one standard used, then $r^2 \geq 0.99$ ($r \geq 0.995$), otherwise no acceptance criteria. The ICAL must pass before running any samples. NOTE: The laboratory currently performs duplicate burns for the ICPAES method.
Initial Calibration Verification (ICV)	Run second-source standard once after each ICAL and prior to sample analysis. All reported analytes must be within ± 10% of expected value. Correct any problems, verify standard, and rerun ICV. If that fails, correct problem and rerun ICAL. Verification must pass before running any samples.
Continuing Calibration Verification (CCV)	Run CCV after every 10 field samples, and at the end of the analysis sequence. All reported values within ± 10% of expected value If the CCV is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project (3HR). Correct any problems then rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since last successful CCV. Results cannot be reported without a valid CCV. Or Immediately (within one hour) 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. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analytes(s) in all samples since the last acceptable CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Low-Level Calibration Check Standard (Low-level ICV)	Run low-level standard at a concentration ≤ LOQ daily after one-point ICAL. All reported analytes must be within ± 20% of expected value. Correct any problems, then reanalyze or repeat ICAL. Results cannot be reported without a valid low-level calibration check standard.

Attachment 11
DoD QSM 5.0 QC Criteria for Analysis by ICP
(continued)

QSM 5.0 Table 8. Inorganic Analysis by ICP

Requirement	DoD QSM 5.0 and DOE QSAS 3.0
Initial and Continuing Calibration Blank (ICB.CCB)	Analyze calibration blank before analyzing samples, after every 10 field samples, and at the end of the analysis sequence. No analytes detected > ½ LOQ (RL) or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. (13ICP) If not accepted by client, ICB/CCB must be <LOD. If criteria not met, correct problem If reanalysis is not possible, apply B-flag to all results for the specific analyte(s) in all samples processed with the contaminated blank. Must be explained in the case narrative. Flagging is only appropriate when samples cannot be reanalyzed. Correct any problems and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed. CCB failures due to carryover may not require an ICAL.
Interference Check Solution (ICS)	Run the ICS at the beginning of an analytical run (after ICAL and prior to sample analysis). ICS-A: Absolute value of concentration for all non-spiked analytes must be < LOD (unless they are a verified trace impurity from one of the spiked analytes). ICS-AB: Within ± 20% of expected value. (Note: ICS-AB not needed if instrument can read negative responses.) Correct any problems and reanalyze ICS. Do not analyze samples without a valid ICS. NOTE: TAL Denver has a letter from the ICSA standards manufacturer for many of the elements.
Method Blank	One per prep batch. No analytes detected > ½ LOQ (RL) or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common lab contaminants not detected > LOQ. (2CLC) For ICP, common lab contaminants are: Al, Ca, Fe, K, Mg, Na, Si, Zn (Ba for TCLP) If criteria not met, correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank. If reanalysis is not possible, apply B-flag to all results for the specific analyte(s) in all samples processed with the contaminated blank. Must be explained in the case narrative. Flagging is only appropriate when samples cannot be reanalyzed.
LCS	One per prep batch. Recovery must meet DoD QSM limits. If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project (3HR). Correct any problems, then re-prep and reanalyze LCS and associated samples for failed analytes in all samples in the associated batch. If corrective action fails, apply Q-flag to specific analyte(s) in all samples in associated batch.

Attachment 11
DoD QSM 5.0 QC Criteria for Analysis by ICP
(continued)

QSM 5.0 Table 8. Inorganic Analysis by ICP

Requirement	**DoD QSM 5.0 and DOE QSAS 3.0**
Matrix Spike (MS)	One MS per prep batch. Use DoD acceptance criteria for LCS. If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.
MSD or Sample Duplicate	Analyze one MSD or sample duplicate per prep batch per matrix. RPD between duplicates must be ≤ 20%. For failures, consult project-specific DQOs and contact client for additional measures to be taken. If acceptance criteria are not met, apply J-flag. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.
Dilution Test	One per prep batch if MS or MSD fails. Only applicable for samples with concentrations >50x LOQ (prior to dilution). For samples with lower concentrations perform PDS. Five-fold dilution must agree within ± 10% of the original result. Apply J-flag if acceptance criteria not met and explain in the case narrative.
Post-Digestion Spike (PDS) Addition	Perform Recovery Test when dilution test fails or analyte concentration in all samples is <50 x LOQ. Recovery must be within 80-120 % of expected result. If test fails, then run samples by MSA or apply J-flag to all sample results (for same matrix) in which MSA was not run when recovery is outside of 80 - 120%.
Method of Standard Additions	When dilution or post digestion spike fails and if required by the project. Document use of MSA in case narrative.

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Title: Extraction of Aqueous Samples by Separatory Funnel, SW846 3510C and EPA 600 Series

Approvals (Signature/Date):

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1.0 Scope and Application

1.1 This Standard Operating Procedure (SOP) is applicable to the solvent extraction of organic compounds from water samples, TCLP leachates, SPLP leachates, and Wyoming Leachates using a separatory funnel. This SOP based on SW-846 Method 3510C, EPA 608, EPA 610, EPA 614, AK102, NWTPH-Dx, and Oklahoma DRO method.

1.2 The determinative methods used in conjunction with this procedure are listed in Table 1. This extraction procedure may be used for additional methods when appropriate pH and spiking mixtures are used.

1.3 This procedure does not include the concentration and cleanup steps. See SOP DV-OP-0007, “Concentration of Organic Extracts”, for details concerning the concentration and cleanup of extracts.

2.0 Summary of Method

A measured volume of sample, is placed in a separatory funnel. The pH is adjusted as required for the efficient extraction of specific compounds. The organic compounds are extracted with three portions of methylene chloride. The water phase is discarded. The organic phase is dried using sodium sulfate.

3.0 Definitions

3.1 **Extraction Holding Time**: The elapsed time expressed in days from the date of sample collection to the date the extraction starts. The holding time is tracked in the laboratory LIMS system, and is the primary basis of prioritizing work.

3.2 **Preparation Batch**: A group of up to 20 samples that are of the same matrix and are processed together in the same extraction event using the same procedure and lots of reagents and standards

3.3 **Method Comments:** The Method Comments are used to communicate to the bench level chemists special requirements and instructions from the client. Please reference WI-DV-0032 for details on Method Comments.

3.4 **Quality Assurance Summary (QAS)**: Certain clients may require extensive specific project instructions or program QC, which are too lengthy to fit conveniently in the Method Comments field in LIMS. In these situations, laboratory Project Managers describe the special requirements in a written QAS to address these requirements. QASs are posted on a public drive for easy accessibility by all lab employees. Normally, QASs are introduced to analysts in an initial project kick-off meeting to be sure that the requirements are understood.

3.5 **Aliquot**: A part that is a definite fraction of a whole; as in “take an aliquot of a sample for testing or analysis.” In the context of this SOP, “aliquot” is also used as a verb, meaning to take all or part of a sample for preparation, extraction, and/or analysis.

4.0 Interferences

4.1 Chemical and physical interferences may be encountered when analyzing samples using this method.

4.2 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All 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. Specific selection of reagents may be required to avoid introduction of contaminants.

4.3 Visual interferences or anomalies (such as foaming, emulsions, odor, etc.) must be documented in an NCM.

4.4 The most common interference is laboratory contamination, which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them. Especially take note of the possibility of phthalate contamination from gloves. Gloves should be changed out frequently and whenever they come in contact with solvent. Glassware should be handled in a fashion that keeps gloves away from the interior and mouth of the glassware.

4.5 The decomposition of some analytes has been demonstrated under basic extraction conditions. Organochlorine pesticides may dechlorinate, phthalate esters may exchange, and phenol may react to form tannates. These reactions increase with increasing pH, and are decreased by the shorter reaction times available in Method 3510C. Method 3510C is preferred over Method 3520C for the analysis of these classes of compounds. However, the recovery of phenols is optimized by using Method 3520C and performing the initial extraction at the acid pH.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual and this document.

5.2 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, nitrile or latex gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.3 Specific Safety Concerns or Requirements

5.3.1 The use of separatory funnels to extract samples using methylene chloride creates excessive pressure very rapidly. Initial venting should be done immediately after the separatory funnel has been sealed and inverted. Vent the funnel into the hood away from people and other samples. This is considered a high-risk activity. Either a face shield must be worn over safety glasses or goggles must be worn when it is performed.

5.3.2 Glass centrifuge tubes can break in the centrifuge if proper care is not taken. This can lead to a hazardous material spill and endanger employees. Do not exceed the manufacturer's recommended maximum RPM for glass containers. Normally speeds greater than 2700 rpm are not advisable.

5.3.3 The procedure calls for the use of an electric rotator. The rotator is equipped with a safety latch that does not allow the rotator to rotate even if the power switch is turned on. The separatory funnels are secured to the rotator using straps. During the procedure it will be necessary to loosen the straps in order to un-stopper the separatory funnels. Whenever the straps are loose, the safety latch must be fastened to prevent the rotator from rotating.

5.3.4 Glasswool is a carcinogen and therefore should be handled in a hood to avoid inhalation of dust.

5.4 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 MSDS 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 MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Materials with Serious or Significant Hazard Rating

Material (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Methylene Chloride	Carcinogen Irritant	25 ppm (TWA) 125 ppm (STEL)	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, and headache. Causes irritation, redness, and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Sodium Hydroxide	Corrosive Poison	2 mg/m3	Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat, and runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes

Material (1)	**Hazards**	**Exposure Limit** (2)	**Signs and Symptoms of Exposure**
			and can cause burns that may result in permanent impairment of vision, even blindness with greater exposures.
Hydrochloric Acid	Corrosive Poison	5 ppm (Ceiling)	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Sulfuric Acid	Corrosive Carcinogen	1 mg/m3	Inhalation may cause irritation of the respiratory tract with burning pain the nose and throat, coughing, wheezing, shortness of breath, and pulmonary edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Causes skin burns. Causes severe eye burns. May cause irreversible eye injury, blindness, permanent corneal opacification.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit			

6.0 Equipment and Supplies

NOTE: All glassware used in this procedure is cleaned following SOP DV-OP-0004. In addition, the glassware is rinsed with methylene chloride immediately prior to use.

6.1 Supplies

- Separatory funnel, 2-liter with polytetrafluoroethylene (PTFE) stopcock and stopper.
- Separatory funnel, 500-mL with polytetrafluoroethylene (PTFE) stopcock and stopper.
- Separatory funnel rack and mechanical rotator.
- Balance, ≥ 1400 g capacity, accurate to ± 1 g, calibration checked daily per SOP DV-QA-0014.
- pH indicator paper, wide range.
- Class A Graduated Cylinder, sizes ranging from 50 mL to 1 L.
- Media bottles, 300 mL with Teflon-lined caps or capped with aluminum foil.

- Media bottles, 100 mL with Teflon-lined caps or capped with aluminum foil.
- Disposable pipettes, various volumes.
- Stemless glass funnel.
- Glass wool, baked at 400 °C for four hours.
- Mechanical pipette, 1 mL, positive displacement, with disposable tips, calibrated per SOP DV-QA-0008.
- Aluminum foil.
- Paper towels.

6.2 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on G:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1 Reagent Water

TestAmerica Denver has two ELGA water purification systems. The water coming from the ELGA system should be 18-18.2 Mohm-cm. The performance of the water polishing system is checked daily and recorded per SOP DV-QA-0026.

7.2 Methylene Chloride

Each lot of solvent is tested following SOP CA-Q-S-001 DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.3 Acids and Bases

7.3.1 1:1 Sulfuric Acid (H2SO4), *TALS Reagent ID "1:1 H2SO4"*

Place an ice water bath on a stir plate. Place a container with a magnetic stir bar in the bath. While stirring, slowly add 1 part concentrated reagent grade sulfuric acid (36N) to 1 part water from the ELGA purification system. Assign a 1 year expiration date from the date made or the vender expiration date, whichever is shorter.

7.3.2 10N Sodium Hydroxide (NaOH), *TALS Reagent ID "10N_NaOH"*

Purchased at ready-to-use concentration from commercial vendors. Assign a 1 year expiration date from the date opened or the vender expiration date, whichever is shorter.

7.3.3 1N Hydrochloric Acid (HCl), *TALS Reagent ID "1N_HCl"*

Dilute 100 mL of stock reagent grade, concentrated HCl to 1000 mL with reagent water.

7.4 Baked Sodium Sulfate, 12-60 mesh

Heat sodium sulfate in a 400 °C oven for at least four hours. Store in tightly closed container.

7.5 Baked Sodium Chloride

Bake in 400 °C oven for at least 4 hours.

7.6 Standards

Please reference SOP DV-OP-00020 and WI-DV-009 for information regarding the surrogate and spike standards used in this procedure.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix and Method	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Water	Amber Glass	1000 mL	Cool, $\leq 6^{o}C$	7 Days	40 CFR Part 136.3
Water for Method AK 102	Amber Glass	1000 mL	Cool, $\leq 6^{o}C$ and pH ≤ 2 with HCl	14 Days if properly preserved. 7 Days if un-preserved.	Method AK 102
Water for Method Oklahoma DRO	Amber Glass	1000 mL	Cool, $\leq 6^{o}C$ and pH ≤ 2 with HCl	7 Days	Oklahoma Dept. of Environmental Quality
Water for Method NWTPH-DX	Amber Glass	1000 mL	Cool, $\leq 6^{o}C$ and pH ≤ 2 with HCl	7 Days	NWTPH-Dx

Matrix and Method	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Water for Method 8082 or 8082A	Amber Glass	1000 mL	Cool, $\leq 6^oC$	None[2]	SW-846 Chapter 4, Revision 4, Feb 2007
Water for Method 8081 or 8082 by Large Volume Injection	Amber Glass	250 mL	Cool, $\leq 6^oC$	7 Days	40 CFR Part 136.3
Water for Method 8270SIM by Large Volume Injection	Amber Glass	250 mL	Cool, $\leq 6^oC$	7 Days	40 CFR Part 136.3
TCLP Leachates	Glass	200 mL for 8270 100 mL for 8081	Cool, $\leq 6^oC$	7 Days from the start of the leach	SW-846 1311
SPLP Leachates	Glass	1000 mL	Cool, $\leq 6^oC$	7 Days from the start of the leach	SW-846 1312
Wyoming Leachates	Glass	1000mL	Cool, $\leq 6^oC$	7 Days from the start of the leach	--

[1] Exclusive of analysis.

[2] Some regulatory agencies do not accept SW-846 Revision 4 of Chapter 4 and will require a 1 week hold time for method 8082 and 8082A. The states of California, South Carolina, Pennsylvania, and Connecticut require a 1 week hold time.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Assurance Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs. This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated.

9.1.3 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 Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 13 for more details on detection limit studies, initial demonstrations of capability, and analyst training and qualification.

9.3 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 that is used to analyze samples from the same preparation batch. See QC Policy DV-QA-003P for further details.

9.4 Method Blank (MB)

9.4.1 At least one method blank must be processed with each preparation batch. The method blank is processed and analyzed just as if it were a field sample.

9.4.2 The method blank for batches of aqueous samples for Large Volume Injection (prep method 3510C_LVI) consists of 250mL of reagent water free of any of the analyte(s) of interest.

9.4.3 The method blank for batches of aqueous samples for all other methods consists of 1 L of reagent water free of any of the analyte(s) of interest.

9.4.4 The method blank for batches of TCLP leachates for method 8081 consists of 100 mL of leach fluid.

9.4.5 The method blank for batches of TCLP leachates for method 8270 consists of 200 mL of leach fluid.

9.4.6 The method blank for batches of SPLP or Wyoming leachates consists of 1 L of leach fluid.

9.5 Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD)

9.5.1 At least one LCS must be processed with each preparation batch. The LCS is carried through the entire analytical procedure just as if it were a sample.

9.5.2 The LCS for batches of aqueous samples for Large Volume Injection (prep method 3510C_LVI) consists of 250mL of reagent water to which the analyte(s) of interest are added at known concentrations.

9.5.3 For aqueous sample batches for all other methods, the LCS consists of 1 L of reagent water to which the analyte(s) of interest are added at known concentration.

9.5.4 For method 8081 TCLP leachates, the LCS consists of 100 mL of leach fluid to which the analyte(s) of interest are added at known concentration.

9.5.5 For method 8270 TCLP leachates, the LCS consists of 200 mL of leach fluid to which the analyte(s) of interest are added at known concentration.

9.5.6 For SPLP leachates and Wyoming leachates, the LCS consists of 1 L of leach fluid to which the analyte(s) of interest are added at known concentration.

9.5.7 Method 608, 614, 610 requires a LCS at a 10% frequency. In other words one LCS is required for a batch of 10 or less samples. A LCSD is required for a batch of 11 or more samples.

9.5.8 Method AK102 requires LCS and a LCSD for every batch for every spike compound.

9.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

9.6.1 One MS/MSD pair must be processed with each preparation batch. A matrix spike (MS) is a field sample to which known concentrations of target analytes have been added. It is prepared in a manner similar to the LCS, but uses a real sample matrix in place of the blank matrix. A matrix spike duplicate (MSD) is a second aliquot of the same sample (spiked exactly as the MS) that is prepared and analyzed along with the sample and matrix spike. Some programs allow spikes to be reported for project-related samples only. Samples identified as field blanks cannot be used for the MS/MSD analysis.

9.6.2 If insufficient sample volume is available for MS/MSD, an NCM must be written and a LCSD must be prepared unless Method Comments indicate otherwise.

9.6.3 Method 608, 610, and 614 requires one matrix spike for every 10 samples. If the batch has more than 10 samples, then two matrix spikes must be performed. The two matrix spikes are to be performed on two different samples. If there is insufficient sample volume for matrix spikes, then a LCSD must be performed.

9.6.4 Method NWTPH-Dx requires a matrix spike and a matrix spike duplicate for every 10 samples. If insufficient sample volume is available for MS/MSD, a NCM must be written and a LCS and LCSD must be performed for every 10 samples.

9.7 Surrogate Spikes

Every calibration standard, field sample, and QC sample (i.e. method blank, LCS, LCSD, MS, and MSD) is spiked with surrogate compounds.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative. Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.2 Critical Procedural Considerations

10.2.1 As stated throughout this SOP, analysts must review the Method Comments and any applicable QASs before starting work. This review is also documented on the Organic Extraction Checklist (see WI-DV-0009).

10.2.2 Analyst must focus on using clean technique throughout this procedure. Any parts or pipettes that come into direct contact with dirty surfaces or any other separatory funnel than the designated one should be cleaned or disposed of before coming into contact with the sample.

10.3 Assemble and clean the glassware immediately before use.

10.3.1 Place a stopcock in each separatory funnel. For 1-liter extractions use a 2000mL sepfunnel. For 250mL, 200mL and 100mL extractions, use a 500mL sepfunnel. Place a stopper for each separatory funnel on a clean sheet of aluminum foil that is marked with individual positions for each stopper. This is done to prevent cross-contamination.

NOTE: Samples logged with method 3510_LVI are for Large Volume Injection methods and require 250mL initial volumes. Samples logged for 8270 with a TCLP pre-prep require 200mL initial volumes. Samples logged for 8081 with a TCLP pre-prep require 100mL initial volumes.

10.3.2 For each separatory funnel, plug a glass funnel with baked glass wool and add baked sodium sulfate. Place the funnel on a media bottle and place the media bottle below the separatory funnel.

10.3.3 Rinse each separatory funnel once with methylene chloride. Be sure that all surfaces come into contact with the solvent. Drain the methylene chloride into the media bottle through the sodium sulfate.

10.3.4 Rinse the sodium sulfate with additional methylene chloride if the first rinse did not completely saturate the sodium sulfate.

10.3.5 Allow the methylene chloride to drain completely into the media bottle. Swirl the media bottle to ensure all surfaces come into contact with the solvent. Add additional methylene chloride to the rinse if necessary.

10.3.6 Discard the methylene chloride.

10.3.7 Label each media bottle with the sample ID or batch QC ID.

10.4 Prepare LCS and Method Blank Samples

NOTE: For SW-846 methods if there is not a MS/MSD pair in the batch then perform a LCS/LCSD. Methods 608, 610, and 614 require a LCS and LCSD in batches of 11 samples or more or if there are no Matrix Spikes in batches of 10 or less.

10.4.1 For aqueous sample batches logged for Large Volume Injection, (3510_LVI), pour 250mL of reagent water into the separatory funnels marked for the LCSs and the MB.

10.4.2 For all other aqueous sample batches, pour 1 liter of reagent water into the separatory funnels marked for the LCSs and the MB.

10.4.3 For 8270 TCLP leachates, use a 250mL or 500mL Class A graduated cylinder to measure out 200 mL of the appropriate leach fluid for each MB and LCS and LCSD. Record the volume to the nearest mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct leach fluid was used.

10.4.4 For 8081 TCLP leachates, use a 100mL or 250mL Class A graduated cylinder to measure out 100 mL of the appropriate leach fluid for each MB and LCS and LCSD. Record the volume to the nearest mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct leach fluid was used.

10.4.5 For SPLP leachates, use a 1000mL Class A graduated cylinder to measure out 1000 mL of the appropriate leach fluid for each MB and LCS and LCSD. Record the volume to the nearest 10 mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct leach fluid was used.

10.4.6 For Wyoming leachates, measure out 1000 mL of the appropriate leach fluid for each MB and LCS and LCSD. This can be done gravimetrically or volumetrically. If done volumetrically, record the volume to the nearest 10mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct blank fluid was used.

10.5 Measure the initial sample pH of the samples.

10.5.1 Measure the initial sample pH with wide-range pH paper and record the pH on the extraction bench sheet.

10.5.2 If the sample is logged for AK102_103, Okla_DRO, or NWTPH_Dx the samples should have been field preserved. See Section 8. If the samples are not preserved, an NCM should be written.

10.6 Aliquot the samples

10.6.1 For 8270 TCLP leachates, use a 250mL or 500mL Class A graduated cylinder to measure out 200 mL of the leachate. Record the volume to the nearest mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct leach fluid was used.

10.6.2 For 8081 TCLP leachates, use a 100mL or 250mL Class A graduated cylinder to measure out 100 mL of the leachate. Record the volume to the nearest mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct leach fluid was used.

10.6.3 For SPLP leachates, use a 1 Liter Class A graduated cylinder to measure out 1000 mL of the leachate. Record the volume to the nearest 10 mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct leach fluid was used.

10.6.4 For Wyoming leachates, measure out 1000 mL of leachate. This can be done gravimetrically or volumetrically. If done volumetrically, use a Class A graduated cylinder and record the volume to the nearest 10mL. Place the leachate bottle beside the separatory funnel so a second analyst can check that the correct blank fluid was used.

10.6.5 For water samples, it should be noted that TestAmerica Denver routinely aliquots gravimetrically. This is done to prevent cross-contamination due to volumetric glassware and to provide a more accurate initial volume measurement. However, some clients and regulatory programs require the laboratory to aliquot samples volumetrically. The Method Comments and QASs must be read before samples are aliquotted to check for this requirement. If samples are to be aliquotted volumetrically, use Class A volumetric glassware only and proceed to Section 10.6.7

10.6.6 Weigh the bottle (250mL amber bottles for 3510C_LVI or 1000mL amber bottles for all other aqueous samples) and record the gross weight to the nearest gram. If there is any indication that the sample's density is not 1g=1mL, then measure the density of the sample using a calibrated pipette and an analytical balance. The weight of the sample extraction will be corrected for the density later. See Section

11 for the calculation. For example, normally a 1 liter bottle weighs 500g when empty and when filled completely can only hold 1060mL, therefore a full bottle weighing more than 1560g is an indication that either the sample density is greater than 1g or the sample bottle contains a lot of sediment. Document any sample with a density greater than 1g in an NCM.

10.6.7 Inspect the samples for large amounts of sediment that may interfere with the extraction of the sample by causing excessive emulsions or clogging the stop-cock.

10.6.7.1 If the sample contains so much sediment that the entire sample volume cannot be extracted, decant the sample into the separatory funnel (or a 1 L graduated cylinder if volumetric aliquotting is required), careful not to transfer the sediment. Write a NCM to document the sediment and that it prevented the entire sample volume from being extracted and the sample container from being solvent rinsed.

10.6.7.2 If the sample does not contain a significant amount of sediment, then the entire sample volume will be used in the extraction. Do not pour the sample into the separatory funnel (or into the graduated cylinder if volumetric aliquotting is required) until after the surrogates and any necessary spikes have been added to the samples.

10.6.8 Place the sample containers in front of the separatory funnel labeled for that sample. A second analyst should then check the labels to make sure the correct sample is being extracted. This check is documented in the Organic Extraction Checklist (WI-DV-0009)

10.7 Add Surrogates to All Field Samples and QC Samples

10.7.1 The standards should be allowed to come to room temperature before spiking the samples. Record the ID of the standard used on the benchsheet.

NOTE: The addition of spikes and surrogates to samples must be done only immediately after a second analyst has reviewed the batch. Reference work instruction WI-DV-009.

10.7.2 Only one batch should be surrogated at a time to ensure the correct standards are used.

10.7.3 Add the appropriate volume of the appropriate working surrogate standard to the sample container for each sample and MS/MSD. Add the surrogate standard to the MB and the LCS's in the separatory funnels. Record the ID of the standard used on the bench sheet. Reference work instruction WI-DV-009 to determine the appropriate standard and the appropriate volume.

NOTE: If the sample contains an amount of sediment that has been deemed to interfere with the extraction process then the surrogate standard is added to the sample in the separatory funnel or in the graduated cylinder. This is considered a deviation and must be documented in a NCM.

10.8 Add Spikes to all LCS's and MS/MSDs

10.8.1 Add the appropriate volume of the appropriate working spike standard to the MS/MSD sample containers and the separatory funnels for the LCS and/or LCSD samples. Record the ID of the standard used on the bench sheet. Reference work instruction WI-DV-009 to determine the appropriate standard and the appropriate volume.

10.9 Add approximately 6g (1 teaspoon) of NaCl to all samples and all QC samples. This is done to give the reagent water used in the MBs and LCSs some ionic strength to more closely mimic the matrix of actual water samples and to aide in the extraction of the more polar target compounds. Record the lot number of the sodium chloride on the bench sheet.

10.10 If volumetric aliquotting is required, transfer the entire sample into a Class A graduated cylinder and record the volume on the benchsheet. If the sample bottle contains more than 1000 mL, a 100mL Class A graduated cylinder can be used to complete the measurement. The entire sample volume must be used. Record the volume to the nearest 10 mL. Then pour the sample into the labeled separatory funnel. Place the used graduated cylinder in front of the appropriate separatory funnel so it can be solvent rinsed later.

NOTE: A 1000 mL Class A graduated cylinder is not accurate enough to measure to the nearest 1 mL. Therefore all samples that are aliquoted using a 1000 mL Class A graduated cylinder will have the initial volume recorded to the nearest 10 mL. This accuracy is sufficient.

10.11 If volumetric aliquotting is not required, pour the sample directly into the separatory funnel. Place the empty sample container in front of the appropriate separatory funnel so it can be solvent rinsed.

10.12 Adjust pH of Field Samples and QC Samples

Adjust the sample pH as indicated in the chart below using a minimum amount of 1:1 sulfuric acid (or 1 M hydrochloric acid for Methods AK102, Okla_DRO and NWTPH_Dx) or 10 N sodium hydroxide, as necessary. Record the adjusted pH and the lot number of the acid or base on the bench sheet. For TCLP leachates by method 8270, usually 1mL of 1:1 sulfuric acid is sufficient.

NOTE: TCLP Leachates may have pH of < 5. In those cases, the pH should be adjusted per the table below.

Method	Initial Extraction pH	Secondary Extraction pH
All 8270 methods *except* SIM.	1 – 2	If samples are TCLP leachates extract at 14. If samples are water extract at 11 - 12
All 8270 SIM methods	As Received	None
All 8081, 8082 and 608 methods.	5 - 9	None
All 8141 and 614 methods	5-8	None
All 8015 methods	As Received	None
All 8310 and 610 methods	As Received	None
AK102_103 Okla_DRO NWTPH_Dx	If samples are preserved between pH 1 – 2, then acidify the MB and LCS. Otherwise extract as received and document insufficient preservation in an NCM.	None

10.13 For 1 Liter samples, add 60 mL of methylene chloride to each empty sample container, unless the entire sample volume was not used. For 250mL or smaller samples, add 30mL of methylene chloride to each empty sample container, unless the entire sample volume was not used. Cap the container and shake gently to rinse all internal surfaces of the bottle. Pour the methylene chloride from the sample container into the appropriate separatory funnel. If a graduated cylinder was used to aliquot volumetrically, rinse the cylinder and add that rinse to the separatory funnel as well. Record the lot number of the methylene chloride on the bench sheet. If the sample contained significant sediment and the entire sample contents could not be extracted, do not rinse the empty sample container, but instead add the solvent directly to the separatory funnel. If the solvent rinse of the sample container cannot be performed, prepare a NCM.

10.14 For water samples that were aliquotted gravimetrically, reweigh the bottle and calculate the initial sample volume by subtracting the empty bottles weight from the full bottles weight, assuming a density of 1g=1mL. If there is any indication that the samples density is not 1g=1mL then measure the density of the sample and correct the calculated initial volume accordingly using the formula in Section 11. Document abnormal sample density in an NCM. For example, normally a 1 liter bottle when filled completely can only hold 1060mL, therefore an initial volume greater than 1060mL is an indication that the density is not 1g. Document any sample with a density greater than 1g in an NCM.

10.15 If the initial volume is less than 80% of the nominal volume, the sample reporting limits and method detection limits will be elevated substantially. Document this in a NCM.

10.16 Stopper and rotate the separatory funnel for 3 minutes with periodic venting to release excess pressure. Document the extraction date and time on the benchsheet.

WARNING: Methylene chloride creates excessive pressure very rapidly! Therefore, initial venting should be done immediately after the separatory funnel has been sealed and shaken a few seconds. Vent into hood away from people and other samples. A face shield or goggles must be worn during venting.

10.17 Allow the organic layer to separate from the water phase for at least 5 minutes or until complete visible separation has been achieved. This can take up to 10 minutes. If the emulsion interface between layers is more than one-third the size of the solvent layer, use mechanical techniques to complete the phase separation. The optimum technique depends upon the sample and may include stirring, pouring the solvent layer and emulsion back through the top of the separatory funnel (pour-back), or centrifugation. The emulsion could also be filtered through the glass funnel by adding additional sodium sulfate to remove all water in the emulsion. This technique should only be used after other techniques have failed to make complete phase separation and only after the last shake.

NOTE 1: If an emulsion forms, the analyst does not have to wait a complete 5 minutes before attempting to break the emulsion with pour-backs and centrifuge. Start employing the mechanical techniques right away to achieve phase separation.

NOTE 2: As much as 15 to 20 mL of methylene chloride is expected to dissolve in 1 L of water. Thus, solvent recovery could be as low as 35 mL from the first shake and still be acceptable. Subsequent shakes should recover at least 50 mL of solvent.

10.18 Drain the lower methylene chloride layer into the sodium sulfate filled glass funnel. Allow the methylene chloride to drain completely into the media bottle. Rinse the sodium sulfate with a small amount of methylene chloride to ensure that all compounds of interest are collected in the media bottle. Record the lot number of the sodium sulfate on the bench sheet. If the sodium sulfate becomes saturated with water, add more to the funnel or replace the existing sodium sulfate with fresh drying agent.

10.19 Repeat the extraction two more times for a total of 3 extractions. Collect all three methylene chloride extracts in the same media bottle. For the 2nd and 3rd extractions it is not necessary to wait 5 minutes to allow the solvent to separate from the water; a 3 minute wait time should be sufficient.

10.20 For the base/neutral and acid extractable method 8270, adjust the pH of the samples according to chart in Section 10.12. For 8270 TCLP leachates an excess of base is required to effectively extract pyridine, therefore at least 7mL of base should be used to ensure the pH is 14. Then extract the sample 3 more times. For these extractions, it is not necessary to wait 5 minutes to allow the solvent to separate from the water; a 3 minute wait time should be sufficient.

10.21 Cap the media bottle with a Teflon-lined cap or aluminum foil and submit for concentration and possible clean-up steps.

10.22 Dispose of the solvent-saturated water remaining in the separatory funnel in the appropriate waste container. See Section 14.

10.23 Initial weights and volumes of samples are entered into LIMS, and the transcribed data must be verified by a second person. This verification is documented on the Organic Extraction Checklists (see WI-DV-009).

10.24 Troubleshooting

10.24.1 If the sample appears very dark or viscous or in any way un-like water, stop and test the sample's miscibility before attempting to extract the sample by this procedure. Place a few milliliters of sample in a vial with methylene chloride. Cap and shake. If the sample is miscible in methylene chloride, the sample should be re-logged as a waste matrix with a prep method of 3580A.

10.25 Maintenance

10.25.1 Approximately every 6 months, the centrifuge should be lubricated.

10.25.2 Contact the Facilities Manager immediately if the rotator is observed to be making un-familiar noises or rotating in a "jerking" manner.

11.0 Data Analysis and Calculations

$$InitialVolume(mL) = \frac{FullBottle(g) - EmptyBottle(g)}{Density(g/mL)}$$

12.0 Method Performance

12.1 Before analyzing samples, the laboratory must establish a method detection limit (MDL). See Policy DV-QA-005P, "Determination of Method Detection Limits", for more information on the method detection limit studies.

12.2 An initial demonstration of capability (IDOC) must be performed by each analyst. On-going proficiency must be demonstrated by each analyst on an annual basis. See DV-QA-0024, "Employee Training", for more information on the IDOCs.

12.3 Training Qualification

The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

13.0 Pollution Control

The volume of spike solutions prepared is minimized to reduce the volume of expired standard solutions requiring hazardous waste disposal.

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in section 13, “Waste Management and Pollution Prevention”, of the Environmental Health and Safety Manual, and DV-HS-001P, “Waste Management Program.”

14.2 The following waste streams are produced when this method is carried out:

14.2.1 Methylene chloride – Waste Stream B

14.2.2 Solid waste/sodium sulfate – Waste Stream D

14.2.3 Basic aqueous sample waste saturated with methylene chloride – Waste Stream X.

14.2.4 Acidic aqueous sample waste saturated with methylene chloride – Waste Stream Y.

14.2.5 Neutral aqueous sample waste saturated with methylene chloride – Waste Stream X or Waste Stream Y.

14.2.6 Expired Standards/Reagents – Contact Waste Coordinator for guidance

NOTE: Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of these materials.

15.0 References / Cross-References

15.1 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition and all promulgated updates, EPA Office of Solid Waste, January 2005, Method 3510C, Separatory Funnel Liquid-Liquid Extraction, Revision 3, December 1996.

15.2 Code of Federal Regulations, Title 40 – Protection of the Environment, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix A – Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Method 608, Organochlorine Pesticides and PCBs.

15.3 Code of Federal Regulations, Title 40 – Protection of the Environment, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix A – Methods for

Organic Chemical Analysis of Municipal and Industrial Wastewater, Method 610, Polynuclear Aromatic Hydrocarbons.

15.4 Code of Federal Regulations, Title 40 – Protection of the Environment, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix A – Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Method 614, Organophosphorous Pesticides.

15.5 Alaska Method AK102, “For the Determination of Diesel Range Organics”, Version 04/08/02.

15.6 Alaska Method AK103, “For the Determination of Residual Range Organics”, Version 04/08/02.

15.7 NWTPH-Dx “Semi-Volatile Petroleum Products Method for Soil and Water.

15.8 Oklahoma Department of Environmental Quality Methods 8000/8100 (Modified) Diesel Range Organics (DRO) Revision 4.1 Date 10/22/97

16.0 Modifications:

16.1 Modifications from SW-846 Method 3510C

16.1.1 Section 7.1 of the method calls for initial sample volume to be determined volumetrically either by measuring out exactly 1 liter or marking the meniscus on the sample container and later determining the volume of water required to fill the bottle back up to the mark. This SOP allows the initial sample volume to be determined by weight in order to achieve a more accurate initial volume and to avoid cross-contamination via glassware.

16.1.2 Section 7.5 of the method calls for shaking the separatory funnel 1-2 minutes. This SOP calls for shaking the separatory funnel for 3 minutes.

16.1.3 Section 7.6 of the method calls for allowing the organic layer to separate from the water phase for a minimum of 10 minutes. This SOP calls for allowing the organic layer to separate from the water phase for a minimum of 5 minutes after the first extraction and a minimum of 3 minutes for subsequent extractions, up to 10 minutes if the separation is not complete.

16.1.4 The source method does not call for the use of sodium chloride. This procedure calls for the addition of approximately 6g of sodium chloride to all samples and all QC samples in order to help the extraction efficiency.

16.1.5 The source method calls for samples to be extracted for method 8141 at the pH they are received. This procedure calls for the extraction to be performed at a pH between 5 and 8. This is done per guidelines found in Section 2 and Section 8 of SW-846 8141B.

16.2 Modifications from 40 CFR Method 608, and 610

16.2.1 Section 10.1 of the method calls for initial sample volume to be determined volumetrically. This SOP allows the initial sample volume to be determined by weight.

16.2.2 Section 10.2 of the method calls for shaking the separatory funnel 1-2 minutes. This SOP calls for shaking the separatory funnel for 3 minutes.

16.2.3 Section 10.2 of the method calls for allowing the organic layer to separate from the water phase for a minimum of 10 minutes. This SOP calls for allowing the organic layer to separate from the water phase for a minimum of 5 minutes after the first extraction and a minimum of 3 minutes for subsequent extractions, up to 10 minutes if the separation is not complete.

16.2.4 Section 10.3 of the method calls for rinsing the sample collection bottle with the 60 mL methylene chloride aliquot for the second and third extraction as well as the first extraction. This SOP calls for rinsing the sample collection bottle with only the first 60-mL methylene chloride aliquot.

16.2.5 The source method does not call for the use of sodium chloride. This procedure calls for the addition of approximately 6g of sodium chloride to all samples and all QC samples in order to help the extraction efficiency.

16.3 Modifications from 40 CFR Method 614

16.3.1 Section 10.1 of the method calls for initial sample volume to be determined volumetrically. This SOP allows the initial sample volume to be determined by weight.

16.3.2 Section 10.2 of the method calls for the extraction to be performed with at 15% v/v methylene chloride in hexane solvent. This procedure uses methylene chloride for the extraction. SOP DV-OP-0007 calls for the methylene chloride extract to be concentrated and exchanged to hexane.

16.3.3 Section 10.2 of the method calls for shaking the separatory funnel 1-2 minutes. This SOP calls for shaking the separatory funnel for 3 minutes.

16.3.4 Section 10.2 of the method calls for allowing the organic layer to separate from the water phase for a minimum of 10 minutes. This SOP calls for allowing the organic layer to separate from the water phase for a minimum of 5 minutes after the first extraction and a minimum of 3 minutes for subsequent extractions, up to 10 minutes if the separation is not complete.

16.3.5 Section 10.3 of the method calls for rinsing the sample collection bottle with the 60 mL solvent aliquot for the second and third extraction as well as the first extraction. This SOP calls for rinsing the sample collection bottle with only the first 60-mL methylene chloride aliquot.

16.3.6 The source method does not call for the use of sodium chloride. This procedure calls for the addition of approximately 6g of sodium chloride to all samples and all QC samples in order to help the extraction efficiency.

16.4 Modifications from Method AK 102

16.4.1 Section 9.1.1.1 of the method calls for using no more than 1 liter of sample and to determine the volume either by measuring out exactly 1 liter or marking the meniscus on the sample container and later determining the volume of water required to fill the bottle back up to the mark. This SOP allows the initial sample volume to be determined by weight in order to achieve a more accurate initial volume and to avoid cross-contamination via glassware. This SOP allows for the extraction of more than 1 L as it calls for the use of the entire sample volume.

16.4.2 Section 9.1.1.6 of the method says to allow the water and solvent layers to separate for approximately 10 minutes. This SOP calls for the allowing the organic layer to separate from the water phase for a minimum of 5 minutes after the first extraction and a minimum of 3 minutes for subsequent extractions, up to 10 minutes if the separation is not complete.

16.4.3 The source method does not call for the use of sodium chloride. This procedure calls for the addition of approximately 6g of sodium chloride to all samples and all QC samples in order to help the extraction efficiency.

16.5 Modifications from Method NWTPH-Dx

16.5.1 The method calls for determining the initial volume of the sample my marking the meniscus on the bottle and later determining the volume of tap water required to fill the bottle back up to the mark. This SOP allows the initial sample volume to be determined by weight in order to achieve a more accurate initial volume and to avoid cross-contamination via glassware.

16.5.2 The method calls for shaking the separatory funnel for one minute. This SOP calls for the separatory funnel to be shaken for at least three minutes.

16.5.3 The source method does not call for the use of sodium chloride. This procedure calls for the addition of approximately 6g of sodium chloride to all samples and all QC samples in order to help the extraction efficiency.

16.6 Modifications from Oklahoma DRO

16.6.1 The method calls for aliquotting 800 mL to 900 mL of the sample volumetrically. This SOP calls for the initial sample volume to be determined by weight in order to achieve a more accurate initial volume and to avoid cross-contamination via glassware. This SOP allows for the extraction of more than 1 L as it calls for the use of the entire sample volume.

16.6.2 The method calls for extracting using 50mL of solvent. This SOP calls for the extraction to be done using at least 60mL of solvent.

16.6.3 The method calls for shaking the separatory funnel for two minutes. This SOP calls for the separatory funnel to be shaken for at least three minutes.

16.6.4 The method calls for a method blank and LCS to be analyzed every 10 samples. This SOP calls for a method blank and LCS to be analyzed every batch of 20 samples.

16.6.5 The source method does not call for the use of sodium chloride. This procedure calls for the addition of approximately 6g of sodium chloride to all samples and all QC samples in order to help the extraction efficiency.

17.0 Attachments

Table 1. Determinative Methods Using Separatory Funnel Extractions

18.0 Revision History

- **Revision 13, August 31, 2015**
    - Annual Technical Review.
    - Removed the Notes from Section 2 and Section 10.9 regarding South Carolina. The laboratory no longer holds South Carolina certification for this method.
    - Added detail to Section 10.12 and 10.20 on how much acid and base is normally required to adjust the pH of leachates for method 8270.

- **Revision 12.0, August 31, 2014**
    - Revised Section 2 to remove references to initial volume. The procedure is used on waters and leachates with a variety of initial volumes. That detail is documented later in the procedure and was therefore removed from the summary found in Section 2.
    - Added a comment to Section 9.1.2 that states: “This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated.”
    - Section 9 was revised to remove Acceptance Criteria and Corrective Action details. This information is found in the analytical procedures.
    - Removed the Note following Section 10.4.2 that instructs the analyst to check the samples for sodium thiosulfate preservation. TestAmerica Denver does not analyze drinking water samples by this procedure and therefore this preservation is not needed.
    - All references to 8270 by LVI were removed. TestAmerica Denver does not extract samples by this procedure for 8270 by LVI. Instead the samples are extracted by 3520C under DV-OP-0008.
    - The table in Section 10.12 was revised to make it easier to read and locate the correct Method.
    - Troubleshooting and Maintenance sections were added per DoD QSM 5.0 requirements.

- **Revision 11.0, August 19, 2013**
  - Added statement to Section 2.0 that LVI must not be used on SC samples
- **Revision 10.0, May 14, 2013**
  - The procedure was revised to instruct the analyst to allow the organic and aqueous phases to separate for a minimum of 5 minutes after the first extraction and 3 minutes after subsequent extractions.
  - The procedure was revised to increase the amount of sodium chloride added to samples and QC from 3g to 6g.
  - Section 5 was revised to include the hazards of glasswool and to instruct the analysts to handle it only in a fumehood.
  - Section 8 was revised to change the hold-time calculation for leachates from the start of the leaching procedure instead of the completion of the leaching procedure. This was done to ensure the holding times are contiguous.
  - Section 10.13 was revised to instruct the analyst to extract 250mL to 100mL samples with 30mL of solvent instead of 15mL of solvent. This was done to increase extraction efficiency while still reducing solvent usage.
  - Sections 2.0, 9.1 and 10.1 were updated to reflect current practice.
- **Revision 9.0, January 15, 2013**
  - Section 10.9 was updated to include note to eliminate use of salt in South Carolina samples.
- **Revision 8.0, September 25, 2012**
  - This procedure was updated to include instructions on how to extract 8270 water samples for Large Volume Injection.
- **Revision 7.0, January 31, 2012**
  - Annual Technical Review
  - Updated Section 6.2 to describe the requirements for computer software and hardware
  - Updated Section 7.0 to describe requirements for Reagents and Standards.
  - Updated Section 8.0 to state PCBs by method 8082 have no holding time as per SW-846 Update 4 and that samples for analysis by NW-TPH have a 7 day hold time, even if acid preserved.
  - Updated Section 9.1.4 and Section 10.1 to accurately describe the NCM notification system.
  - Updated Section 10.4 and 10.6 to state the appropriate size of the graduated cylinders to be used to measure out 100mL and 200mL of leachate.

  - Updated Sections 10.6.6 and 10.14 to give guidance to the analyst when a density check of a sample is required.
  - Updated Section 10.9 to give more detail on how much sodium chloride should be added to the samples.
  - Updated Section 16 to include the method modification of the sodium chloride addition.
  - Updated Table 1 to reflect the current analytical SOPs.
  - Corrected grammatical and formatting errors

- **Revision 6.0 dated 01/10/11**
  - Added note to Section 6 that sodium sulfate should be stored in tightly closed container.
  - Revised Section 7 to reference DV-OP-00020 for information about surrogate and spike standards.
  - Corrected Section 7.1 to indicate that the reagent water should be 18 to 18.2 Mohm/cm.
  - Revised procedure to include details on the extraction of Wyoming Leachates.
  - Added references to methods NWTPH-Dx, and Oklahoma DRO.
  - Added Section 6.2 computer software and hardware.
  - Section 8 was revised to give more detail on the preservation and hold times for methods AK102, AK103, NWTPH-Dx, and Oklahoma DRO.
  - Revised Section 9 to include more detail on QC requirements for methods AK102_103, NWTPH-Dx, and Oklahoma DRO.
  - Revised Section 10 to clarify that when 1 liter graduated cylinders are used to measure the initial volume of the water samples, that the volume should be recorded to the nearest 10mL.
  - Revised Section 10 to instruct that if samples for methods AK102_103, NWTPH-Dx, and Oklahoma DRO are received preserved, then the MB and the LCS samples should also be acidified with HCl. Otherwise the samples are extracted as received.
  - Revised Section 16 to include more detail on modification from methods AK102_103, NWTPH-Dx, and Oklahoma DRO
  - Revised the procedure to call for the 2nd fraction of 8270 TCLP leachates to be extracted at a pH of 14 instead of the pH 11 to 12 used in water samples. This was done to help the recovery of pyridine.

Earlier revision histories have been archived and are available upon request.

TABLE 1.

Determinative Methods Using Separatory Funnel Extractions

Method Description	*Determinative Method*	*SOP*
Diesel Range Organics & Jet Fuels	SW-846 8015, California LUFT Method, Alaska Methods AK102 & AK103 SW-846 8015C	DV-GC-0027
Chlorinated Pesticides	SW-846 8081A SW-846 8081B EPA Method 608	DV-GC-0020 DV-GC-0016
Polychlorinated Biphenyls	SW-846 8082 SW-846 8082A EPA Method 608	DV-GC-0021 DV-GC-0016
Organophosphorus Pesticides	SW-846 8141A, & EPA Method 614	DV-GC-0017
Polynuclear Aromatic Hydrocarbons (PAH)	SW-846 8310 & EPA Method 610	DV-LC-0009
Semi-volatiles by GC/MS	SW-846 8270 SW-846 8270D	DV-MS-0011 DV-MS-0012
PAH by GC/MS SIM	SW-846 8270	DV-MS-0002

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Title: Concentration and Clean-up of Organic Extracts [SW-846, 3510C, 3520C, 3540C, 3546, 3550B, 3550C, 3620C, 3660B, 3665A, ASTM Method D7065-11, and EPA 600 Series Methods]

Approvals (Signature/Date):

12/11/2014
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Adam W Alban 12 Dec 14
Adam Alban — Date
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1.0 Scope and Application

1.1 This standard operating procedure (SOP) provides instructions for the concentration, and if necessary, cleanup, of solvent extracts of organic compounds from water samples, soil samples, TCLP leachates, and SPLP leachates. This SOP is based on SW-846 Methods 3510C, 3520C, 3540C, 3546, 3550B, 3550C, 3620C, 3630C, 3660B, 3665A, ASTM Method D7065-11, and EPA 600 Series methods.

1.2 The determinative methods and extraction methods used in conjunction with this procedure are listed in Attachment 1.

NOTE: This SOP does <u>not</u> include the concentration steps of extracts for Herbicides by method 8151A. See DV-OP-0011 instead.

1.3 This procedure does not include the extraction steps. See the following SOPs for the applicable extraction procedures:

DV-OP-0006:	Extraction of Aqueous Samples by Separatory Funnel, SW-846 3510C and EPA 600 Series
DV-OP-0008:	Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C, and Method 625 and ASTM Method D7065-11
DV-OP-0010:	Soxhlet Extraction of Solid Samples, SW-846 3540C
DV-OP-0015	Microwave Extraction of Solid Samples, SW-846 3546
DV-OP-0016:	Ultrasonic Extraction of Solid Samples, SW-846 3550B and 3550C
DV-OP-0021:	Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C for Low-Level NDMA by GC/CI/MS/MS
DV-MS-0005, Appendix II:	Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C for Extended List PAHS for CSLP.

2.0 Summary of Method

Sample extracts are concentrated to a specific final volume using an S-EVAP, N-EVAP, or Turbo-Vap. Some methods require a solvent exchange. If necessary, various clean-up techniques are performed before the extract is sent for analysis.

3.0 Definitions

3.1 **Extraction Holding Time:** The elapsed time expressed in days from the date of sample collection to the date the extraction starts. The holding time is tracked in the laboratory LIMS system, and is the primary basis of prioritizing work.

3.2 **Preparation Batch:** A group of up to 20 samples that are of the same matrix and are processed together in the same extraction event using the same procedure and lots of reagents and standards.

3.3 **Method Comments:** The Method Comments are used to communicate to the bench level chemists special requirements and instructions from the client. See WI-DV-0032

3.4 **Quality Assurance Summary (QAS):** Certain clients may require extensive specific project instructions or program QC, which are too lengthy to fit conveniently in the special instructions/Method Comments field in LIMS. In those situations, laboratory Project Managers describe the special requirements in a written QAS to address these requirements. QASs are posted on a public drive for easy accessibility by all lab employees. Normally QASs are introduced to analysts in an initial project kick-off meeting to be sure that the requirements are understood.

4.0 Interferences

Chemical and physical interferences may be encountered when analyzing samples using this method.

4.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All 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. Specific selection of reagents may be required to avoid introduction of contaminants.

4.2 Visual interferences or anomalies (such as foaming, emulsions, odor, more than one layer of extract, etc.) must be documented.

4.3 The most common interference is laboratory contamination, which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them.

4.4 Due to the low reporting limits and the potential for contamination, the extracts that are to be analyzed for NDMA by GC/CI/MS/MS must be concentrated in glassware designated for that method. K-D flasks, concentrator tubes, stem-less glass funnels, and snyder columns will be clearly marked and segregated for this purpose.

5.0 Safety

Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual 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, nitrile gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

5.1.1 In order to limit the emission of methylene chloride, TestAmerica Denver uses a solvent recovery system. The system condenses and collects methylene chloride that has been evaporated off the sample extracts while on the S-EVAP.

5.1.1.1 Each analyst must inspect the system before using it to ensure the collection tubes are in good condition, the in-process tanks are not full, and the chiller is operating correctly.

5.1.1.2 While concentrating methylene chloride or methylene chloride / acetone extracts on the S-Evap, the analyst must check the level of the solvent collected in the in-process tanks at a frequency to ensure the tank will not be overfilled. A tank will not be filled more than 90%. The analyst may use a timer set at 30 minute intervals to help remind the analyst to check the level of the solvent collected in the in-process tanks.

5.1.1.3 The solvent recovery system will never be used for the collection of ether due to the potential danger to analysts if the system were to fail during operation.

5.1.2 Glasswool is a carcinogen and therefore should be handled in a hood to avoid inhalation of dust.

5.2 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 MSDS 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 MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material	Hazards	Exposure Limit (1)	Signs and Symptoms of Exposure
Acetonitrile	Flammable Irritant Poison	40ppm TWA	Exposure may cause cyanide poisoning resulting in reddening of the skin and eyes and pupil dilation. Effects of overexposure are often delayed due to the slow formation of cyanide ions in the body. May cause nose and throat irritation, flushing of the face, tightening of the chest. Also may cause headache, nausea, abdominal pain, convulsions, shock.
Hexane	Flammable Irritant	50ppm TWA	Causes irritation to eyes, skin and respiratory tract. Aspiration hazard if swallowed. Can enter lungs and cause damage. May cause nervous system effects. Breathing vapors may cause drowsiness and dizziness. Causes redness and pain to the skin and eyes.

Material	Hazards	Exposure Limit (1)	Signs and Symptoms of Exposure
Methanol	Flammable Irritant Poison	200 ppm TWA	Methanol evaporates at room temperature. Inhalation, ingestion and/or eye and skin contact can all possibly cause light-headedness, nausea, headache, and drowsiness. Prolonged exposure can lead to permanent blindness.
Acetone	Flammable	1000 ppm-TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Mercury	Corrosive Irritant Highly Toxic	0.05 mg/m3 TWA	May be fatal if inhaled. May cause respiratory tract irritation. May be harmful if absorbed through skin. May cause skin irritation.
Methylene Chloride	Irritant Carcinogen	25ppm TWA 125ppm STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, and headache. Causes irritation, redness, and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

NOTE: All glassware used in this procedure is cleaned following SOP# DV-OP-0004. In addition, the glassware is rinsed with methylene chloride immediately prior to use.

NOTE: Due to the low reporting limits and the potential for contamination, the extracts that are to be analyzed for NDMA method 8270D_SIM_LL and PAHs by method 8270C_SIM_LL must be concentrated in glassware designated for that method. K-D flasks, glass funnels, concentrator tubes, and snyder columns will be clearly marked and segregated for this purpose.

- Kuderna-Danish (K-D) flasks.
- Concentrator tubes for K-D flasks, un-graduated, approximately 10 mL.
- Concentrator tubes for K-D flasks, graduated at 1mL, calibration checked before use following the steps detailed in DV-QA-0008.
- Snyder columns, 3-ball with ground glass joints at top and bottom
- Manual, adjustable positive-displacement pipette and bottle-top re-pipettor, used to dispense 1 to 20 mL. Calibration is checked following the steps detailed in DV-QA-0008.
- Extract Storage Vials – variety of sizes, clear and amber

- Pasteur pipettes – 6 inch and 9 inch in length.
- Stem-less glass funnels
- Glass wool, baked at 400℃ for four hours.
- Boiling Chips – contaminant free, approximately 10/40 mesh Teflon®, PTFE. For concentrating extracts to a final volume greater than 1mL.
- Boiling Chips – contaminant free, carborundum #12 granules, for concentrating extracts to a 1mL final volume. These boiling chips are sufficiently small as to not add any error to the 1mL final volume.
- Solvent Recovery System – includes re-circulating chiller, set at 5℃, cooling condensers, Teflon® PTFE tubing and In-Process Tanks with quick-connect attachments
- S-Evap, thermostat controlled water bath
- N-Evap, thermostat controlled water bath with regulated nitrogen supply
- 6mL Glass Reaction Tube with 1 Teflon frit and additional Teflon frits for use in silica gel clean-up.

6.1 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on G:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

Reagents - All materials must be reagent grade or higher quality, unless otherwise specified

7.1 Methylene Chloride

Each lot of solvent is tested following CA-Q-S-001 or before it is put into use. QA personnel post the list of approved lots at solvent storage areas. For solvents packaged in CYCLETAINERS, that have not been previously tested per CA-Q-S-001, the first batch of samples prepared with a new lot of solvent is monitored and reported to the QA group per the instructions in CA-Q-S-001 DV-1. If any problems are identified, use of the solvent is suspended until further testing can be done and determines the solvent is acceptable.

7.2 Hexane

For solvents packaged in bottles, each lot of solvent is tested following CA-Q-S-001 before it is put into use. QA personnel post the list of approved lots at solvent storage areas. For solvents packaged in CYCLETAINERS, the first batch of samples prepared with a new lot of solvent is monitored and reported to the QA group per the instructions in CA-Q-S-001 DV-1. If any problems are identified, use of the solvent is suspended until further testing can be done and determines the solvent is acceptable.

7.3 Methanol, HPLC Grade

Each lot of solvent is tested following CA-Q-S-001 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.4 Acetone

Each lot of solvent is tested following CA-Q-S-001 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.5 Acetonitrile

Each lot of solvent is tested following CA-Q-S-001 DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.6 Baked Sodium Sulfate, 12-60 mesh

Heat sodium sulfate in a 400 °C oven for at least four hours.

7.7 Sulfuric Acid, Concentrated –

For use in PCB extract clean-up.

7.8 Florisil Solution, (FlorisilSol)

Add 900mL of hexane to a Class A graduated cylinder. Add 100mL of Acetone to the same graduated cylinder for a final volume of 1000mL. Pour the mixture into a 1L amber bottle.

7.9 Florisil Cartridges,

Purchased ready to use. 1000mg in 6mL tube. Stored in a desiccator after opening. Restek part number 24034 or equivalent.

7.10 Anhydrous Silica Gel, 60-100 mesh, (SiGel60-100UA)

Sigma Aldrich part number 23799-1KG or equivalent

7.11 Activated Anhydrous Silica Gel, 60-100 mesh, (Active_SilGel)

Bake Silica Gel from Section 7.10 above at 400°C for at least 4 hours. Store in a desiccator.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample extracts waiting to be concentrated are stored refrigerated at 4°C ± 2°C in glass bottles or flasks and capped with Teflon-lined lids or aluminum foil. Final sample extracts are stored in glass vials with Teflon-lined lids. See Table 3 for details on storage vial types. Final concentrated extracts are stored refrigerated at 0°C – 6°C. Extracts have a holding time of 40 days from the date of extraction to the date of analysis.

9.0 Quality Control

9.1 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.

The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in DV-QA-003P, Quality Assurance Program.

Specific QC requirements for Federal programs, e.g., Department of Defense (DoD) Department of Energy (DoE), AFCEE etc., are described in TestAmerica Denver policy DV-

QA-024P, Requirements for Federal Programs. This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated.

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.

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 DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 12 for more details on detection limit studies, initial demonstrations of capability, and analyst training and qualification.

9.3 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 that is used to analyze samples from the same preparation batch. See QC Policy DV-QA-003P for further details.

9.4 Method Blank (MB)

At least one method blank must be processed with each preparation batch. The method blank for batches of aqueous samples consists of reagent water, and for batches of soil samples, consists of Ottawa sand, both of which are free of any of the analyte(s) of interest. The method blank for batches of TCLP and SPLP leachates consists of leach fluid. The method blank is processed and analyzed just as if it were a field sample.

9.5 Laboratory Control Sample (LCS)

At least one LCS must be processed with each preparation batch. For aqueous sample batches, the LCS consists of reagent water to which the analyte(s) of interest are added at known concentration. For soil sample batches, the LCS consists of Ottawa sand to which the analyte(s) of interest are added at a known concentration. For TCLP and SPLP leachates, the LCS consists of leach fluid to which the analyte(s) of interest are added at known concentration. The LCS is carried through the entire analytical procedure just as if it were a sample.

EPA Methods 608, 610, and 625 require a LCS at a 10% frequency. In other words, one LCS is required for a batch of 10 or less samples. A LCSD is required for a batch of 11 or more samples.

9.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

One MS/MSD pair must be processed with each preparation batch. A matrix spike (MS) is a field sample to which known concentrations of target analytes have been added. It is prepared in a manner similar to the LCS, but uses a real sample matrix in place of the blank matrix. A matrix spike duplicate (MSD) is a second aliquot of the same sample (spiked exactly as the MS) that is prepared and analyzed along with the sample and matrix spike. Some programs allow spikes to be reported for project-related samples only. Samples identified as field blanks cannot be used for the MS/MSD analysis.

EPA Methods 608, 610, 614, and 625 require one matrix spike for every 10 samples. If the batch has more than 10 samples, then two matrix spikes must be performed. The two matrix spikes are to be performed on two different samples.

If insufficient sample volume is available for MS/MSD, an NCM must be written and a LCSD must be prepared.

9.7 Surrogate Spikes
Every calibration standard, field sample, and QC sample (i.e. method blank, LCS, LCSD, MS, and MSD) is spiked with surrogate compounds.

10.0 <u>Procedure</u>

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an 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 DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Critical Procedural Considerations

10.2.1 As stated throughout this SOP, analysts must review Method Comments and any applicable QASs before starting work. This review is also documented on the Organic Extraction Checklist (see WI-DV-0009).

10.2.2 Analyst must focus on using clean technique throughout this procedure. Any parts or pipettes that come into direct contact with dirty surfaces should be cleaned or disposed of before coming into contact with the sample.

10.2.3 According to the type of sample and any cleanup procedures needed, different final solvents and volumes will be required. Refer to WI-DV-0009 for the appropriate final solvents and final volumes.

10.3 Refer to WI-DV-0009 to determine if the extract is to be concentrated by the Kuderna-Danish / N-Evap method described in Section 10.4 and 10.5, or the Turbo-Vap method described in Section 10.6

10.4 Concentration by the Kuderna-Danish Method

10.4.1 Refer to WI-DV-0009. If the extract is to be concentrated to a 1mL final volume, use a 1mL graduated concentrator tube. For extracts that are to be concentrated to any other final volume, use an un-graduated concentrator tube.

10.4.2 Assemble the Kuderna-Danish concentrator by attaching the appropriate concentrator tube to the 500 mL K-D flask with a clip. Make sure the attachment is firm at the joint. While wearing cut-resistant gloves, tighten the joint with your fingertips and thumb. Do NOT over-tighten. Refer to Attachment 3 for configuration of the Kuderna-Danish concentrator.

NOTE: Due to the low reporting limits and the potential for contamination, the extracts that are to be analyzed for NDMA by method 8270D_SIM_LL and PAHs by method 8270C_SIM_LL must be concentrated in glassware designated for those methods. K-D flasks, concentrator tubes, and Snyder columns will be clearly marked and segregated for this purpose.

10.4.3 Rinse the apparatus with methylene chloride. Discard the rinse solvent into the appropriate waste container. Care should be taken to ensure all surfaces of the glass are coated with solvent.

10.4.4 If the extract is to be concentrated to a 1mL final volume, add 2-3 carborundum granules to the K-D concentrator. If the extract is to be concentrated to a final volume greater than 1mL, add 1-2 Teflon® boiling chips to each K-D concentrator.

10.4.5 If the sample extracts have not been filtered through sodium sulfate at the time of extraction, or if the sample extract have visible water, then the extracts must be dried at this point. Plug a glass funnel with baked glass wool and add approximately 1 teaspoon of baked sodium sulfate. Rinse the funnel and the sodium sulfate with methylene chloride and place it on top of the K-D. During the quantitative transfer in section 10.4.6 the extract will be filtered through the sodium sulfate.

NOTE: Glass wool dust is a carcinogen and therefore glass wool should only be handled in a hood to avoid inhaling any glass particles. Once covered with sodium sulfate, it can be removed from the hood.

NOTE: If the extract contains more water than can be easily removed by filtering through 1 teaspoon of sodium sulfate, either more sodium sulfate can be used or a solvent-rinsed separatory funnel can be used to separate the water out of the extract. A NCM should be prepared if this is necessary.

10.4.6 Quantitatively transfer the sample extract to the K-D flask. Transfer the sample label to the K-D flask. Perform a quantitative transfer of the extract by rinsing the sample extract container with methylene chloride and adding the rinse solvent to the K-D. If the extract is being filtered through sodium sulfate, be sure to rinse the sodium sulfate well to ensure no target compounds are left on the sodium sulfate. Allow the solvent to drain from the sodium sulfate into the K-D flask then discard the sodium sulfate.

10.4.7 Turn a three-ball Snyder column upside down and rinse with methylene chloride, then rinse the bottom joint with methylene chloride. Attach the Snyder column to the top of the K-D concentrator as shown in Attachment 3.

10.4.8 Place the K-D concentrator on a water bath so that the tip of the receiver tube is submerged. The water level should not reach the joint between the concentrator tube and the K-D flask. Refer to WI-DV-0009 for the correct water bath temperature. Record both the observed and the corrected temperature on the benchsheet.

10.4.9 For extracts that are methylene chloride or 50/50 methylene chloride/acetone, attach the solvent recovery system tube to the top of the Snyder column. At the appropriate rate of distillation, the balls will actively chatter but the chambers should not flood.

NOTE: For extracts for analysis for low-level NDMA by method 8270D_SIM_LL and PAHs by 8270C_SIM_LL, the solvent recovery system will not be used to avoid possible contamination.

NOTE: At this time, a timer may be set for no longer than 30 minutes as a reminder to check the in-process solvent tanks.

10.4.10 If the method does not require a solvent exchange~~,~~ skip to Section 10.4.12. If the method requires a solvent exchange, continue on to Section 10.4.11.

10.4.11 If the method requires a solvent exchange at this time, detach the solvent recovery system tube from the top of the Snyder column and add the appropriate exchange solvent through the top of the Snyder column. The exchange solvent should be added when the extract has concentrated to a level that it forms a quarter-sized pool of solvent in the bottom of the K-D. Refer to WI-DV-0009 for details of exchange solvents and volumes. Mark the K-D flask and sample label to indicate the exchange has been performed. There is no need to re-attach the solvent recovery system at this time as the majority of the methylene chloride has already been evaporated and collected.

10.4.12 Continue to concentrate the sample on the water bath back down to 10-15 mL, or just below the K-D and concentrator tube joint. At this point the boiling sample is just barely splashing above the top of the receiver tube.

NOTE: It is very important not to concentrate to dryness as analytes will be lost. Also, some of the analyses, especially for 8270 and 8015, are especially temperature sensitive and the sample should be taken off the water bath as soon as possible to avoid losing analytes. Also the 8081 surrogate TCMX is also fairly volatile and can be lost if the extract is allowed to concentrate too low either before or after hexane exchange. If the analyst has concerns that the extract might have concentrated too low, they should notify their supervisor and/or write a NCM.

10.4.13 Remove the K-D concentrator from the water bath. Rinse the Snyder column down with a minimal amount of solvent. If the extract was exchanged, use the exchange solvent to perform the rinse, otherwise use methylene chloride.

10.4.14 Allow the extract to cool to room temperature, about 10 minutes.

10.4.15 After the extract is allowed to cool, if the level of the extract is above the level of the concentrator tube joint, add a fresh boiling chip and return the K-D concentrator to the water bath.

10.4.16 After the extract is cool, remove the snyder column. Remove the clip holding the K-D flask and concentrator tube together. Use a Kim-wipe to dry the water off of the joint area so that water does not get into the extract. Remove the concentrator tube from the K-D flask and rinse the lower K-D flask joint into the concentrator tube with methylene chloride or the appropriate exchange solvent.

10.5 Nitrogen Evaporation (N-Evap) to Final Concentration.

10.5.1 N-evap needles should be cleaned weekly by soaking overnight in methylene chloride. This is documented in the N-evap needle log-book.

10.5.2 At the beginning of each shift, the N-evap needles should be wiped clean with a Kim-wipe soaked in methylene chloride to remove any potential contamination. If a needle comes in contact with an extract, then it needs to be cleaned before being used on the next extract.

10.5.3 Place the concentrator tube on the nitrogen evaporator. The temperature of the water bath should be at least 5 °C below the boiling temperature of the solvent being evaporated (See Attachment 2). Lower the needle down to the sample so that a small dimple forms on the surface of the solvent. The stream of nitrogen should be gentle enough that it does not cause the extract to splash.

10.5.4 During the course of the evaporation, rinse the sides of the concentrator tube with approximately 1 mL of clean solvent. The rinse should occur when the solvent gets close to the final volume. Concentrate the solvent to just below the final volume and remove from the nitrogen evaporator.

10.5.5 Transfer the extract into the appropriate vial. Refer to WI-DV-0009 for the appropriate final volume and correct vial.

10.5.5.1 If the extracts are to have a final volume of 1mL, they should be in 1mL graduated concentrator tubes. Using a Pasteur pipette, add the appropriate solvent to the tube until the extract meniscus reaches the 1mL gradation. Then using the Pasteur pipette transfer the extract to a labeled 2mL amber glass vial.

10.5.5.2 For extracts with a final volume greater than 1mL, the vials should be calibrated using the manual, adjustable positive-displacement pipette or bottle-top re-pipettor. Pipette the correct volume of clean solvent into the vial and mark the bottom of the meniscus with a thin marker. Discard the solvent. Transfer the extract into the vial using a Pasteur pipette and rinse the concentrator tube with solvent. Transfer the rinse to the vial. Bring the meniscus of the solvent up to the marked line. Cap with a Teflon-lined cap.

NOTE: The final concentration and volume measurement steps are critical. Use care when concentrating and make certain that the final volume measurement is accurate.

NOTE: Some extracts might not concentrate down to the required final volume. If the extract is very dark and viscous, or an oil layer or precipitate starts to form, a higher final volume can be used. This should be documented in an NCM.

10.6 TurboVap Method

10.6.1 Turn on the TurboVap and adjust the water temperature to 40 °C. Turn the nitrogen supply on. Record both the observed and the actual temperature on the benchsheet.

10.6.2 Switch the endpoint sensor to “Manual”.

10.6.3 Adjust the water bath level. The water level should be at least 1 inch above the extract level.

10.6.4 Turn on the nitrogen gas and adjust the gas pressure to approximately 12 psi. Lower pressure may be used if needed to prevent samples from splashing out of the TurboVap tubes.

10.6.5 Rinse the TurboVap tube with methylene chloride or the solvent the extract is in. Discard the waste.

10.6.6 Transfer the sample to the TurboVap tube. For 8141 soils extracted by soxhlet, dry the extract first by filtering through a funnel with baked sodium sulfate. Rinse the sample extract container with clean solvent and transfer to the TurboVap tube. Do not fill the TurboVap tubes over the fill line or approximately ¾ full.

10.6.7 Place the TurboVap tube into the TurboVap and turn on nitrogen to the position the tube is in.

10.6.8 Close the lid. You should be able to see the sample extracts swirling in the tubes.

NOTE: If the extract splashes when the nitrogen flow starts, transfer a portion of the extract back into the original extract container, or lower the gas pressure.

10.6.9 As the extract concentrates, transfer the remainder of the extract in to the appropriate Turbovap tube. Rinse the sample container with a few milliliters of methylene chloride or appropriate solvent and transfer to the Turbovap tube.

10.6.10 During the concentration rinse the Turbovap tube walls with a few milliliters of solvent 1 or 2 times.

10.6.11 If a solvent exchange is required, concentrate to about 5 mL and add the exchange solvent. After the exchange solvent is added, swirl the extract to make sure the extract is well mixed. Concentrate back down to slightly less than the appropriate volume. Refer to Attachment 3 for details of exchange solvents and final volumes.

10.6.12 Transfer the extract into the appropriate vial.

10.6.12.1 Currently, the TurboVap is only used to concentrate extracts with final volumes greater than 1mL. Ask the QA Manager or the supervisor for guidance if a project requires a 1mL final volume by TurboVap.

10.6.12.2 For extracts with a final volume greater than 1mL, the vials should be calibrated using the manual, adjustable pipette or bottle-top re-pipettor. Pipette the correct volume of clean solvent into the vial and mark the bottom of the meniscus with a thin marker. Discard the solvent. Transfer the extract to the vial using a Pasteur pipette and rinse the concentrator tube with solvent. Transfer the rinse to the vial. Bring the meniscus of the solvent up to the marked line. Cap with a Teflon-lined cap.

10.6.12.3 Rinse the Turbovap tube with methylene chloride 2-3 times before washing. Turbovap tubes are not baked. They are cleaned in accordance with DV-OP-0004. If the Turbovap tubes need to be used again before they are dry, rinse with acetone to dry the Turbovap tube.

10.7 Cleanup Techniques

NOTE: If any sample in a batch requires a clean-up, the batch QC must also undergo the same clean-up technique.

10.7.1 Florisil Cartridge Cleanup

Florisil can be used to remove low-medium molecular weight polar hydrocarbon interfering compounds from pesticide extracts. The laboratory will use Florisil cleanups whenever water extracts have any color, whenever soil extracts have any color darker than a Post-It® Note, or whenever there is clear evidence of interferences, such as significant interfering peaks in the RT range for the target pesticide compounds or failing sample surrogate recoveries. Extracts that are to be analyzed for kepone will not be florisil cleaned, because florisil will remove kepone from the extract.

NOTE: Florisil cartridge performance checks are conducted for every lot of Florisil before use. Add 1.0 mL of the Florisil check solution described in Attachment 4 to a pre-rinsed Florisil cartridge. Following the procedure described below, load and elute the 1mL of check solution through the Florisil cartridge. Bring the final volume back down to 1.0 mL in hexane. The test sample must show 80-115 % recovery of the controlled analytes with < 5% trichlorophenol recovery, and no peaks interfering with target compounds can be detected. The non-controlled analytes will be monitored for problems, but do not have to pass the 80-115% limits. If the check fails, repeat the test. If the re-check fails, contact QA for guidance.

10.7.1.1 Clean the manifold and ports

Prior to each use, the top and underside of the manifold lid must be wiped down with hexane and a Kim-wipe to prevent any cross-contamination. The manifold ports must be left open and placed in a jar with fresh acetonitrile, in a sonication bath for a minimum of 30 minutes. The jar used in the soak and sonication of the ports must be replaced weekly to ensure it does not spread contamination. This is documented in the Organic Extraction Weekly Cleaning Logbook.

10.7.1.2 Place one Florisil cartridge into the vacuum manifold for each sample extract. Make sure all valves are closed.

10.7.1.3 Add approximately 6mL of hexane to each cartridge by filling the tube.

10.7.1.4 Slowly open the valves to allow a few drops of hexane to pass through, then close the valve and allow the hexane to soak the cartridge for at least 5 minutes.

10.7.1.5 Slowly open the valves again and allow the hexane to drain through the cartridge but close the valve when the solvent level is right above the glass frit. Do not allow the cartridges to go dry. If cartridges go dry, repeat the conditioning step.

10.7.1.6 Remove the manifold top and place one clean, labeled 16 × 125 mm disposable glass test tube in each position for each of the samples. Replace the manifold top. Make sure that the solvent line from each cartridge is placed inside the appropriate tube.

10.7.1.7 Add exactly 2.0 mL of the concentrated extract to the appropriate Florisil cartridge. Turn the valve to the on position.

10.7.1.8 Allow the extract to gravity drip through the cartridge. The flow through the cartridges should be drop-wise, not streaming.

10.7.1.9 Just before the extract level drops below the glass frit, fill the cartridge with (90:10) Florisil solution. Allow this to pass through the cartridge, then just before it falls below the glass frit again, fill the cartridge again with (90:10) Florisil solution.

10.7.1.10 Allow all of the 90:10 solution to drip through the cartridges.

NOTE: Do not use the vacuum to recover solvent from the cartridge. If the vacuum is used and the cartridge goes dry under vacuum, then the interfering compounds that should be retained in the packing might come through into the cleaned extract.

10.7.1.11 Remove the tubes from the vacuum manifold and concentrate them back down to just below 2.0 mL on the nitrogen evaporator. Quantitatively transfer the extract to a 4mL vial that has been calibrated to hold 2.0mL and bring the extracts up to the 2.0 mL calibration mark with hexane.

10.7.1.12 Discard the used cartridges.

10.7.2 Sulfur Removal

Sulfur can be removed by one of three methods: mercury, copper, or tetrabutylammonium sulfite (TBA), according to laboratory preference. If the sulfur concentration is such that crystallization occurs in the concentrated extract, centrifuge the extract to settle the crystals, and carefully draw off the sample extract with a disposable pipette, leaving the excess sulfur in the centrifuge tube. Transfer the extract to a clean concentrator tube before proceeding with further sulfur cleanup.

NOTE: Some programs (e.g., South Carolina) do not allow the use of elemental mercury. Copper or TBA will be used as an alternative.

10.7.2.1 Sulfur Removal with Elemental Mercury

NOTE: Use Mercury in a hood and sparingly in order to minimize exposure and disposal costs.

10.7.2.1.1 Transfer approximately 2 mL of sample extract into a clean Teflon-sealed vial.

10.7.2.1.2 Add one to three drops of mercury to the extract vial and seal.

10.7.2.1.3 Shake well for 15-30 seconds. If prolonged shaking is required, use a mechanical shaker.

10.7.2.1.4 Remove the extract from the mercury using a disposable pipette and transfer to a clean vial.

10.7.2.1.5 If the mercury turns black, sulfur was present. Decant or pipette off the extract to a clean vial and repeat the procedure by adding one to three drops of fresh mercury. Do this until the mercury does not turn black.

10.7.2.1.6 If the extract is cloudy, filter the extract through a 1um disposable syringe filter.

10.7.2.1.7 Properly dispose of the mercury waste.

10.7.2.2 Sulfur Removal with Copper Powder

NOTE: This technique requires the copper powder to be very reactive, as demonstrated by a bright and shiny appearance. A pre-cleaned, activated copper may be purchased from a valid vendor. If manual preparation of reactive copper is performed, take care to remove all traces of acid in order to prevent degradation of some analytes.

10.7.2.2.1 Weigh out copper into a 20ml VOA VIAL assuming two grams of copper needed per sample.
10.7.2.2.2 Remove oxides by treating with 10% nitric acid.
10.7.2.2.3 Rinse the copper with DI organic-free water three times to remove all traces of acid.
10.7.2.2.4 Rinse the copper with acetone and dry under a stream of nitrogen.
10.7.2.2.5 Add approximately 2 grams of the copper powder to a 2ml vial with approximately 1ml of sample extract and shake vigorously on a mechanical shaker for at least one minute.
10.7.2.2.6 After phase separate, draw off extract and transfer to a clean vial.

10.7.3 Sulfuric Acid Cleanup

10.7.3.1 Add 1 mL of concentrated sulfuric acid to approximately 2 mL of sample extract in a Teflon capped vial.

CAUTION: There must be no water or acetone present in the extract or the reaction may shatter the sample container.

10.7.3.2 Vortex for about 5 seconds and allow to settle. (Centrifuge if necessary)

10.7.3.3 Remove the sample extract (top layer) from the acid using a Pasteur pipette and transfer to a clean vial.

CAUTION: It is not necessary to remove all the extract since the final volume is already determined. Transferring any amount of sulfuric acid along with the extract will result in extremely rapid degradation of the chromatographic column

10.7.3.4 If the sulfuric acid layer becomes highly colored after shaking with the sample extract, transfer the hexane extract to a clean vial and repeat the cleanup procedure until color is no longer being removed by the acid, or a maximum of 5 acid cleanups.

10.7.3.5 Properly dispose of the acid waste.

10.7.4 Silica Gel Clean-up for DRO extracts

10.7.4.1 Concentrate the DRO to slightly below 1mL on the N-Evap. Add 100uL of the “SilicaGelSurr” standard to the extract and then bring the sample to a 1mL final volume with methylene chloride.

10.7.4.2 While the extract is still in the concentrator tube, add approximately 0.05g of activated silica gel to the extract and mix with a Pasteur pipette.

10.7.4.3 Allow the silica gel to settle out and then transfer the extract to a new vial and add a 2nd aliquot of activated silica gel to the extract and mix by capping and shaking.

10.7.4.4 Allow the silica gel to settle out again and then transfer the extract to an empty vial and send on for analysis.

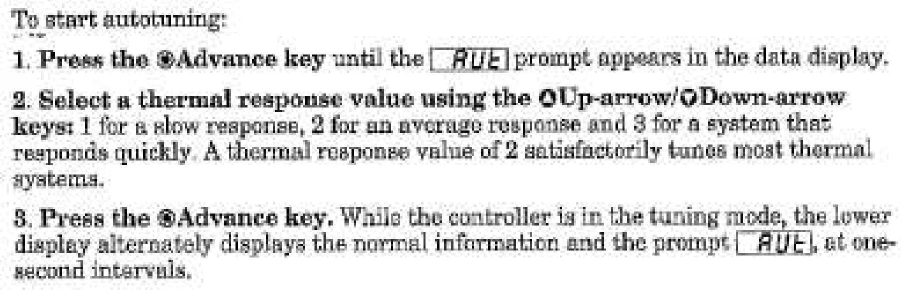
10.8 Documentation

All observations are recorded either directly into LIMS or on the hard-copy benchsheets. Any hand-written data recorded on the hard-copy benchsheets are transferred into LIMS before extracts are delivered to the analytical group. The hard-copy benchsheets are then saved and scanned into pdf files and sent to QA for archiving.

10.9 Maintenance

- The chiller that operates the solvent recovery system should be checked periodically to ensure the water level is sufficient.
- The SPE ports and valves used in the florisil are open and placed in a jar with fresh acetonitrile, in a sonication bath for a minimum of 30 minutes. The jar used in the soak and sonication of the ports must be replaced weekly to ensure it does not spread contamination. This is documented in the Organic Extraction Weekly Cleaning Logbook.
- The N-Evap needles are removed once a week and soaked overnight in a jar of methylene chloride. This is documented in the Organic Extraction Weekly Cleaning Logbook.

- The water bath used in the concentration of extracts has a thermostat that occasionally needs auto-tuned to keep the bath temperature within a narrow range.



To start autotuning:

1. **Press the ⊛Advance key** until the AUt prompt appears in the data display.

2. **Select a thermal response value using the ○Up-arrow/○Down-arrow keys:** 1 for a slow response, 2 for an average response and 3 for a system that responds quickly. A thermal response value of 2 satisfactorily tunes most thermal systems.

3. **Press the ⊛Advance key.** While the controller is in the tuning mode, the lower display alternately displays the normal information and the prompt AUt, at one-second intervals.

10.10 Troubleshooting

Unusual sample matrix may cause problems. If the extracts do not behave normally, contact a supervisor or senior analyst if you are unsure how to proceed. Document all observations and anomalies in a NCM.

11.0 Calibration

Not applicable to this procedure. See the determinative methods for calibration of the analytical instrumentation.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

Before analyzing samples, the laboratory must establish a method detection limit (MDL). The laboratory also operates under programs that require instrument detection limits (IDLs). See DV-QA-005P, “Determination of Method Detection Limits”, for more information on the method detection limit studies.

12.2 Demonstration of Capabilities

An initial demonstration of capability (IDOC) must be performed by each analyst. On-going proficiency must be demonstrated by each analyst on an annual basis. See SOP DV-QA-0024, “Employee Training”, for more information on the IDOCs.

12.3 Training Requirements

The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and who has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

13.0 Pollution Control

It is TestAmerica’s 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 Safety Manual for “Waste Management and Pollution Prevention.”

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in section 13, "Waste Management and Pollution Prevention", of the Environmental Health & Safety Manual, and DV-HS-001P, "Waste Management Plan."

14.2 The following waste streams are produced when this method is carried out:

14.2.1 Methylene chloride – Waste Stream B
14.2.2 Flammable Solvents – Waste Stream C
14.2.3 1:1 MeCl2:Acetone – Waste Stream CA
14.2.4 Solid waste/sodium sulfate – Waste Stream D

14.3 Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Waste Coordinator for proper management of these materials.

15.0 References / Cross-References

15.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition and all promulgated updates, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, January 2005.

15.1.1 Method 3510C, Separatory Funnel Liquid-Liquid Extraction, Revision 3, December 1996.

15.1.2 Method 3520C, Continuous Liquid-Liquid Extraction, Revision 3, December 1996.

15.1.3 Method 3550B, Ultrasonic Extraction, Revision 2, December 1996.

15.1.4 Method 3550C, Ultrasonic Extraction, Revision 3, February 2007.

15.1.5 Method 3540C, Soxhlet Extraction, Revision 3, December 1996.

15.1.6 Method 3546, Microwave Extraction, Revision 0, February 2006.

15.1.7 Method 3620C, Florisil Cleanup, Revision 3, February 2007.

15.1.8 Method 3660B, Sulfur Cleanup, Revision 2, December 1996.

15.1.9 Method 3660A, Sulfur Cleanup, Revision 1, July 1992.

15.1.10 Method 3665A, Sulfuric Acid/Permagante Cleanup, Revision 1, December 1996.

15.1.11 Method 3630C, Silica Gel Cleanup, Revision 3, December 1996.

15.2 Code of Federal Regulations, Title 40 – Protection of the Environment, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix A – Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater

15.2.1 Method 608, Organochlorine Pesticides and PCBs.

15.2.2 Method 610, Polynuclear Aromatic Hydrocarbons.

15.2.3 Method 614, The Determination of Organophosphorus Pesticides in Municipal and Industrial Wastewater

15.2.4 Method 625, Base/Neutrals and Acids.

15.3 ASTM D7065-11, Standard Test Method for Determination of Nonylphenols, Bisphenol A, p-tert-Octylphenol, Nonylphenol Monoethoxylate, and Nonylphenol Diethoxylate in Environmental Waters by Gas Chromatography Mass SpectrometryMethod Modifications:

16.0 Modifications

16.1 Method SW-846 3665A calls for the clean-up to be performed using 1:1 Sulfuric Acid:H2O. This procedure calls for the clean-up to be performed using concentrated sulfuric acid.

16.2 ASTM D7065-11 calls for the samples to be concentrated to a 0.5mL final volume. This procedure calls for a 1mL final volume.

16.3 Method SW-846 3620C calls for the florisil lot check to be performed using a standard containing the some pesticides at various concentrations from 5ug/L to 50ug/L. Per the source method, 1mL of the standard is diluted to 2mL (for concentrations between 2.5ug/L and 25ug/L) and the cleanup is then carried out and the cleaned extract concentrated to 1mL for a final concentration of 5ug/L to 50ug/L. This procedure calls for the lot check to be performed using a standard containing all the pesticides at the same concentration of 50ug/L. 1mL of this standard is cleaned up without prior dilution and then concentrated back down to 1mL.

16.4 Method SW-846 3620C states that the florisil lot check passes if the pesticide recoveries are between 80% and 110% recovery. This procedure says the lot check passes if the pesticide recoveries are between 80% and 115%. This is done to match the CCV control limits.

16.5 Method SW-846 3620C states that the florisil lot check is to be performed using a standard containing the 2,4,5-Trichlorophenol at 0.1ug/L. Per the source method, 0.5mL of this standard is diluted to 2mL (for a concentration of 0.025ug/L) and the cleanup is then carried out and the cleaned extract concentrated to 1mL for a concentration of 0.05ug/L. This procedure calls for the lot check to be performed using a standard containing 2,4,5-trichlorophenol at 100ug/L. 1mL of this standard is cleaned up without prior dilution and then concentrated back down to 1mL.

16.6 Method SW-846 3620C Section 11.1.3 states to condition the florisil cartridge with 4mL of hexane. This procedure calls for 5mL of hexane to be used. This is done for convenience.

16.7 Method SW-846 3630C calls for the silica gel clean-up to be performed with a column or SPE cartridge. This procedure calls for the silica gel to be added directly to the extract and mixed. The reverse surrogate used indicates if the clean-up is effective.

17.0 Attachments

Attachment 1: Determinative and Extraction Methods Used in Conjunction with this SOP.

Attachment 2: Boiling Points of Solvents

Attachment 3: Kuderna-Danish Concentrator

Attachment 4: Florisil Check Solution

18.0 Revision History

- Revision 9 dated 31 December 2014
    - Section 5.1.1.2 and Section 10.4.9 were revised to match current practice on the use of the solvent recovery system.
    - Section 6.1 Computer Software and Hardware was added.
    - Section 7.6 Baked Sodium Sulfate was revised to match current practice and the latest revision of CA-Q-S-001 DV-1.
    - Section 7.11 was revised to correct the TAL Reagent ID.
    - Section 9.1 was revised to include the statement “This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated”.
    - Section 9.4, 9.5, 9.6, and 9.7 were revised to remove information on Acceptance Criteria and Corrective Action. This information can be found in the analytical and QA SOPs.
    - Section 10.4.5 was revised to instruct the analyst to use approximately 1 teaspoon of sodium sulfate to dry extracts. This was done to limit the extract’s exposure to sodium sulfate which can cause low recoveries for some acid compounds. A note was also added to this section to instruct the analyst to use more sodium sulfate or a separatory funnel to remove water if a teaspoon of sodium sulfate is not sufficient.
    - The Note in Section 10.4.12 was revised to instruct the analyst to write an NCM and/or notify their supervisor if they have a concern that an extract concentrated too low.
    - Section 10.7.1 Florisil Clean-up was revised to give guidance on what to do if the florisil check fails.
    - Section 10.7.1 was revised to instruct the analyst to not use the vacuum to pull all of the solvent from the cartridge. This was done to prevent interfering compounds and 2,4,5-TCP from eluting off of the cartridge.
    - Section 10.7.1 and Attachment 4 Florisil Check Solution were revised to indicate which compounds are controlled and which compounds are monitored. In addition, surrogate compounds were added to the solution.
    - Section 10.7.1 and 10.9 were revised to instruct the analyst to soak the SPE ports in a jar with the valves open instead of disassembling the valves.
    - Section 10.7.3 was revised to instruct the analyst to perform the clean-up on approximately 2mL of extract. This was done to match current practice.
    - Section 10.7.4 Silica Gel Clean-up and Sections 15.1 and 16.0 were revised to match current practice.

  - Section 10.9 Maintenance was revised to include instructions on how to tune the water bath thermostat.
  - Attachment 3 – Concentration Summary was removed and replaced with WI-DV-0009. All other Attachments were re-numbered.
- Revision 8 dated 13 December 2013
  - The procedure was revised to include ASTM D7065-11.
  - The procedure was revised to include steps for silica gel clean-up for DRO extracts.
  - Section 7 was revised to include details on the Florisil Solution and Florisil cartridges. These details were lacking in previous revisions.
  - Section 10.4.2 was revised to give more detail on how to safely tighten the ground glass joint between the KD and concentrator tube.
  - Section 10.6.3 was revised to give more detail about the required water level in the Turbo-Vap.
  - Maintenance and Troubleshooting sections were added as Sections 10.8 and 10.9.
  - Section 16 was revised to include method modifications from SW-846 3620C.
  - Attachment 1 was updated to reflect the current SOPs in use in the laboratory.
  - Attachment 3 was updated.
- Revision 7 dated 5 December 2012
  - Section 5 and Section 10.4.5 were revised to instruct the analysts to handle glass wool in a hood to avoid breathing in the dust.
  - Revised Section 10.4.8 to instruct the analysts to document both the observed and corrected temperatures.
  - Section 10.7.1.11 was revised to describe in more detail how the florisiled extracts are taken to the 2 mL final volume.
  - Section 14.2 was revised to include the waste stream for 1:1 MeCl2:Acetone – Waste Stream CA.
  - Attachment 1 was revised to include DV-OP-0015 as an acceptable extraction for Diesel Range Organics.
  - Attachment 3 was revised to include details on 8081/3510_LL concentration steps.
- Revision 6.0 dated 14 October 2011
  - The procedure was revised to remove instructions on how to concentrate and clean up extract for method 8070 and 607. TestAmerica Denver no longer supports these methods.
  - Section 1.3 was corrected to give the correct SOP number to Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C for Low-Level NDMA by GC/CI/MS/MS.
  - Section 7.5 was revised to state acetonitrile is tested before use. Previously this solvent was not tested before use.
  - The procedure was revised to include instructions that all extracts for analysis by method 8081, 8082, or 608 to be hexane exchanged only after concentration on the S-Evap. Previously the SOP instructed analysts to add the hexane exchange before the S-Evap for extracts that were concentrated by microwave extraction. This resulted in poor hexane exchanges, therefore the extracts are now concentrated before the exchange.
  - The procedure was revised to instruct analysts not to use the solvent recovery system when concentrating samples for analysis of low-level NDMA by GC/CI/MS/MS. This was done to eliminate a possible source of contamination in this ppt level analysis.

  - The procedure was revised to instruct analysts to use concentrated sulfuric acid in the acid clean up of PCB extracts.
  - The procedure was revised to clarify the exact steps used in the sulfur removal with mercury.
- Revision 5 dated 07/20/10
  - Note added to section 9.5 to not allow marginal exceedances for South Carolina work.
  - Updated to reflect changes to the LIMS system.
  - Updated Attachment 1 and Section 1.3 to include the most recent extraction and analysis SOPs.
  - Added procedures to concentrate microwave extracts by K-D.
- Revision 4, dated 26 August 2009
  - Added instructions on the concentration of extracts from microwave extraction, SW846 3546.
  - Added clarification that the solvent recovery system is only to be used with extracts containing methylene chloride.
  - Added instructions on the use of 1mL graduated concentrator tubes to determine 1mL final volumes.
  - Changed the required temperature of the re-circulating chiller used in the solvent recovery system from 10°C to 8°C.
  - Added instructions on how to properly clean the manifold and valves used in florisil clean-up.
  - Added guidance on when samples should be taken through the florisil clean-up.
  - Change to the use of 1:1 Sulfuric Acid in the clean-up procedure.
- Revision 3.1, dated 10 October 2008
  - Added references to method 3550C throughout SOP.
- Revision 3, dated 25 April 2008
  - Integration for TestAmerica and STL operations

Attachment 1.

Determinative and Extraction Methods Used in Conjunction with this SOP

Method Description	Determinative Method	Determinative Method SOP	Extraction Method	Extraction Method SOP
Diesel Range Organics & Jet Fuels	SW-846 8015B, 8015C, 8015D, California LUFT Method, & AK102 & AK103, NW-TPH, OK DRO	DV-GC-0027	WATER: SW-846 3510C, AK102 AK103 NW-TPH OK DRO SOIL: SW-846 3550B/C SW-846 3546 AK102, AK103 NW-TPH OK DRO	WATER: DV-OP-0006 SOIL: DV-OP-0016 or DV-OP-0015
Chlorinated Pesticides	SW-846 8081A, 8081B & EPA Method 608	DV-GC-0020 DV-GC-0016	WATER: SW-846 3510C SOIL: SW-846 3550B/C SW-846 3546	WATER: DV-OP-0006 SOIL: DV-OP-0016 or DV-OP-0015
Polychlorinated Biphenyls	SW-846 8082, 8082A EPA Method 608	DV-GC-0021 DV-GC-0016	WATER: SW-846 3510C SOIL: SW-846 3550B/C SW-846 3546	WATER: DV-OP-0006 SOIL: DV-OP-0016 or DV-OP-0015
Organo-phosphorus Pesticides	SW-846 8141A, 8141B, & EPA Method 614	DV-GC-0017	WATER: SW-846 3510C SOIL: SW-846 3540C	WATER: DV-OP-0006 SOIL: DV-OP-0010
Polynuclear Aromatic Hydrocarbons	SW-846 8310 & EPA Method 610	DV-LC-0009	WATER: SW-846 3510C SOIL: SW-846 3550B/C	WATER: DV-OP-0006 SOIL: DV-OP-0016
Semi-volatiles by GC/MS	SW-846 8270C, 8270D & EPA 625	DV-MS-0011 DV-MS-0012	WATER: SW-846 3510C SW-846 3520C SOIL: SW-846 3550B/C	WATER: DV-OP-0006 or DV-OP-0008 SOIL: DV-OP-0016
Low-Level Semi-Volatiles by GC/MS	SW-846 8270C	DV-MS-0011	WATER: SW-846 3520C	WATER: DV-OP-0008
Polynuclear Aromatic Hydrocarbons by GC/MS SIM	SW-846 8270C SIM	DV-MS-0002	WATER: SW-846 3510C SOIL: SW-846 3550B/C SW-846 3546	WATER: DV-OP-0008 SOIL: DV-OP-0016 or DV-OP-0015
Isotope Dilution Analysis of n-Nitrosodimethylamine by GCMS SIM using LVI	SOP	DV-MS-0015	WATER: SW-846 3520C SOIL: SW-846 3550B/C	WATER: DV-OP-0021 SOIL: DV-OP-0016
Extended List PAHs by GC/MS SIM for CSLP and Full Scan	SW-846 8270C	DV-MS-0005	WATER: SW-846 3520C	WATER: DV-MS-0005, Appendix II

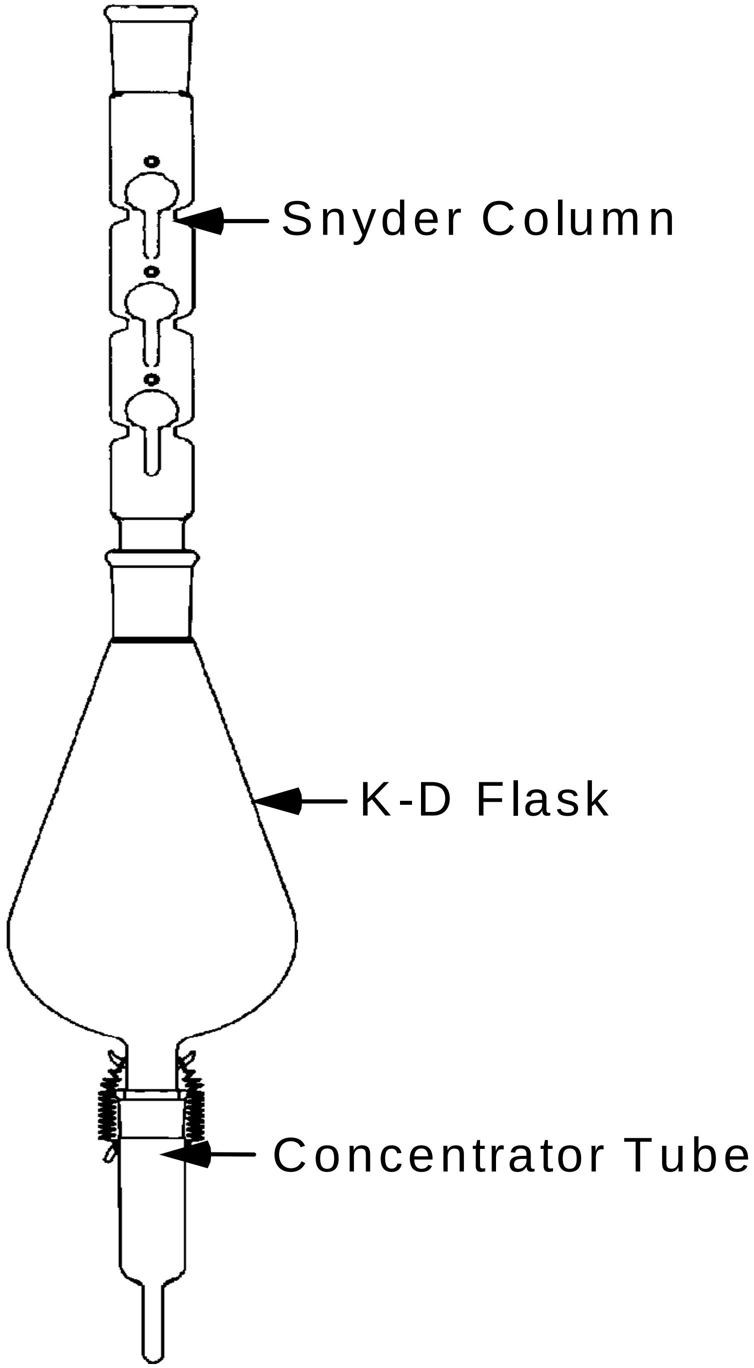
Attachment 2.

Boiling Points of Solvents

Solvent	Boiling Point (°C)
Methylene chloride	40
Acetone	56
Hexane	69
Methanol	65
Acetonitrile	82

Attachment 3.

Kuderna-Danish Concentrator



Attachment 4.

Florisil Check Solution
Prepared in Hexane

Compound	Concentration	Control
2,4,5-Trichlorophenol	0.1ug/mL	Y
Alpha-BHC	0.05ug/mL	Y
Alpha-Chlordane	0.05ug/mL	N
Aldrin	0.05ug/mL	N
Beta-BHC	0.05ug/mL	N
Dieldrin	0.05ug/mL	Y
Endosulfan I	0.05ug/mL	Y
Endosulfan II	0.05ug/mL	N
Endosulfan sulfate	0.05ug/mL	N
Endrin	0.05ug/mL	Y
Endrin Aldehyde	0.05ug/mL	N
Endrin Ketone	0.05ug/mL	N
Gamma-BHC	0.05ug/mL	Y
Gamma-Chlordane	0.05ug/mL	N
Heptachlor	0.05ug/mL	Y
Heptachlor expoxide	0.05ug/mL	N
Methoxychlor	0.05ug/mL	Y
4,4-DDD	0.05ug/mL	Y
4,4-DDE	0.05ug/mL	N
4,4-DDT	0.05ug/mL	Y
Tetrachloro-m-xylene	0.02ug/mL	Y
Decachlorobiphenyl	0.02ug/mL	Y

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Title: Extraction of Aqueous Samples by Continuous Liquid/Liquid Extraction (CLLE) by Method SW-846 3520C and Method 625 and ASTM Method D7065-11

Approvals (Signature/Date):

12/29/14
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Technical Specialist

Adam W Alban 29 Dec 14
Adam Alban — Date
Health & Safety Manager / Coordinator

Margaret S. Sleevi 12/29/14
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1.0 Scope and Application

This Standard Operating Procedure (SOP) is applicable to the solvent extraction of organic compounds from aqueous samples, TCLP leachates, and SPLP leachates using a continuous liquid/liquid extractor (CLLE). This SOP is based on SW-846 Method 3520C and EPA Method 625 and ASTM Method D7065-11.

The determinative methods used in conjunction with this procedure are listed in Table 1. This extraction procedure may be used for additional methods when appropriate pH and spiking mixtures are used.

This procedure does not include the concentration and cleanup steps. See SOP DV-OP-0007, “Concentration and Clean-up of Organic Extracts”, for details concerning the concentration and cleanup of extracts.

This procedure does not include the extraction of samples for low-level NDMA analysis by 8270D_SIM_LL. The CLLE extraction procedure utilized for that analysis is described in DV-OP-0021.

2.0 Summary of Method

A measured volume of sample is placed in a continuous liquid/liquid extractor (CLLE). The pH is adjusted, as required, for the efficient extraction of specific compounds. The organic compounds are extracted with methylene chloride for a designated length of time. A second extraction at a different pH also may be required. The water phase is discarded.

3.0 Definitions

3.1 Aliquot: A part which is a definite fraction of a whole; as in a “sample aliquot for testing or analysis.” “Aliquot” is also used as a verb meaning to take all or part of a sample for preparation, extraction, and/or analysis.

3.2 Extraction Holding Time: The elapsed time, expressed in days, from the date of collection of the sample to the date of extraction, i.e., the date solvent comes in contact with the sample. The holding time is tracked in the laboratory LIMS system, and is the primary basis of prioritizing work.

3.3 Preparation Batch: A group of up to 20 samples that are of the same matrix and are processed together in the same extraction event using the same procedure and lots of reagents and standards.

3.4 Quality Assurance Summary (QAS): Certain clients may require extensive specific project instructions or program QC, which are too lengthy to fit conveniently in the Method Comments field in LIMS. In those situations, laboratory Project Managers describe the special requirements in a written QAS to address these requirements. QASs are posted on a public drive for easy accessibility by all laboratory employees. Normally, QASs are introduced to analysts in an initial project kick-off meeting to be sure that the requirements are understood.

4.0 Interferences

4.1 Chemical and physical interferences may be encountered when analyzing samples using this method.

4.2 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All 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. Specific selection of reagents may be required to avoid introduction of contaminants.

4.3 Visual interferences or anomalies (such as foaming, emulsions, odor, etc.) must be documented.

4.4 The most common interference is laboratory contamination, which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them. Especially take note of the possibility of phthalate contamination from gloves. Gloves should be changed out frequently and whenever they come in contact with solvent. Glassware should be handled in a fashion that keeps gloves away from the interior and mouth of the glassware.

4.5 The decomposition of some analytes has been demonstrated under basic extraction conditions. Organochlorine pesticides may dechlorinate, phthalate esters may exchange, and phenol may react to form tannates. These reactions increase with increasing pH, and are decreased by the shorter reaction times available in Method 3510C. Method 3510C is preferred over Method 3520C for the analysis of these classes of compounds. However, using Method 3520C and performing the initial extraction at the acid pH optimizes the recovery of phenols.

4.6 The recovery of some target analytes and the surrogate 2-fluorobiphenyl can be reduced if proper care isn’t taken to target the pH during the base extraction to 11-12. It is not recommended to add excess base that will cause the sample pH to be greater than 12.

5.0 Safety

Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual 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, nitrile gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

5.1.1 CLLE glassware is often times fragile and awkward to use. Care should be taken to prevent breakage and injury. During the course of the procedure it might be necessary to adjust the height of the heating mantle. This will cause the CLLE body to tilt. Do not tilt the CLLE body more than 15 degrees to avoid stressing the glass and making the CLLE unstable. The condenser bank has been equipped with plastic holders to steady the CLLEs and to prevent them from tipping. See Attachment 1 for troubleshooting.

5.1.2 The procedure requires that the ground glass joints are fitted tightly to prevent loss of the extract. Cut resistant gloves will be worn when assembling or dis-assembling the ground glass joints to protect against cuts if the glass were to break.

5.1.3 The procedure calls for the use of condensers. In times of high humidity, water may collect on the outside of the condensers and collect inside the condenser holders. If the condenser holders and not emptied, they may overflow and excess water may then drip onto the bench top. This is an electrical hazard if electrical cords are also on the bench tops. In order to protect the electrical receptacles, cord connectors, and attachment plugs from wet conditions, excess water must be removed from the condenser cups before it overflows onto the bench top. If possible, secure electrical cords above the benchtop.

5.1.4 CLLE glassware that is full of water, should not be lifted by the arm, but by the top. The arm may not be able to support the full weight of the full CLLE.

5.1.5 When adding sodium hydroxide to the extractor, care should be taken to not get the base on the ground glass joints as the base will “glue” the joint together. If base does get on a ground glass joint, rinse it off with reagent water.

5.2 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.

Materials with Serious or Significant Hazard Rating

Material (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Methylene Chloride	Carcinogen Irritant	25 ppm (TWA) 125 ppm (STEL)	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, & headache. Causes irritation, redness, & pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Sodium Hydroxide	Corrosive Poison	2 mg/m3	Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of

Material (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
			exposure. Symptoms may include sneezing, sore throat, and runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes and can cause burns that may result in permanent impairment of vision, even blindness with greater exposures.
Sulfuric Acid	Corrosive Carcinogen	1 mg/m3	Inhalation may cause irritation of the respiratory tract with burning pain, coughing, wheezing, shortness of breath, and pulmonary edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Causes skin & severe eye burns. May cause irreversible eye injury, blindness, permanent corneal opacification.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit			

6.0 Equipment and Supplies

NOTE: All glassware used in this procedure is cleaned following SOP DV-OP-0004. In addition, the CLLEs are dried with acetone and then rinsed with methylene chloride twice prior to use.

6.1 Supplies

- Continuous Liquid-Liquid Extractor (CLLE) equipped with ground glass joints and polytetrafluoroethylene (PTFE) stopcock. (See Figure 1.) This procedure uses both 1000mL and 250mL extractors.
- 250mL boiling flask with ground glass joint.
- Boiling Chips, contaminant free, approximately 10/40 mesh, Teflon®, PTFE.
- Cooling Condensers, Allihn or Friedrichs style
- Re-circulating Chiller – kept at 5°C to 10°C
- Heating Mantle, Rheostat controlled, or Hotplate with temperature control. If hotplates are used then an aluminum cup must also be used to evenly heat the boiling flasks.
- Balance, ≥ 1600 g capacity, accurate to ± 1 g, calibration checked daily per SOP DV-QA-0014.
- pH indicator paper, wide range.
- Class A Graduated Cylinder, 1 L in size.
- Teflon® stir rods

- Mechanical pipette, 1 mL, positive displacement, with disposable tips, calibration checked daily per SOP DV-QA-0008.
- Aluminum foil.
- Disposable Pasteur Pipettes – used to take initial pH of sample.

6.2 Computer Software and Hardware

Please refer to the master list of documents and software located on R:\QA\Read\Master List of Documents\Master List of Documents and Software.xls (or current revision) for the current software to be used for data processing.

7.0 Reagents and Standards

Reagents - All materials must be reagent grade or higher quality, unless otherwise specified

7.1 Reagent Water

TestAmerica Denver utilizes ELGA water purification systems to generate reagent water. The water coming from the ELGA system should be 18-18.2 Mohm-cm. The performance of the water polishing system is checked daily and recorded per SOP DV-QA-0026.

7.2 Methylene Chloride

Each lot of solvent is tested following Corporate SOP CA-Q-S-001 or TestAmerica Denver SOP CA-Q-S-001 DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.3 Acids and Bases

7.3.1 1:1 Sulfuric Acid, (1:1 H2SO4)
Place an ice water bath on a stir plate. Place a container with a magnetic stir bar in the bath. While stirring, slowly add 1 part concentrated reagent grade sulfuric acid (36 N) to 1 part water from the ELGA purification system. Assign a 1 year expiration date from the date made or the vender expiration date, whichever is shorter.

7.3.2 10N Sodium Hydroxide (10N_NaOH)
Purchased at ready-to-use concentration from commercial vendors. Assign a 1 year expiration date from the date opened or the vender expiration date, whichever is shorter.

7.4 Baked Sodium Chloride

Bake in 400 °C oven for at least 4 hours. Assign an expiration date of 1 year after date opened, unless vender expiration date is shorter.

Standards

7.5 Please reference SOP DV-OP-00020 and WI-DV-009 for information regarding the surrogate and spike standards used in this procedure.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. 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 for Methods 8270C, 8270D, and 625	Amber Glass	1000 mL	Cool, $\leq 6^{o}$C, not frozen	7 Days	40 CFR Part 136.3 SW-846 Table 4-1
Waters for Methods 8270C, 8270D by Large Volume Injection	Amber Glass	250 mL	Cool, $\leq 6^{o}$C, not frozen	7 Days	40 CFR Part 136.3 SW-846 Table 4-1
TCLP Leachates for Methods 8270C and 8270D	Glass	200 mL	Cool, $\leq 6^{o}$C, not frozen	7 Days from the start of the leach	SW-846 1311
SPLP Leachates for Methods 8270C and 8270D	Glass	1000 mL	Cool, $\leq 6^{o}$C, not frozen	7 Days from the start of the leach	SW-846 1312
Waters for Method D7065_11	Amber Glass	1000 mL	H_2SO_4 to a pH of 2 Cool, $\leq 6^{o}$C, not frozen	28 Days	D7065_11

[1] Exclusive of analysis.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS Method Comments to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Assurance Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs. This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated.

9.1.3 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 Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 12 for more details on detection limit studies, initial demonstrations of capability, and analyst training and qualification.

9.3 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 that is used to analyze samples from the same preparation batch. See QC Policy DV-QA-003P for further details.

9.4 Method Blank (MB)

At least one method blank must be processed with each preparation batch.

- The method blank for batches of aqueous samples consists of 1 L of reagent water, which is free of any of the analyte(s) of interest.
- The method blank for batches of aqueous samples for Large Volume Injection (prep method 3520C_LVI) consists of 250 mL of reagent water free of any of the analyte(s) of interest.
- The method blank for batches of TCLP leachates consists of 200 mL of leach fluid.
- The method blank for batches of SPLP leachates consists of 1 L of leach fluid. The method blank is processed and analyzed just as if it were a field sample.

9.5 Laboratory Control Sample (LCS)

At least one LCS must be processed with each preparation batch.

- For aqueous sample batches, the LCS consists of 1 L of reagent water to which the analyte(s) of interest are added at known concentration.
- For batches of aqueous samples for Large Volume Injection (prep method 3520C_LVI), the LCS consists of 250mL of reagent water to which the analyte(s) of interest are added at known concentration.

- For TCLP leachates, the LCS consists of 200 mL of leach fluid to which the analyte(s) of interest are added at known concentration.
- For SPLP leachates, the LCS consists of 1 L of leach fluid to which the analyte(s) of interest are added at known concentration.

The LCS is carried through the entire analytical procedure just as if it were a sample.

Method 625 requires a LCS at a 10% frequency. In other words one LCS is required for a batch of 10 or less samples. A LCSD is required for a batch of 11 or more samples.

9.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

One MS/MSD pair should be processed with each preparation batch. A matrix spike (MS) is a field sample to which known concentrations of target analytes have been added. It is prepared in a manner similar to the LCS, but uses a real sample matrix in place of the blank matrix. A matrix spike duplicate (MSD) is a second aliquot of the same sample (spiked exactly as the MS) that is prepared and analyzed along with the sample and matrix spike. Some programs allow spikes to be reported for project-related samples only. Samples identified as field blanks cannot be used for the MS/MSD analysis.

Method 625 requires one matrix spike for every 10 samples. If the batch has more than 10 samples, then two matrix spikes must be performed. The two matrix spikes are to be performed on two different samples. If a client requests a MS and MSD for method 625, the MS and MSD shall be performed, but an NCM should be prepared documenting the deviation from the source method.

If insufficient sample volume is available for MS/MSD for SW-846, or for MS for method 625, an NCM must be written and a LCSD must be prepared.

9.7 Surrogate Spikes

Every calibration standard, field sample, and QC sample (i.e. method blank, LCS, LCSD, MS, and MSD) is spiked with surrogate compounds.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 Critical Procedural Considerations

10.3.1 As stated throughout this SOP, analysts must review Method Comments and any applicable QASs before starting work. This review is also documented on the Organic Extraction Checklist (see WI-DV-0009).

10.3.2 Analysts must focus on using clean technique throughout this procedure. Any parts or pipettes that come into direct contact with dirty surfaces or any piece of glassware other than the designated one should be cleaned or disposed of before coming into contact with the sample.

10.3.3 If problems arise during the extraction, see Attachment 1: Troubleshooting Guide.

10.4 Assemble and Clean the Glassware Immediately Before Use

10.4.1 For each sample and QC sample, rinse a 250 mL boiling flask with methylene chloride. Add a few boiling chips and fill with about 150 mL of methylene chloride.

10.4.2 For each sample and QC sample, rinse a CLLE once with acetone to ensure the CLLE is dry, and then rinse two times with methylene chloride. Make sure the stop-cock is open during the rinses. Then fill the bottom of the CLLEs with methylene chloride to a level approximately 2 cm above the opening of the solvent flow arm, or to a level that fills the funnel bottom completely. (See Figure 1.) If the samples are logged for prep method 3520C_LVI use the 250 mL CLLEs.

10.4.3 Set the CLLE with the stop-cock open on a stand under a slot hood and in front of a heating mantle or hotplate with a metal cup. Attach the 250 mL boiling flask containing methylene chloride and boiling chips to the side arm of the CLLE and place a heating mantle or hotplate with metal cup under the flask.

10.4.4 Cap the CLLE with aluminum foil to prevent contamination or solvent evaporation.

10.4.5 Label each boiling flask with the sample ID or batch QC ID. Also include on the label what fraction (acid or base) if the method calls for extraction at a secondary pH. (See Section 10.13).

10.5 Prepare LCS and Method Blank Samples

NOTE: For SW-846 methods if there is not a MS/MSD pair in the batch then perform a LCS/LCSD. Method 625 requires a LCS and LCSD in batches of 11 or more samples or if there is not a MS in batches of 10 or less samples.

10.5.1 For aqueous sample batches, dissolve approximately 6 g (approximately 1 tsp.) of baked NaCl to 1 liter of reagent water. For aqueous sample batches for LVI extraction (3520C_LVI) dissolve approximately 6 g of baked NaCl to 250 mL of reagent water.

NOTE: South Carolina samples must be batched separately. QC samples for these batches use reagent water directly from the Elga system. DO NOT ADD NaCl to any South Carolina samples or QC samples.

NOTE: The LVI procedure must not be used for South Carolina samples.

10.5.2 With the stopcock of the CLLE open, pour this water into the CLLEs marked for the LCS's and MB until the methylene chloride in the bottom of the CLLE starts to spill over through the solvent flow arm and into the boiling flask. Be careful not to allow water to spill over. You may need to add additional methylene chloride to the CLLE to prevent water from entering the solvent flow arm.

10.5.3 For TCLP batches, prepare the LCS's and method blanks using 200 mL of the appropriate leach fluid. For SPLP batches, prepare the LCS using 1 liter of the appropriate leach fluid. Add reagent water as necessary to the CLLE to cause the methylene chloride to begin to pour through the solvent flow arm and into the boiling flask. Place the leachate bottle beside the CLLE so a second analyst can check that the correct blank fluid was used. This is documented on the Organic Extraction Worksheet (WI-DV-0009).

10.6 Prepare the samples and the MS/MSDs

10.6.1 Measure the initial sample pH with wide-range pH paper and record the pH on the extraction bench sheet. Note any observations in an NCM. Usually samples have pH between 6 and 8. If the pH is outside of this range, an NCM should be prepared.

10.6.2 For TCLP leachates, use a Class A graduated cylinder to measure out 200 mL into the labeled CLLE. Add reagent water to the CLLE to ensure proper flow. For SPLP leachates, either use a Class A graduated cylinder to measure out 1000 mL into the labeled CLLE, or if the leachate was delivered in a 1 liter bottle from the TCLP lab, then the leachate can be aliquotted gravimetrically following the procedure in Section 10.6.3. Place the leachate container beside the CLLE so that a second analyst can check the labels. This is documented on the Organic Extraction Worksheet (WI-DV-0009).

10.6.3 For aqueous samples, it should be noted that TestAmerica Denver routinely aliquots samples gravimetrically. This is done to prevent cross-contamination due to volumetric glassware and to provide a more accurate initial volume measurement. However, some clients and regulatory programs require the laboratory to aliquot samples volumetrically. The client requirements and QASs must be read before samples are aliquotted to check for this requirement. If samples are to be aliquotted volumetrically, use Class A volumetric glassware only and proceed to Section 10.6.5.

10.6.4 Weigh the bottle containing the approximately 1 liter sample and record the gross weight to the nearest gram. If there is any indication that the sample's density is not 1g=1mL, then measure the density of the sample. Normally a full 1 liter bottle should weigh no more than 1560 g and a full 250 mL bottle should weigh no more than 424 g.

10.6.5 Inspect the samples for large amounts of sediment that may interfere with the extraction of the sample by clogging the solvent flow arm.

10.6.5.1 If the sample contains so much sediment that the entire sample volume cannot be extracted, decant the sample into the CLLE (or a 1 L graduated cylinder if volumetric aliquotting is required), be careful not to transfer the sediment. Write a NCM to document the sediment and that it prevented the entire sample volume from being extracted and the sample container from being rinsed.

10.6.5.2 If the sample does not contain a significant amount of sediment, then the entire sample volume will be used in the extraction. Do not pour the sample into the CLLE (or into the graduated cylinder if volumetric aliquotting is required) until after the surrogates and any necessary spikes have been added to the samples.

10.6.6 Place the sample containers in front of the CLLE labeled for that sample. A second analyst should then check the labels to make sure the correct sample is being extracted. This check is documented in the Organic Review Checklist (WI-DV-0009)

10.7 Add Surrogates to All Field Samples and QC Samples

10.7.1 Add the appropriate volume of the appropriate working surrogate standard to the sample container for each sample and MS/MSD. Add the surrogate standard to the MB and the LCS's in the CLLEs. Record the ID of the standard used on the bench sheet. Reference work instruction WI-DV-009 to determine the appropriate standard and the appropriate volume.

Note: If the sample contains an amount of sediment that has been deemed to interfere with the extraction process then the surrogate standard is added to the sample in the CLLE or in the graduated cylinder. This is considered a deviation and must be documented in a NCM.

10.8 Add Spikes to all LCS's and MS/MSDs

10.8.1 Add the appropriate volume of the appropriate working spike standard to the MS/MSD sample containers and the CLLEs for the LCS and/or LCSD samples. Record the ID of the standard used on the bench sheet. Note that the standard should be allowed to come to room temperature before spiking the samples. Record the time on the benchsheet as the Batch Open time.

NOTE: The addition of spikes and surrogates to samples must be done only immediately after a second analyst has reviewed the batch. Reference work instruction WI-DV-009.

10.9 Add NaCl to all samples and all QC samples

10.9.1 Add approximately 6 grams (approximately 1 tsp.) of baked NaCl to each sample container and each MS/MSD container. Cap the container and shake to dissolve the salt. If the sample is in a graduated cylinder at this point, then add the salt to the graduated cylinder and stir to dissolve. If the sample is in the CLLE at this point, add the salt to the CLLE slowly while stirring, or dissolve the salt in a small amount of reagent water before adding it to the sample.

10.10 If volumetric aliquotting is required, transfer the entire sample into a 1 L Class A graduated cylinder and record the volume on the benchsheet. If the sample bottle contains more than 1000 mL, a 100 mL Class A graduated cylinder can be used to complete the measurement. The entire sample volume must be used. Record the volume to the nearest 10 mL. Then pour the sample into the labeled CLLE on top of the methylene chloride. Rinse the sample container and the graduated cylinder with methylene chloride and add the rinse to the CLLE.

NOTE: A 1000 mL Class A graduated cylinder is not accurate enough to measure to the nearest 1 mL. Therefore all samples that are aliquoted using a 1000 mL Class A graduated cylinder will have the initial volume recorded to the nearest 10 mL. This accuracy is sufficient.

10.11 If volumetric aliquotting is not required, pour the sample directly into the CLLE on top of the methylene chloride. Rinse the sample container with methylene chloride and add the rinse to the CLLE. When rinsing 1 liter bottles at least 40 mL of solvent should be used. When rinsing 250 mL bottles, at least 20 mL of solvent should be used.

NOTE: It is very important to use sufficient solvent to perform the rinse. A bottle-top pump can be used to ensure that at the correct volume of solvent was used. The sample container should then be capped and shaken to ensure a good rinse of the internal surface area of the bottle. Failure to do so may cause low terphenyl-d14 surrogate recoveries.

10.12 Be careful to allow only the methylene chloride in the bottom of the CLLE to spill over into the boiling flask, and not to allow water to spill over. Add additional methylene chloride or reagent water to the CLLE if needed to ensure proper solvent flow.

10.13 Reweigh the bottle and document the weight as the Tare Weight in LIMS. LIMS will then calculate the initial sample volume by subtracting the empty bottle's weight from the full bottle's weight, assuming a density of 1g=1mL. If the sample's density is not 1g=1mL, then correct the calculated initial volume accordingly. See Section 11 for the calculation. Document abnormal sample density in an NCM.

10.14 If the initial volume is less than 800 mL for 1 liter extractions, or less than 200 mL for 250 mL extractions, the sample reporting limits and method detection limits will be elevated substantially and this should be documented in a NCM.

10.15 Adjust pH of Field Samples and QC Samples

10.15.1 Adjust the sample pH as indicated in the chart below using a minimum amount of 1:1 sulfuric acid or 10 N sodium hydroxide, as necessary.

NOTE: Samples for nonylphenols by method D7056_11 should be received in sulfuric acid preserved bottles. If the samples are received with an initial pH ≤2, then acid is not added to the samples. Acid should be added to the MB and any LCSs to reach a pH ≤2.

10.15.2 When adjusting neutral 1 liter samples to a pH of 1-2, start by adding 2 mL of the 1:1 sulfuric acid. When adjusting neutral 250 mL samples to a pH of 1-2, start by adding 0.5mL of the 1:1 sulfuric acid.

10.15.3 Use a Teflon® stir rod to mix the sample and check the pH using wide-range pH paper. Record the adjusted pH and the lot number of the acid on the bench sheet. If more acid is required, continue adding the acid in 1 mL increments until the proper pH is achieved and document on the benchsheet and in an NCM how many milliliters of acid were required.

NOTE: It is important to use Teflon® stir rods whenever possible instead of glass rods or pipettes as the glass will scratch the extractor bodies.

10.15.4 When adjusting neutral samples to a pH of 14 for 8270_LL when only 1,4-Dioxane or NDMA are requested, start by adding 10 mL of the sodium hydroxide. Use a Teflon® stir rod to mix the sample and check the pH using wide range pH paper. Record the adjusted pH and the lot number of the base on the bench sheet. If more than 10 mL of sodium hydroxide is required, continue adding the base in 1 mL increments until the proper pH is achieved and document in an observation NCM how many milliliters of base were required. It is important to try to achieve a pH of 14 in order to most effectively extract the 1,4-dioxane.

Extraction Method	Initial Extraction pH	Secondary Extraction pH
3520C *3520C_LVI* *625_Prep*	1 – 2	11 - 12
3520C_Base	14	None
D7065_11_W_Prep	1-2	None

10.16 Start the Initial Extraction

10.16.1 Attach the cold condenser (chilled at 5°C to10°C). Check that the hoses are not kinked. Check the temperature and water level of the chiller.

10.16.2 Turn on the heating mantle or hotplate. Check again for boiling chips in the boiling flask and inspect joints for leaks once solvent has begun cycling. Leaks might appear as frost that forms as the methylene chloride evaporates. The methylene chloride in the round bottom flask should be boiling steadily, but not too rapidly that the condenser cannot condense the vapor as fast as it is being generated.

10.16.3 Record the date and the time the extraction started on the bench sheet.

10.16.4 Extract the samples for the time indicated in the chart below.

Extraction Method Code	Analytical Method Code	Extraction Duration
3520C	All methods except “DoD” methods that are not also “LL”	18-24 Hours
3520C	All “DoD” methods except “LL”.	24 Hours
625_Prep	625	24 Hours
3520C_LVI	All Methods	4-6 Hours
D7065_11_W_Prep	D7065_11	18-24 Hours
3520C_Base	All Methods	18-24 Hours

Note: In order to consistently meet the DoD QSM control limits for the method 8270 surrogate 2-fluorobiphenyl in a 1 liter sample, a 24 hour extraction is required.

10.16.5 At the end of the extraction, turn off the heating mantle or hotplate and allow the extractor to cool. Record the date and time the extraction stopped on the bench sheet.

10.16.6 Remove the boiling flask, cap tightly with aluminum foil, and store refrigerated until concentration. If a second extraction at basic pH is required, continue on to Section 10.17. If a second extraction is not required, go to Section 10.18.

10.17 Start the Secondary Base Extraction

10.17.1 Attach a boiling flask with fresh methylene chloride and boiling chips to the CLLE. Label each boiling flask with the sample ID or batch QC ID.

10.17.2 Remove the condenser. Using a minimum amount of sodium hydroxide, adjust the pH of the sample in the extractor body to a pH of 11-12 for the methods indicated in Section 10.15.

10.17.3 When adjusting 1 liter samples, to a pH of 11-12, usually 5 mL of base is needed. When adjusting 250mL samples to a pH of 11-12, usually 1.2mL of base is needed.

10.17.4 Use a Teflon ® stir rod to mix the sample. Measure with wide-range pH paper and record the adjusted pH and the lot number of the base used on the bench sheet. If more base is needed add it in 1mL increments until a pH of 11-12 is reached. Document in an NCM how many milliliters of base were required. It is important to try to achieve a pH between 11-12. A pH above 12 might be detrimental to the recovery of some target analytes.

10.17.5 Re-attach the cold condenser, turn on the heating mantle or hotplate, and inspect the joints for leaks. Record the date and time the extraction started on the bench sheet.

10.17.6 Extract for the time indicated in Section 10.16.4.

10.17.7 At the end of the second extraction, turn off the heating mantle or hotplate and allow the extractor to cool. Record the date and time the extraction stopped on the bench sheet.

10.17.8 Remove the boiling flask, cap tightly with aluminum foil, and store refrigerated until concentration.

10.18 Disposal of Waste

10.18.1 Dispose of the methylene chloride remaining in the CLLE body in the methylene chloride Waste Stream B.

10.18.2 Dispose of the solvent-saturated water remaining in the CLLE in Waste Stream X if pH is neutral or basic.

10.18.3 Dispose of the solvent-saturated water remaining in the CLLE in Waste Stream Y if the pH is acidic.

10.19 Initial weights and volumes of samples and all extraction dates/times and reagents are entered into TALS, and the transcribed data must be verified by a second person. This verification is documented on the Organic Extraction Checklist (see WI-DV-0009).

10.20 Wash glassware following SOP DV-OP-0004.

10.21 Troubleshooting

10.21.1 See Attachment 1 for troubleshooting guide.

10.22 Maintenance – See QA SOPs for balance maintenance and pipette maintenance.

11.0 Data Analysis and Calculations

$$InitialVolume(mL) = \frac{FullBottle(g) - EmptyBottle(g)}{Density(g/mL)}$$

12.0 Method Performance

12.1 Before analyzing samples, the laboratory must establish a method detection limit (MDL). See Policy DV-QA-005P, “Determination of Method Detection Limits”, for more information on the method detection limit studies.

12.2 An initial demonstration of capability (IDOC) must be performed by each analyst. On-going proficiency must be demonstrated by each analyst on an annual basis. See DV-QA-0024, “Employee Training”, for more information on the IDOCs.

12.3 Training Qualification

The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

12.4 Calibration

N/A

12.5 Sample Analysis

N/A

13.0 Pollution Control

The volume of spike solutions prepared is minimized to reduce the volume of expired standard solutions requiring hazardous waste disposal.

The laboratory currently purchases only low-solvent extractors that allow the procedure to be performed with approximately 50mL of methylene chloride in the bottom of the extractor body.

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in section 13, “Waste Management and Pollution Prevention”, of the Environmental Health and Safety Manual, and HS-001, “Waste Management Program.”

14.2 The following waste streams are produced when this method is carried out:

14.2.1 Methylene chloride – Waste Stream B

14.2.2 Neutral aqueous sample waste saturated with methylene chloride – Waste Stream X.

14.2.3 Basic aqueous sample waste saturated with methylene chloride – Waste Stream X.

14.2.4 Acid aqueous sample waste saturated with methylene chloride – Waste Stream Y.

14.2.5 Expired Standards/Reagents – Contact Waste Coordinator for guidance

NOTE: Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of these materials.

15.0 References / Cross-References

15.1 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition and all promulgated updates, EPA Office of Solid Waste, January 2005, Method 3520C, Continuous Liquid-Liquid Extraction, Revision 3, December 1996.

15.2 Code of Federal Regulations, Title 40 – Protection of the Environment, Part 136 – Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix A – Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Method 625.

15.3 ASTM D7065-11, Standard Test Method for Determination of Nonylphenols, Bisphenol A, p-tert-Octylphenol, Nonylphenol Monoethoxylate, and Nonylphenol Diethoxylate in Environmental Waters by Gas Chromatography Mass Spectrometry.

16.0 Modifications:

16.1 Modifications from SW-846 Method 3520C

16.1.1 Section 7.1 of the method calls for initial sample volume to be determined volumetrically. This SOP allows the initial sample volume to be determined by weight.

16.1.2 Section 7.7 of the method states that if the acid and base extracts are not to be analyzed separately, then the boiling flask and solvent does not need to be changed, but may be used for the second pH extraction. This is currently not the practice here at TestAmerica Denver in order to prevent loss of some of the compounds that would extract in the first 18-hour extraction.

16.1.3 Table 1 of the method calls for the secondary extraction pH for method 8270C to be >11. This SOP calls for the secondary extraction pH for method 8270C to be between 11 and 12. Guidance is given in order to prevent the pH of the secondary extraction from being greater than 12 as this has been demonstrated to produce lower recoveries of some target compounds including the surrogate 2-flurobiphenyl.

16.2 Modifications from 40 CFR Method 625

16.2.1 Section 2.1 of the method calls for extracting the method at a pH greater than 11 and then again at a pH less than 2. This SOP calls for the acid extraction to be performed first followed by the base extraction. This is done to improve the recoveries of the phenols.

16.2.2 Section 11.2 of the method calls for initial sample volume to be determined volumetrically. This SOP allows the initial sample volume to be determined by weight.

16.2.3 The Method calls for the acid and base extracts to be concentrated and analyzed separately. This SOP calls for the extracts to be combined, then concentrated and analyzed.

16.3 Modifications from ASTM D7065-11

16.3.1 Section 6.2 of the source method calls for the glassware to be baked at 250℃ for 15 to 30 minutes. This procedure referen ces DV-OP-0004 for glassware cleaning in which the CLLEs are not baked, but dried with acetone.

16.3.2 Section 13.1 of the source method calls for the initial sample volume to be determined volumetrically. This SOP allows the initial sample volume to be determined by weight.

16.3.3 Section 13.1 of the source method calls for the sample container to be rinsed twice with 100mL portions of methylene chloride and the rinsed added to the extractor. This SOP calls for the sample container to be rinsed with at least

40mL of solvent. The extractor used in this procedure will not hold 200mL of solvent rinse. This procedure calls for the surrogate to be added to the sample while still in the sample container. Therefore if the 40mL solvent rinse is not sufficient, the surrogate recoveries would indicate a low recovery.

17.0 Attachments

Figure 1. Continuous Liquid-Liquid Extractor (CLLE)

Table 1. Determinative Methods Using CLLE Extractions

Attachment 1. Trouble-shooting Guide

18.0 Revision History

Revision 9.0 dated 12/31/14

- Sections 5.1.4 and 5.1.5 were added to give more guidance on how to safely handle the extractors and to prevent ground glass joints from sticking.
- Section 8 was revised to correct the holding time for leachates. The holding time starts at the beginning of the leach.
- Section 9.1.2 was revised to state the procedure meets all criteria for DoD QSM 5.0.
- Section 9.4, 9.5, 9.6, and 9.7 were revised to remove the Acceptance Criteria and the Corrective Action sections. This information can be found in the analytical SOPs listed in Table 1.
- Section 10.4.2 was revised to instruct the analyst to use 1L extractors for TCLP leachates. This was done to match current practice.
- Section 10.6.1 was revised to give more guidance on when an NCM is required for sample pH.
- Section 10.9.1 was revised to give more guidance on how to ensure the sodium chloride is dissolved into the sample.
- Section 10.15.3 was revised to explain why it is important to Teflon stir rods to stir the sample instead of glass rods.
- Section 10.15 was revised to clarify what methods require which extraction pH.
- Section 10.16.4 was revised to clarify what methods require which extraction time.
- Sections 10.18 and 14.2 were revised to include the waste stream for acidic sample waste.

Revision 8.0 dated 12/11/13

- The procedure was revised to reference nonylphenols by ASTM Method D7056-11. Previously the method reference was 8270C SIM.
- The procedure was revised to include details on the reduced volume extraction used for Large Volume Injection (LVI) analysis.
- Replaced reference to GC/CI/MS/MS for low-level NDMA analysis with 8270D_SIM_LL. TestAmerica Denver no longer supports the GC/CI/MS/MS analysis.
- Instructions were added to Section 5 to address the safety issue caused by excess water condensing off of the cold-water condensers and collecting near electrical equipment.
- Sodium thiosulfate was removed from the procedure. Sodium thiosulfate is used as a treatment for chlorinated samples, and since TestAmerica Denver does not hold

drinking water certification for the methods described in this SOP, the reagent is not needed.

- Section 8 was revised to include sample collection, preservation, and holding time requirements for ASTM Method D7056-11 and for samples analyzed by 8270 by Large Volume Injection. Preservation temperature range was updated to be consistent with EPAs current terminology used in 40 CFR Part 136 and SW-846.
- Note in Section 9.5 was added regarding DoD QSM 5.0 requirements for marginal exceedances.
- Section 9.6 was revised to instruct the analyst to document in an NCM when MS samples are not extracted a the frequency detailed in the source method 625.
- A note was added to Section 10.5 instructing the analyst that South Carolina does not accept LVI.
- The procedure was revised to instruct the analyst to add 6g of baked sodium chloride to each sample and each QC sample. This is done to increase sample extraction efficiency.

Revision 7.0 dated 10/19/12

- Section 6.0 was revised to make it explicitly clear that CLLEs are rinsed twice with methylene chloride before use.
- Section 10.9 was revised to give more detail on the solvent rinse of the sample bottle.
- Section 10.13.3 was revised to instruct the analyst to add 10mL of base. It is the laboratory's experience that 10mL of base is required to reach a pH of 14.
- Section 10.15.2 was revised to instruct the analyst to add 5mL of base. It is the laboratory's experience that 5mL of base is usually sufficient to reach a pH of 11 to 12.

Revision 6.0 dated 09/23/11

- This procedure was revised to remove instructions for the extraction of samples for Method 607. TestAmerica Denver no longer supports this method.
- This procedure was revised to remove instructions for the extraction of samples for PAH compounds by method 8270C SIM. TestAmerica Denver extracts water samples for PAH compounds by method 8270C SIM by separatory funnel. See DV-OP-0006.
- The procedure was revised to include instructions for the extraction of samples for nonylphenols by method 8270C SIM.
- Section 1 of this procedure was revised to correct the SOP reference for the extraction of samples for low-level NDMA analysis by GC/CI/MS/MS. The correct SOP is DV-OP-0021.
- Section 7.6 was revised to remove instructions on the preparation of surrogate and spike standards. Please reference SOP DV-OP-00020 and WI-DV-009 for information regarding the surrogate and spike standards used in this procedure. Tables 2 through 5 were removed.
- Sections 9.6 and 10.3 were revised to clarify that for method 625 if a MS is not performed in a batch of 10 or less samples, then a LCSD is required.
- Section 10.13.3 was revised to require an extraction at a pH of 14 whenever NDMA or 1,4-dioxane are the only compounds requested by method 8270C_LL.
- Various typographical errors were corrected.
- Section 6 was revised to clarify CLLEs are dried with acetone.
- Section 10.2.2 was revised to clarify how much methylene chloride should be added to the CLLE.
- Section 10.4 was revised to clarify that full sample containers should weigh less than 1560g, and if a sample container weighs more, a density check needs to be performed.

- Section 10.13.2 was revised to instruct the analyst to continue adding acid in 1mL increments if the first 2mL aliquot was insufficient.
- Attachment 1 was revised to include more troubleshooting tips.

Revision 5.0 dated 08/02/10

- This procedure was revised to remove the steps required for the extraction of samples for low-level NDMA analysis by GC/CI/MS/MS. The CLLE extraction procedure utilized for that analysis is described in DV-OP-0020.
- This procedure was revised to incorporate the requirements of TestAmerica Denver's new LIMS "TALS".
- Section 5.1.2 was added to discuss the hazards of ground glass joints and required PPE for tightening and loosening the joints.
- Section 6.1 and Section 10 were revised to state that the chiller temperature should be set at 5ºC to 10ºC instead of 8ºC to 10ºC.
- Section 6.1 was revised to stat the capacity of the balance should be greater than or equal to 1600g, not 1400g.
- Section 7.1 was revised to state that he lab has 3 ELGA analytical units instead of 2 and that the water should be at or above 18 Mohm-cm instead of 17 Mohm-cm.
- Section 7 was revised to clarify the expiration dates of the reagents.
- Section 7.9.5 was revised to state that instead of preparing a separate LCS standard for method 8270C_LL, 0.125mL of the method 8270 standard will be used.
- Note added to section 9.5 to not allow marginal exceedances for South Carolina work.
- The 8270/625 standard (8270LCS80ppm) described in Table 2 was revised to be made at a concentration of 80ug/mL instead of 100ug/mL. The surrogate compounds were corrected to remove compounds that are not used in the surrogate recovery evaluations.
- The TCLP spike standard (8270TCLPSpike) described in Table 4 was corrected to accurately reflect the concentrations of 3-Methylphenol and 4-methylphenol.

Revision 4.3 dated 01/04/10

- Basic Annual Review

Revision 4.2 dated 9/30/09

- Added clarification for the criteria of surrogating and spiking samples directly into the original container.

Revision 4.1 dated 9/18/09

- Added criteria for surrogating and spiking samples directly into the original container.
- Added comments in Section 4 about phthalate contamination arising from gloves.
- Removed the Organic Extractions Checklist. The checklist is now included in work instruction WI-DV-0009.
- The procedure was revised to include the addition of approximately 3 grams of baked sodium chloride to every sample and QC sample except those being extracted for low-level NDMA. This was done in order to increase the ionic strength of QC samples and field QC samples to more closely match the ionic strength of typical samples and to aide in the extraction of the more polar compounds.
- Changed the concentration of the benzidine LCS spike to 200µg/mL and the volume used to 1mL per liter of sample.

- Eliminated the “short-list” 8270 LCS spike mix. All 8270 LCSs are spiked using the full list 8270/625 LCS mix, which was also revised to correct the analyte list.
- Eliminated the acid only extraction for pentachlorophenol by 8270C SIM.

Revision 4 dated 12/20/08

- Added Section 4.6 to discuss the importance of targeting the pH of the base extraction.
- Added the option for hotplates in Section 6.
- Section 7.1.2 was revised to change the amount of sodium chloride used in the preparation of reagent water from 1g per liter to 3g per liter. This was done to compensate for seasonal changes in the water quality.
- Section 7.3.1 was revised to reflect actual laboratory practice. It was changed to state that the water used in the preparation of the 1:1 sulfuric acid is “water from the ELGA purification system” instead of “reagent” water. The laboratory’s practice has been to use water from the purification system in the making of the reagent, not water from the purification system that has had salt added.
- Section 10.2.2 and 10.3.2 were revised to give better guidance on the glassware rinsing. This was done to match the instructions given in DV-OP-0004 “Glassware Washing for Organic Analysis Applications”.
- Sections 10.4.3.4 and 10.4.4.6 were revised to include a label check after the sample transfer into the CLLE body.
- Section 10.8 was revised to give more guidance on the pH adjustment by instructing the analyst to add 2mL of acid when adjusting neutral samples to a pH of 1-2 with additional acid added in 1mL increments. The section was also revised to instruct the analyst to add 10mL of base when adjusting neutral samples to a pH of 14 wth additional base added in 1mL increments. The table was revised to change all base extractions to a pH of 11-12, except 8270 Best Practice, Low-Level 1,4-Dioxane which requires a pH of 14.
- Section 10.10.2 was revised to change the amount of base added to adjust an acidic sample to a pH of 11-12. The previous version of this SOP stated that normally 10mL of sodium hydroxide is to be used. This was revised to state 5-6 mL of sodium hydroxide should be used.
- Section 13 was revised to include the laboratory’s current practice of purchasing only low-solvent extractor bodies in order to reduce the amount of methylene chloride needed.
- Section 16.1.4 was revised to document the differences between the basic pH range used in the SW-846 method 3520C and the range used in this procedure.

Revision 3, dated 20 March 2008

- Integration for TestAmerica and STL operations.

FIGURE 1.

1000mL Continuous Liquid-Liquid Extractor (CLLE)

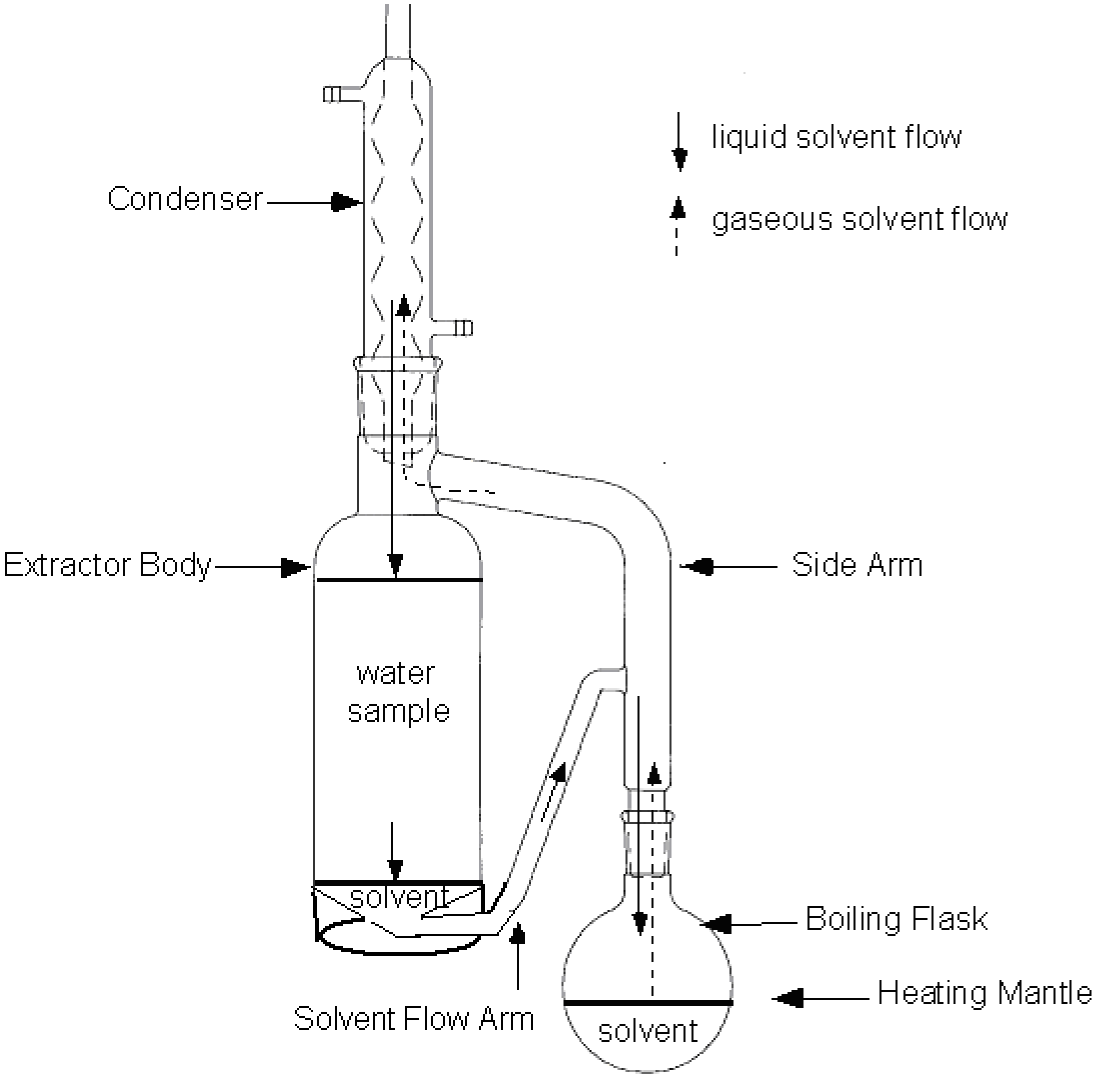

FIGURE 1 Continued

250mL Continuous Liquid-Liquid Extractor (CLLE)

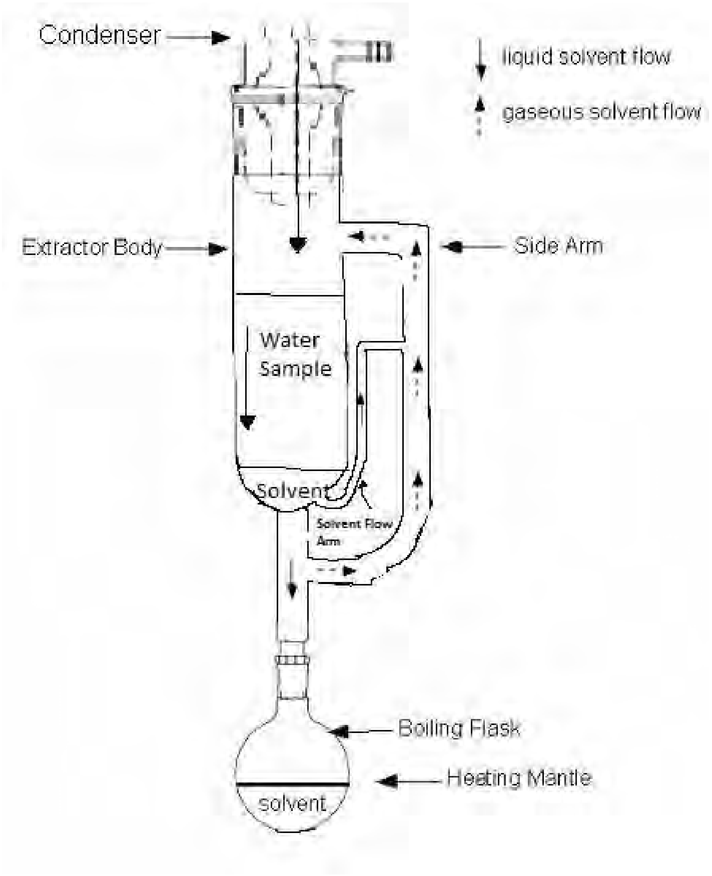

TABLE 1.

Determinative Methods Using CLLE Extractions

Method Description	*Determinative Method*	*SOP*
Semi-Volatiles by GC/MS	SW-846 8270C EPA Method 625	DV-MS-0011
Semi-Volatiles by GC/MS	SW-846 8270D	DV-MS-0012
Low-Level Semi-Volatiles by GC/MS Best Practice	SW-846 8270	DV-MS-0011
Nonylphenols by GC/MS SIM	SW-846 8270C SIM	DV-MS-0014

ATTACHMENT 1.

Trouble-shooting Guide

Burn-ups - *Whenever one of these things happen, document it in an NCM, and on the benchsheet!*

- **Is the stopcock closed?** If yes, then the sample never extracted. The solvent just went up the arm, condensed, and collected in the body of the CLLE. At this point the boiling flask can be very hot because it was boiled dry, so turn off the heating mantle. It is best if you replace the boiling flask with a new empty flask with new boiling chips because the old boiling chips could be ruined. Once the new empty boiling flask is on the arm, open the stopcock and the solvent will spill over the arm and into the flask. Turn on the heating mantle and start the 18 or 24 extraction clock over.
- **Is the condenser warm?** If yes, then the extraction is most likely ruined, especially if the boiling flask was dry. If there is sample volume and hold time remaining, then the sample should be re-extracted. If there is no sample volume remaining, then get a cold condenser on the CLLE, add more solvent and continue with the extraction. If there is sample remaining, but hold time has expired we need to save this extraction because it is the only one in hold. So get a cold condenser on the CLLE, but start the re-extraction ASAP.
- **Is there a loose joint?** If yes, then the extraction is most likely ruined. Follow corrective actions for warn condenser above.
- **Was the CLLE not topped off?** If the answers to numbers 1, 2, and 3 above is no, then look at the solvent return arm. If the return arm is not full, then maybe the CLLE was never topped off and the solvent just went up the arm, condensed, and collected in the body of the CLLE. Follow corrective actions for closed stopcock above.

Flooded Arms

- If the arm is equipped with a Snyder column, the arm might have become flooded because the solvent was boiling too fast and flooded the chambers of the Snyder column. When this happens, the solvent level in the round bottom flask might actually be low because the solvent is boiling out of the flask faster than it can flow back in. If this is the case, turn down the temperature of the heating mantle.
- If the flask and arm contain only solvent, just let the extraction finish. At the end of the extraction time, close the stopcock while the heating mantle is still on. Monitor the CLLE closely as the solvent boils and collects in the body of the CLLE. When the solvent level is low enough to remove the flask, turn off the heating mantle and let it cool. Remove the flask and cap with foil. If a second extraction is needed, place an empty boiling flask on the arm and open the stopcock. The excess solvent from the first extraction will flow into the empty boiling flask. Add more solvent if needed.
- If the flask and arm contain solvent and water, turn off the heating mantle and let the boiling flask cool. If there remains enough solvent in the boiling flask, close the stopcock and boil off enough solvent so you can remove the boiling flask. Once solvent level is low enough, then turn off heating mantle and allow it to cool. Then remove boiling flask and pour the water and solvent from the flask into the CLLE body while the stopcock is closed. Re-attach the boiling flask, open the stopcock, and allow the solvent to flow into the flask. If this doesn’t work, the sample and all the solvent needs to be transferred to a larger CLLE.

- If the flask and arm contains solvent and water, and the step above didn't work or there is not enough solvent left in the boiling flask to attempt the step above, turn off the heating mantle and let the boiling flask cool. Rinse a 2L separatory funnel with methylene chloride. When the boiling flask is cool, remove the condenser from the CLLE, grasp the CLLE at the body and at the joint with the boiling flask and pour the sample and the solvent into the rinsed separatory funnel. This needs to be done in a hood and you will need to have someone help you. Add a few more boiling chips to the boiling flask and place the empty CLLE back on the stand under the slot hood. Drain the methylene chloride from the separatory funnel into the body of the CLLE. Once all the methylene chloride has been transferred, continue to drain the water into the CLLE body on top of the methylene chloride. The water level in the CLLE will reach a high enough level that it will force the solvent over into the boiling flask. If the solvent level in the body of the CLLE gets too low, stop and add more solvent to the CLLE body to prevent water from going into the boiling flask. Rinse the separatory funnel with methylene chloride and add it to the CLLE.

Stuck Joints

- **Stuck Condenser** If the condenser is stuck, first close the stopcock and remove the boiling flask. Put on cut-resistant gloves. Try to loosen the joint with the cut-resistant gloves. Try rocking the joint back and forth. Try to gently twist both clock-wise and counter-clock-wise. If this doesn't work, heat the outside of the joint with the torch, but be sure not to keep the flame on one part of the glass, instead keep moving the flame. Watch for vapor bubbles between the glass joints as an indication the joint is loosening. Try to loosen the joint again. Repeat a few times. If heating the outside of the joint is not working, let the glass cool for about 30 minutes then come back and try again. If it is still stuck, unplug the condenser and empty the CLLE. Then soak the stuck joint in soapy water overnight.
- **Stuck Boiling Flask** If the boiling flask is stuck, first close the stopcock and remove the condenser. Put on cut-resistant gloves. Try to loosen the joint with the cut-resistant gloves. Try to loosen the joint both clock-wise and counter-clock-wise. If this doesn't work, tap the joint downward with a heavy object and try again. A plastic media-bottle cap can be used.
- **Stuck CLLE Body** If the CLLE body is stuck to the stand, close the stopcock and remove the condenser and the boiling flask. If possible, remove the plastic support from the rack with by removing the screws that hold it in place. Then lift the CLLE and the plastic support off the rack and empty the CLLE. Run hot water over the CLLE and plastic support to separate the glass from the plastic.

Solvent not Boiling

- If the heating mantle is hot, but the solvent is not boiling, check to see if there are boiling chips. Even if there are boiling chips, they might have stopped working. Turn off the heating mantle, allow the solvent to cool to room temp, remove flask, add boiling chips and return flask to CLLE.

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Title: Microwave Extraction of Solid Samples by Method [SW-846 3546]

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Facility Distribution No. ___________ **Distributed To:** ______________________

1.0 Scope and Application

1.1 This SOP is applicable to the solvent extraction of organic compounds from solid samples using microwave energy to produce elevated temperature and pressure conditions in a closed vessel containing the sample and organic solvent. This procedure achieves analyte recoveries equivalent to those from soxhlet or sonications methods, but uses less solvent. This SOP is based on SW-846 Method 3546.

1.2 The determinative methods used in conjunction with this procedure are listed in Table 1. This extraction procedure may be used for additional methods when appropriate solvents and spiking mixtures are used.

1.3 This procedure does not include the concentration and cleanup steps. See SOP DV-OP-0007, Concentration of Organic Extracts, for those details.

2.0 Summary of Method

A measured weight of sample, typically 30 g, is solvent extracted using a microwave extractor.

3.0 Definitions

3.1 **Extraction Holding Time**: The elapsed time expressed in days from the date of sample collection to the date the extraction starts. The holding time is tracked in the laboratory LIMS system, and is the primary basis of prioritizing work.

3.2 **Preparation Batch**: A group of up to 20 samples that are of the same matrix and are processed together in the same extraction event using the same procedure and lots of reagents and standards

3.3 **Method Comments:** The Method Comments are used to communicate to the bench level chemists special requirements and instructions from the client. Please reference WI-DV-0032 for details on Method Comments.

3.4 **Quality Assurance Summary (QAS)**: Certain clients may require extensive specific project instructions or program QC, which are too lengthy to fit conveniently in the Method Comments field in LIMS. In these situations, laboratory Project Managers describe the special requirements in a written QAS to address these requirements. QASs are posted on a public drive for easy accessibility by all lab employees. Normally, QASs are introduced to analysts in an initial project kick-off meeting to be sure that the requirements are understood.

3.5 **Aliquot**: A part that is a definite fraction of a whole; as in “take an aliquot of a sample for testing or analysis.” In the context of this SOP, “aliquot” is also used as a verb, meaning to take all or part of a sample for preparation, extraction, and/or analysis.

4.0 Interferences

4.1 Chemical and physical interferences may be encountered when analyzing samples using this method.

4.2 Sodium sulfate is not used in the extraction vessel. This is because salts are known to super heat when exposed to microwave energy. Samples are extracted without the addition of sodium sulfate, but the extracts are dried with sodium sulfate after the extraction, before concentration of the extracts. If the sample is excessively wet the aliquot can be divided among two or three extraction vessels and the extracts combined prior to concentration.

4.3 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All 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 of this SOP (Section 9). Specific selection of reagents may be required to avoid introduction of contaminants.

4.4 Visual interferences or anomalies (such as foaming, emulsions, odor, etc.) must be documented.

4.5 The most common interference is laboratory contamination, which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them.

4.6 Paint chips are an especially difficult matrix to extract. Oftentimes the paint chips dissolve or partially dissolve in solvents and therefore can ruin glassware and extraction vessels. It is the laboratory’s experience that paint chips are best extracted by method SW-846 3580 instead of 3550C or 3546.

5.0 Safety

Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual 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.

5.1 Specific Safety Concerns or Requirements

5.1.1 A post-run cool down must be used after each extraction to prevent the possibility of operator burns. Pressure builds up in the closed vessel at high temperatures. Care should be taken when opening the vessel when it is above room temperature.

5.1.2 Samples that contain metal fragments or metal components of any kind should not be extracted by this procedure. These samples should be extracted by method SW-846 3550C instead. Care should be taken to inspect samples carefully as they are aliquotted.

5.1.3 Eye protection that satisfies ANSI Z87.1 (as described in the Corporate Safety Manual), laboratory coat, and appropriate gloves must be worn while performing this procedure. Nitrile gloves shall be worn when handling solvents; latex gloves may be worn when handling samples only; and cut resistant gloves shall be worn when washing glassware.

5.2 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 (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Methylene Chloride	Carcinogen Irritant	25 ppm (TWA) 125 ppm (STEL)	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, and headache. Causes irritation, redness, and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Acetone	Flammable	1000 ppm (TWA)	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm (TWA) 4 ppm (STEL)	Nitric acid is extremely hazardous. It is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Material (1)	**Hazards**	**Exposure Limit** (2)	**Signs and Symptoms of Exposure**
Hexane	Flammable	50 ppm (TWA)	Prolonged or repeated contact with skin can cause defatting and dermatitis. Contact with eyes can cause redness, tearing, and blurred vision. Exposure can cause lung irritation, chest pain, and edema, which may be fatal.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Equipment

6.1.1 Microwave extractor. CEM MARS®

At least once a year, power measurement calibration should be performed at 400 W, 800 W, and 1600 W. This calibration can be performed by the vender or by TestAmerica staff following the instructions in the Operations Manual for the microwave.

6.1.2 Microwave extraction vessels. 75 mL Teflon™ Express vessels with stopper and cap (CEM Corp.)

6.1.3 Hand wrench to tighten the caps on the extraction vessels.

6.1.4 MARS 40 position carrousel (CEM Corp)

6.1.5 Balance, >1400-g capacity, accurate to ± 0.1 g, calibrated daily per SOP DV-QA-0014.

6.2 Supplies

6.2.1 Media bottles, 100 mL or 250 mL capped with aluminum foil.

6.2.2 Stainless steel conical funnels

6.2.3 Ashless cellulose filter paper

6.2.4 Pipetter with disposable 1.0-mL tips, calibrated daily per SOP DV-QA-0008.

6.2.5 Metal spatulas or tongue depressors.

6.2.6 Solvent dispenser pump.

6.2.7 Filter flask.

6.2.8 Vacuum pump.

6.2.9 Washing tool for Teflon™ extractor vessels. This tool is a long thin sponge-like brush.

6.3 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on R:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1 Methylene chloride – Each lot of solvent is tested following CA-Q-S-001 or CA-Q-S-001-DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.2 Acetone - Each lot of solvent is tested following CA-Q-S-001 or CA-Q-S-001-DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.3 Hexane - Each lot of solvent is tested following CA-Q-S-001 or CA-Q-S-001-DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.4 Baked Sodium Sulfate, 12-60 mesh - Heat sodium sulfate in a 400°C oven for at least four hours. QA personnel post the list of approved lots at solvent storage areas.

7.5 Baked Ottawa Sand – Heat Ottawa sand in a 400°C oven for at least four hours.

7.6 35% Nitric Acid – Dilute concentrated (70%) Nitric Acid 1:1 in water.

7.7 Standards - Please reference SOP DV-OP-0020 and WI-DV-009 for information regarding the surrogate and spike standards used in this procedure.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Soils for Method 8082A[2]	Glass with Teflon-lined lids	30 grams	Cool, $\leq$ 6°C	None	SW-846
Wipes for Method 8082A[2]	Glass with Teflon-lined lids	N/A	Cool, $\leq$ 6°C	None	SW-846
Soils for all other Methods, including 8082	Glass with Teflon-lined lids	30 grams	Cool, $\leq$ 6°C	14 days	SW-846
Wipes for all other Methods, including 8082	Glass with Teflon-lined lids	N/A	Cool, $\leq$ 6°C	14 days	SW-846

[1] Exclusive of analysis.

[2] Some regulatory agencies do not accept SW-846 Revision 4 of Chapter 4 and will require the 14 day holding time for Method 8082. The states of Alabama, California, Colorado, Connecticut, Nevada, New Jersey, Pennsylvania, and Rhode Island require the 14 day holding time for Method 8082.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, reference the Method Comments and QAS to determine specific QC requirements that apply.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, *Quality Assurance Program.*

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs. This procedure meets all criteria of DoD QSM 5.0 unless otherwise stated.

9.1.3 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 in the Quality Assurance Summaries (QAS) available in the public folders.

9.1.4 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 NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 13 for more details on detection limit studies, initial demonstrations of capability, and analyst training and qualification.

9.3 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 that is used to analyze samples from the same preparation batch. See QC Policy DV-QA-003P for further details.

9.4 Method Blank (MB)

9.4.1 A method blank must be processed with each preparation batch. The method blank is processed and analyzed just as if it were a field sample.

9.4.2 The method blank consists of 30 g of baked Ottawa sand free of any of the analyte(s) of interest.

9.5 Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD)

9.5.1 At least one LCS must be processed with each preparation batch. The LCS is carried through the entire analytical procedure just as if it were a sample.

9.5.2 The LCS consists of 30 g of baked Ottawa sand to which the analyte(s) of interest are added at known concentration.

9.5.3 Method AK102 requires LCS and a LCSD for every batch for every spike compound.

9.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

9.6.1 One MS/MSD pair must be processed with each preparation batch. A matrix spike (MS) is a field sample to which known concentrations of target analytes have been added. It is prepared in a manner similar to the LCS, but uses a real sample matrix in place of the blank matrix. A matrix spike duplicate (MSD) is a second aliquot of the same sample (spiked exactly as the MS) that is prepared and analyzed along with the sample and matrix spike. Some programs allow spikes to be reported for project-related samples only. Samples identified as field blanks cannot be used for the MS/MSD analysis.

9.6.2 If insufficient sample volume is available for MS/MSD, an NCM must be written and a LCSD must be prepared.

9.7 Surrogate Spikes

Every calibration standard, field sample, and QC sample (i.e. method blank, LCS, LCSD, MS, and MSD) is spiked with surrogate compounds.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must also be documented as a nonconformance, with a cause and corrective action described.

10.3 Critical Procedural Considerations

10.3.1 As stated throughout this SOP, analysts must review the LIMS Method Comments and any applicable QASs before starting work. This review is also documented on the Organic Extraction Checklist (see WI-DV-009).

10.3.2 Analysts must focus on using clean technique throughout this procedure. Any parts or pipettes that come into direct contact with dirty surfaces or any other beaker or media bottle than the designated one should be cleaned or disposed of before coming into contact with the sample.

10.4 Periodic cleaning.

10.4.1 At least once every two weeks, the extraction vessels must be cleaned using a "Clean Method" on the microwave. The method is under the User Directory with the settings that follow:

- Sample Type: Inorganic
- Control Type: Ramp to Temperature
- Power: 100%
- Ramp: 5 minutes to 180°C
- Hold: 10 minutes

10.4.2 Fill each tube with 30 mL of the nitric acid solution described in Section 7 and cap tightly. Place the tubes in the carousel, then run the "Clean Method"

10.4.3 Allow the vessels to cool, and then dispose of the nitric acid in waste stream J. Rinse the vessel with DI water three times.

10.4.4 Fill each tube with 30 mL of 1:1 Methylene Chloride: Acetone solution and cap tightly. Place the tubes in the carousel, then run the "Clean Method" again.

10.4.5 Allow the vessels to cool, and then dispose of the solvent in waste stream C. Allow the vessels to air dry.

10.5 Assemble and Clean the Extraction Tubes Immediately Before Use.

10.5.1 If the microwave tube, cap, or plugs are wet, pre-rinse with acetone.

10.5.2 Rinse the microwave tube, cap and plug with methylene chloride. The plugs can be placed in a large glass jar to help facilitate the rinse.

10.5.3 Discard the solvent in the correct waste stream.

10.6 Aliquot Samples

10.6.1 If the sample is a soil, mix and homogenize samples according to the instructions provided in SOP DV-QA-0023, Subsampling. If the sample is a wipe, transfer the wipe to the extraction vessel.

10.6.2 Label microwave vessel with the sample ID, method, and batch number. The label needs to be flat.

10.6.3 For each MB and LCS sample, weigh 30 to 33 g of baked Ottawa sand into labeled microwave vessels. Record the weight to the nearest 0.1 g directly into LIMS or hand record the weight on the benchsheet.

10.6.4 For each sample and MS/MSD, weigh 30 to 33 g of sample into the labeled microwave vessel. Record the weight to the nearest 0.1 g directly into LIMS or hand record the weight on the benchsheet.

NOTE: If the sample matrix appears to be unusual, or especially wet, the 30 g aliquot can be equally divided between two or three separate microwave extraction vessels. The vessels will be extracted independently, but the extracts will be re-combined before concentration. This will prevent the extraction vessels from over-heating and venting if the sample is unusually wet, oily, or bulky (if a 30 g aliquot would fill the tube more than ¾ full). If the sample is split into two or three separate vessels, prepare an NCM.

NOTE: Care should be taken to ensure that the top lip of the tube is clean of any sample material or debris so that the plug will fit tightly later.

10.6.5 Place the microwave vessel on a cart next to the sample container so that a second analyst can check the labels. This is documented on the Organic Extraction Checklists (See WI-DV-009).

10.7 Prepare a bottle with a bottle-top dispenser with the appropriate solvent.

10.7.1 Methylene Chloride is used for soil and wipe samples for the following methods:

- SW-846 8015B
- SW-846 8015C
- SW-846 8015D
- Alaska Methods AK102 and AK103 (AK102_103)
- Low-Level NDMA (8270D_SIM_LL)

10.7.2 For soil extraction by all other methods, the solvent used is a 1:1 mixture of methylene chloride and acetone.

10.7.3 For wipe samples by method 8081 and 8082, the solvent used is hexane.

10.7.4 For wipe samples by method 8270 SIM, the solvent used is a 1:1 mixture of methylene chloride and acetone.

10.8 Add Surrogate and Spike Solutions

NOTE: The standards should be allowed to come to room temperature before spiking the samples.

NOTE: The addition of spikes and surrogates to samples must be done only immediately after a second analyst has reviewed the batch. Reference work instruction WI-DV-009.

10.8.1 Only one batch should be surrogated at a time to ensure the correct standards are used and to ensure the solvent is added as soon as possible to the samples.

10.8.2 Using a calibrated pipette, add the appropriate volume of the appropriate working surrogate standard (see WI-DV-009) to the microwave vessel for each field sample and QC sample. Record the ID of the standard used on the benchsheet.

NOTE: If the sample aliquot was split into two or three separate tubes in Section 10.6.4 above, split the surrogate volume into the separate tubes as well.

10.8.3 Using a calibrated pipette, add the appropriate volume of the appropriate working spike standard (see DV-OP-009) to the microwave vessel containing any LCS, LCSD, MS, and MSD samples. Record the ID of the standard used on the benchsheet.

NOTE: If the MS or MSD aliquot was split into two or three separate tubes in Section 10.6.4 above, split the spike volume into the separate tubes as well.

10.9 Making sure not to overflow the vessel, slowly add approximately 25-30 mL of the appropriate solvent to the vessel. See Section 10.7 above for the appropriate solvent. Note that the solvent should be added as soon as possible after the addition of the surrogate and spiking standards to prevent loss of the more volatile compounds.

NOTE: For wipe samples add the solvent to the container that the wipe was received in and then transfer it to the microwave vessel. This is done to ensure a quantitative transfer of any solvent and material in the wipe sample container.

NOTE: The solvent should completely cover and saturate the sample so additional solvent may be needed depending on the matrix of the individual sample. The sample and solvent must not fill more than 2/3 of the vessel.

10.10 Seal the vessels by placing the plug on top of the vessel, small side down, and hand tighten the cap over the plug.

NOTE: Care should be taken to ensure that the plug, the cap, and the threads of the vessel are clean of any material or debris.

10.11 After being sealed, the vessels must be inverted several times to ensure that the material is well mixed and saturated. It is recommended that when extracting with 100% methylene chloride to vent and re-cap the vessels before continuing to relieve excess pressure and thereby preventing the vessels from venting during the extraction.

10.12 Load vessels into the carousel.

10.12.1 There must be at least 8 vessels in the carrousel. Adding blank vessels with sand and solvent may be necessary.

10.12.2 Balance the tubes around the carousel to ensure that all samples are exposed to an equal amount of energy during the extraction. See Attachment 1 for details. Only samples using the same extraction solvent should be placed in the same carrousel and run at the same time.

10.12.3 For the vessels to be correctly loaded in the carrousel the cap should completely touch the top of the carrousel with no other part of the extraction vessel visible.

10.13 Place the carrousel into the microwave, making sure that it sits on the turning apparatus correctly. The carrousel should be able to rotate. Close the door.

10.14 The Method Menu screen should indicate “Start Current Method” as being 3546 Full Xpress. Press the green “Start/Pause” button to begin the extraction.

NOTE: If a different method is shown, go to the “Load Method” on the menu screen. Choose “User directory” and place the cursor on the desired method. Press the “Home” button to return to the main menu, where the test highlighted will appear under the “Start Current Method”.

10.14.1 The method is under the User Directory with the settings that follow:

- Sample Type: Organic
- Control Type: Ramp to Temperature
- Power: 100% (1600 W)
- Ramp: 20 minutes to 115°C
- Hold: 10 minutes

10.14.2 When the extraction is complete, the vessels will need to return to room temperature prior to opening the vessels. The microwave will indicate the approximate temperature of the vessels.

CAUTION: If the carousel is removed from the microwave before the vessels are at room temperature, do NOT open the vessels. The vessels may be placed in a rack outside of the microwave to cool down.

10.14.3 The microwave contains a solvent sensor that will indicate the presence of solvent in the microwave and will stop the extraction. To minimize this, care needs to be taken not to overfill the vessel and to properly cap and tighten the vessel prior to extraction. If the solvent sensor indicates the presence of solvent, open the door and inspect the tops of the tubes for evidence of a solvent leak. If solvent has vented or leaked out of an extraction vessel, the sample must be re-aliquotted and the extraction started over. It is best to re-aliquot the sample into two or three separate extraction vessels to prevent over-heating again. Document this in an NCM.

10.15 Assemble and Clean Filter Funnels and Media Jars.

10.15.1 Without gloves on, fold a 18 cm diameter cellulose filter paper in quarters. Open the folds to create a cone. Place the filter paper in the bottom of a conical stainless steel funnel. Place the funnel on a 100 mL or 250 mL media bottle.

NOTE: For low-level NDMA samples by method 8270D_SIM_LL, use designated glass funnels instead of the stainless steel funnels and instead of re-usable media jars, use disposable amber bottles. This is done to prevent contamination.

10.15.2 Place approximately 1 tablespoon of baked sodium sulfate in the funnel. Rinse all surfaces of the funnel, the filter and the sodium sulfate with the extraction solvent (see Section 10.7), so all surfaces of the funnel, filter, and sodium sulfate are rinsed.

NOTE: When preparing glassware for the extraction of wipe samples, sodium sulfate is not necessary and the solvent used in the rinse should be the solvent used in the extraction of the wipe samples. (Normally hexane for methods 8081 and 8082).

10.15.3 Allow the solvent to drain completely into the media bottle. Swirl the media bottle to ensure all surfaces come into contact with the solvent. Add additional solvent to the rinse if necessary.

10.15.4 Pour the solvent out of the media bottle over the stem of the stainless steel funnel to rinse the funnel stem.

10.15.5 Discard the solvent in the correct waste stream.

10.16 Filter the Extracts

10.16.1 After the extraction method is complete and the vessels reach room temperature, quantitatively transfer the entire sample through solvent rinsed sodium sulfate funnels and into the media jar. The quantitative transfer is performed by rinsing the microwave extraction vessel at least three times with solvent.

NOTE: The quantitative rinse is vital in order to achieve good recoveries. The rinses should be significant enough that when done, the extract volume is between 75 mL and 100 mL.

NOTE: If the sample aliquot was split between two or three tubes, the extracts from all the tubes shall be combined at this time. Filter all of the extracts through the same sodium sulfate funnel and collect in the same media jar.

10.16.2 Once the solvent has completely drained into the collection apparatus, rinse the funnel contents with 10 to 20 mL of additional solvent. Dispose of the solid sample and sodium sulfate into Waste Stream D and cap the media jar with aluminum foil.

10.17 If the extract contains visible solids, it will be necessary to filter the extract again prior to concentration.

10.18 Store the extract refrigerated at $\leq$ 6°C until concentration.

10.19 Handwritten notes on the benchsheet are entered into LIMS, and the transcribed data must be verified by a second person. This verification is documented on the Organic Extraction Checklists (see WI-DV-009).

10.20 All glassware and microwave tubes, plugs, and caps are washed according to DV-OP-0004.

10.21 Maintenance

10.21.1 As needed, wipe out the inside and outside of the microwave with a damp cloth.

10.21.2 See Section 10.2 for vessel cleaning.

10.21.3 At least once a year, power measurement calibration should be performed at 400 W, 800 W, and 1600 W. This calibration can be performed by the vender or by TestAmerica staff following the instructions in the Operations Manual for the microwave.

10.22 Troubleshooting

10.22.1 If it appears that the solvent sensor is malfunctioning, ensure that the sensor is aligned at a 45 degree upward angle on the back of the unit.

10.22.2 The snorkel vent should be set inside of a hood, but care should be taken so that the opening is not blocked. Make sure the snorkel does not press against the back of the hood.

11.0 Calibration

Not applicable to this procedure.

12.0 Calculations / Data Reduction

Not Applicable.

13.0 Method Performance

13.1 Method Detection Limit Study (MDL)

Before analyzing samples, the laboratory must establish a method detection limit (MDL). See DV-QA-005P, Determination of Method Detection Limits, for more information on the method detection limit studies.

13.2 Demonstration of Capabilities

An initial demonstration of capability (IDOC) must be performed by each analyst. On-going proficiency must be demonstrated by each analyst on an annual basis. See M-Q-001, TestAmerica Quality Management Plan, and the TestAmerica Denver Laboratory Quality Assurance Manual (QAM) for more information on the IDOCs.

13.3 Training Requirements

The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

14.0 Pollution Control

The volume of spike solutions prepared is minimized to reduce the volume of expired standard solutions requiring hazardous waste disposal.

15.0 Waste Management

15.1 All waste will be disposed of in accordance with Federal, State, and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method, the policies in section 13 of the Environmental Health and Safety Manual for “Waste Management and Pollution Prevention”, and the Waste Management procedure, DV-HS-001P.

15.2 Waste Streams Produced By This Method

15.2.1 Methylene chloride – Waste Stream B

15.2.2 1:1 MeCl2:Acetone – Waste Stream CA

15.2.3 Flammable solvent – Waste Stream C

15.2.4 Solid waste/sodium sulfate – Waste Stream D

15.2.5 Nitric Acid Waste – Waste Stream J

15.2.6 Expired Standards/Reagents – Contact Waste Coordinator for guidance

NOTE: Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of these materials.

16.0 References / Cross-References

16.1 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 3456 Microwave Extraction, Revision 0, February 2007.

16.2 Alaska Method AK102, “For the Determination of Diesel Range Organics”, Verision 04/08/02.

16.3 Alaska Method AK103, “For the Determination of Residual Range Organics”, Version 04/08/02.

16.4 NWTPH-HCID “Hydrocarbon Identification Method for Soil and Water”, Manchester Environmental Laboratory, Dept of Ecology, State of Washington.

17.0 Method Modifications:

17.1 SW-846 Method 3546 calls for samples to be either air-dried and ground or mixed with sodium sulfate prior to extraction. This procedure does not call of the air-drying of samples unless requested by the client as this may lead to loss of the more volatile compounds. Sodium sulfate is not used in the extraction vessel, rather the extracts are dried with sodium sulfate after extraction and prior to concentration. Salts are known to superheat when exposed to microwave energy.

17.2 SW-846 Method 3546 calls for samples to be aliquoted on a balance capable to weighing to 0.01 g. This SOP calls for a balance capable to weighing to 0.1 g as this is sufficient to report data to 3 significant figures.

17.3 SW-846 Method 3546 Section 1.4 states “2-20 g of material is usually necessary and can be accommodated by this extraction procedure.” This SOP calls for 30-33 g of material.

17.4 SW-846 Method 3546 Section 11.7 states “Add approximately 25 mL of the appropriate solvent system to the vessel.” This SOP calls for the addition of 30mL of solvent.

17.5 Method NWTPH-Dx calls for samples to be extracted by method SW-846 3550C. Valid MDLs and IDOCs have been completed using both method SW-846 3550C and SW-846 3546 and they are comparable therefore method NWTPH-Dx is a possible determinative method by this procedure.

17.6 Method AK102 and AK103 calls for samples to be extracted by soxhlet. Valid MDLs and IDOCs have been completed using this procedure, therefore method AK102 and AK103 are listed as a possible determinative methods by this procedure.

18.0 Attachments

Table 1: Determinative Methods Using Microwave Extraction

Attachment 1: Proper Carousel Loading

19.0 Revision History

- Revision 5, January 31, 2015
    - Annual Technical Review
    - Reformatted SOP
    - Revised Section 7.4 to remove the requirement to test the sodium sulfate before use. This was done to reflect current practice in CA-Q-S-001-DV-1.
    - Added “NWTPH DRO” to the procedure
    - Revised Section 10.5.2 to state that the plugs and caps can be rinsed in a large glass jar.
    - Added a note in Section 10.15.1 to state that for method 8270D_SIM_LL, designated glass funnels and disposable amber bottles will be used to filter the extracts.
    - Added Sections 16.2-16.5 to list AK102, AK103, and NWTPH methods as references.
    - Removed Section 17.8, redundant with 17.5.
    - Updated Table 1 to reference the correct methods and SOPs.

- Revision 4, January 31, 2014
  - Annual Technical Review
  - Revised Section 1.2 to state that the procedure may be used for additional methods when appropriate solvents are used instead of pH as there are no pH adjustments made in the procedure.
  - Removed TeflonTM lined caps from the Equipment and Supplies list in Section 6 as the lab now uses aluminum foil.
  - Added footnote to the table in Section 10 stating some regulatory agencies do not accept SW-846 Revision 4 of Chapter 4 and will require 14 day hold time for method 8082A.
  - Revised Section 9.1.2 to state that this procedure meets all criteria of DoD QSM 5.0.
  - Revised Section 9.4 to clarify that one method blank is processed with each batch.
  - Removed "Acceptance Criteria" and "Corrective Action" information from Sections 9.4, 9.5, 9.6, and 9.7. This information can be found in the analytical SOPs.
  - Added a bullet point in Section 10 to clarify that any deviations discovered after the procedure is performed are to be documented in an NCM.
  - Revised Section 10 to remove the instruction to place the label towards the bottom of the vessel. This is not necessary. Also removed the requirement that the label must include the date. The label includes the batch number, which is unique and the date of extraction is recorded in the batch.
  - Revised the procedure to state the periodic acid cleaning of the tubes should be done at least once every two weeks instead of weekly.
  - Removed methods "NWTPH DRO" and "Okla_DRO" from the procedure. The lab does not perform microwave extraction for these methods at this time.
  - Added sub-sections for Maintenance and Troubleshooting to Section 10 per DoD QSM 5.0.
  - Added low-level NDMA and 8015D as a possible analytical method to Section 10 and to Table 1
  - Removed 8310 as a possible analytical method in Table 1.
  - Added Attachment 1 to give instructions on how to properly load the vessels in the carousel.
- Revision 3, January 31, 2013
  - Annual Technical Review
  - Sections 4.2 and 10.5.4 were revised to remove the optional addition of sodium sulfate to the samples before extraction. It was determined that the better option when dealing with wet samples is to split the sample into two or three tubes and re-combine the extracts before concentration.
  - Section 4 was revised to add instructions on how to deal with paint chip samples.
  - Section 5 was revised to add comments about the dangers of metal fragments in samples.
  - Section 6 was revised to include the requirement that the Power Measurement

Calibration procedure be performed on the unit every year.

  - Section 8 was revised to update the hold times for Method SW-846 8082A.
  - Section 10.8 was revised to give more detail on how full the extraction vessel should be once solvent has been added.
  - Section 10.13.1 was revised to allow the carousel to be removed from the microwave unit before the vessels are cool so long as the vessels are not opened.
  - Section 10.15.1 was revised to add a note about the importance of quantitative transfers and rinses while filtering the extracts.
  - Section 10.15.1 was revised to add instructions to combine all extracts from samples that were originally split across two or three tubes.
  - Section 15 was revised to include the waste stream CA.
  - Added the Note to Table 1

- Revision 2.0, January 31, 2012
  - Annual Technical Review
  - Updated Section 4.2 and Section 10.5.4 to describe when sodium sulfate should be used in the extraction vessel.
  - Updated Section 6.0 to allow the use of aluminum foil to cap 100mL and 250mL media jars.
  - Updated Section 6.1 to include details on computer software and hardware.
  - Updated Section 7.0 to include details on the purity of reagents and standards.
  - Updated Section 9.1.4 and Section 10.1 to more accurately reflect the NCM process.
  - Corrected grammatical and formatting errors
  - Updated Section 10.3 to include a solvent cleaning after the weekly acid cleaning.
  - Updated Section 10.5.4, Section 10.7.2, and Section 10.7.3 to include an option to split the sample aliquot into two separate microwave vessels.
  - Updated Section 10.10 and 10.13.2 to give details on how to prevent vessels from over-heating and venting and steps to be taken if venting does occur.
  - Updated Section 10.16 to accurately reflect how the laboratory handles extracts with suspended sediment.
  - Updated Section 10.19 to reference SOP DV-OP-0004 on how to clean the microwave vessels.

- Revision 1 dated 01 Jan 2011
  - Added 8270C SIM as a valid determinative method by microwave extraction.
  - Changed the procedure to call for the extract to be filtered thru a conical steel funnel lined with cellulose filter paper instead of a glass funnel with glass wool. This was done to help remove sediment from the extracts.
  - Removed details about the surrogate and spike standards used in the extraction. This information can now be found in DV-OP-0020.
  - Added instructions to Section 7 on how to prepare the nitric acid solution used in the weekly cleaning of the tubes.

  - Changed the solvent used in the extraction of samples for method 8081 and 8082. The samples are now extracted in a 1:1 Mixture of MeCl2:Acetone instead of a 1:1 Mixture of MeCl2:Hexane.
  - Revised the procedure in Section 10.5 for aliquotting samples to state that 30 to 33g of sample should be used instead of 30±2g and that the weight should be recorded to the nearest 0.1g instead of the nearest mg.

- Revision 0.1 dated 12 March 2010
  - Updated implementation date
  - Added section 6.1

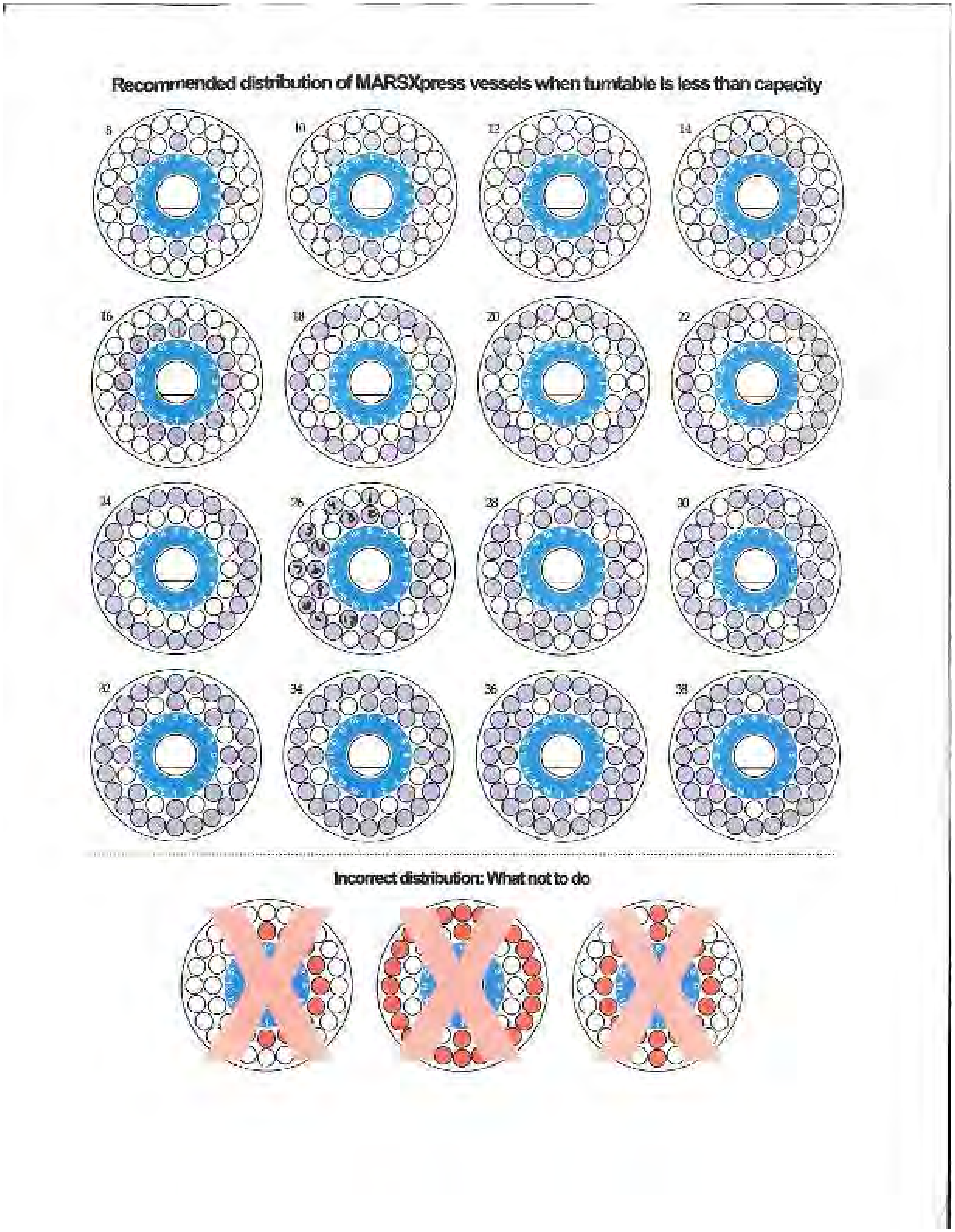
TABLE 1.

Determinative Methods Using Microwave Extraction

Method Description	Determinative Method	SOP
Chlorinated Pesticides	SW-846 8081A SW-846 8081B	DV-GC-0020
Polychlorinated Biphenyls (PCBs)	SW-846 8082 SW-846 8082A	DV-GC-0021
Diesel and Residual Range Organics	SW-846 8015B SW-846 8015C SW-846 8015D NWTPH-Dx AK102 AK103	DV-GC-0027
Polynuclear Aromatic Hydrocarbons by GC/MS SIM	SW-846 8270C SIM SW-846 8270D SIM	DV-MS-0002
Low-Level NDMA by Isotope Dilution, GC/MS SIM, Large Volume Injection	SW-846 8270C/D SIM	DV-MS-0015

ATTACHMENT 1.

Proper Carousel Loading



Recommended distribution of MARSXpress vessels when turntable is less than capacity

Incorrect distribution: What not to do

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Title: Ultrasonic Extraction of Solid Samples [SW-846 3550B & 3550C]

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1.0 Scope and Application

1.1 This SOP is applicable to the solvent extraction of organic compounds from solid samples, including wipes, using sonication (i.e., ultrasonic extraction). This SOP is based on SW-846 Method 3550B and 3550C.

1.2 The determinative methods used in conjunction with this procedure are listed in Table 1. This extraction procedure may be used for additional methods when appropriate spiking mixtures and extraction solvents are used.

1.3 This procedure does not include the concentration and cleanup steps. See SOP DV-OP-0007, Concentration of Organic Extracts, for those details.

2.0 Summary of Method

A measured weight of sample, typically 30 g, is mixed with anhydrous sodium sulfate to form a free flowing powder. This mixture is solvent extracted three times using an ultrasonic horn.

3.0 Definitions

3.1 **Extraction Holding Time**: The elapsed time expressed in days from the date of sample collection to the date the extraction starts. The holding time is tracked in the laboratory LIMS system, and is the primary basis of prioritizing work.

3.2 **Preparation Batch**: A group of up to 20 samples that are of the same matrix and are processed together in the same extraction event using the same procedure and lots of reagents and standards

3.3 **Method Comments:** The Method Comments are used to communicate to the bench level chemists special requirements and instructions from the client.

3.4 **Quality Assurance Summary (QAS)**: Certain clients may require extensive specific project instructions or program QC, which are too lengthy to fit conveniently in the Method Comments field in LIMS. In these situations, laboratory Project Managers describe the special requirements in a written QAS to address these requirements. QASs are posted on a public drive for easy accessibility by all lab employees. Normally, QASs are introduced to analysts in an initial project kick-off meeting to be sure that the requirements are understood.

3.5 **Aliquot**: A part that is a definite fraction of a whole; as in “take an aliquot of a sample for testing or analysis.” In the context of this SOP, “aliquot” is also used as a verb, meaning to take all or part of a sample for preparation, extraction, and/or analysis.

4.0 Interferences

4.1 Chemical and physical interferences may be encountered when analyzing samples using this method.

4.2 In order to extract especially wet solids, the initial sample weight might have to be reduced in order to achieve a free-flowing mixture with the sodium sulfate. This can raise the reporting limits and method detection limits.

4.3 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All 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 of this SOP (Section 9). Specific selection of reagents may be required to avoid introduction of contaminants.

4.4 Visual interferences or anomalies (such as foaming, emulsions, odor, etc.) must be documented.

4.5 The most common interference is laboratory contamination, which may arise from impure reagents, dirty glassware, improper sample transfers, dirty work areas, etc. Be aware of potential sources of contamination and take appropriate measures to minimize or avoid them.

4.6 There are many sources of phthalate contamination in the laboratory. The most common of which are nitrile gloves. The analyst should never touch the inside of glassware with gloves. For the analysis of low-level phthalates by method 8270C SIM, common filter paper can introduce phthalate contamination. Therefore when samples are extracted for this analysis, the Method Comments will instruct the analyst that only glass wool can be used.

4.7 It has been observed that 8270 compounds benzoic acid, 2,4-dinitrophenol, and 4,6-dinitro-2-methylphenol will not recover well if the extract does not drain completely and quickly through the sodium sulfate. Therefore it is very important that a thorough rinse is performed – especially after the 1st sonication. Recoveries will also be improved if the filter paper and funnels used allow for quick drainage. It has been observed that Büchner funnels and glass fiber filter paper will slow drainage.

5.0 Safety

Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual 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, nitrile or latex gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

5.1.1 Ultrasonic disrupters can produce high intensity noise and must be used in an area with adequate noise protection. During operation, the horns will be kept in a sound enclosure inside the fume hood to protect the analyst. If a sound enclosure is not used, then hearing protection is required when within 10 feet of an operating ultrasonic disrupter and the analyst must be in the Hearing Protection Program per DV-HS-0010, Hearing Conservation Program.

5.1.2 Eye protection that satisfies ANSI Z87.1 (as described in the Environmental Health and Safety Manual), laboratory coat, and appropriate gloves must be worn while performing this procedure. Nitrile gloves shall be worn when handling solvents; latex gloves may be worn when handling samples only; and cut resistant gloves shall be worn when washing glassware.

5.2 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 (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Methylene Chloride	Carcinogen Irritant Poison	25 ppm (TWA) 125 ppm (STEL)	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, and headache. Causes irritation, redness, and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Hexane	Flammable	50 ppm (TWA)	Prolonged or repeated contact with skin can cause defatting and dermatitis. Contact with eyes can cause redness, tearing, and blurred vision. Exposure can cause lung irritation, chest pain, and edema, which may be fatal.
Acetone	Flammable	1000 ppm (TWA)	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Sonicator, at least 300 watts.

6.2 Sonicator horn, ¾ inch

6.3 Balance, >1400-g capacity, accurate to ± 0.1 g, calibrated daily per SOP DV-QA-0014.

6.4 Beakers, 400 mL.

6.5 Media bottles, 250 mL with Teflon-lined caps.

6.6 Stainless steel conical funnels

6.7 Ashless cellulose filter paper

6.8 Glass wool - For the analysis of low-level phthalates by method 8270 SIM.

6.9 Pipetter with disposable 1.0-mL tips, calibrated daily per SOP DV-QA-0008.

6.10 Aluminum foil.

6.11 Wooden tongue depressors

6.12 Metal spatulas.

6.13 Solvent dispenser pump.

6.14 Filter flask.

6.15 Vacuum pump.

6.16 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on R:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

7.1 Reagents - All materials must be reagent grade or higher quality, unless otherwise specified

7.1.1 Methylene chloride – Each lot of solvent is tested following SOP CA-Q-S-001 or CA-Q-W-001 DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.1.2 Acetone - Each lot of solvent is tested following SOP CA-Q-S-001 or CA-Q-W-001 DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.1.3 Hexane - Each lot of solvent is tested following SOP CA-Q-S-001 or CA-Q-W-001 DV-1 before it is put into use. QA personnel post the list of approved lots at solvent storage areas.

7.1.4 Baked Sodium Sulfate, 12-60 mesh - QA personnel post the list of approved lots at solvent storage areas. Heat sodium sulfate in a 400°C oven for at least four hours. Cool, covered tightly with foil, and store in tightly closed jars.

7.1.5 Baked Ottawa Sand – Heat Ottawa sand in a 400°C oven for at least four hours.

7.2 Standards

7.2.1 Please reference SOP DV-OP-0020 for information regarding the surrogate and spike standards used in this procedure.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Soils for Method 8082A	Glass with Teflon-lined lids	30 grams	Cool, $\leq 6^{o}$C	None	SW-846
Wipes for Method 8082A	Glass with Teflon-lined lids	N/A	Cool, $\leq 6^{o}$C	None	SW-846
Soils for all other Methods, including 8082	Glass with Teflon-lined lids	30 grams	Cool, $\leq 6^{o}$C	14 days	SW-846
Wipes for all other Methods, including 8082	Glass with Teflon-lined lids	N/A	Cool, $\leq 6^{o}$C	14 days	SW-846

[1] Exclusive of analysis. Some regulatory agencies do not accept SW-846 Revision 4 of Chapter 4 and will require the 14 day holding time for both Methods 8082. The states of Alabama, California, Colorado, Connecticut, Nevada, New Jersey, Pennsylvania, and Rhode Island require the 14 day holding time for method 8082.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS Method Comments to determine specific QC requirements that apply. For SOPs that address only preparation, QC acceptance limits on the analytical results are not included. Refer to the appropriate SOP that describes the determinative method.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Assurance Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs. This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated.

9.1.3 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 Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 13 for more details on detection limit studies, initial demonstrations of capability, and analyst training and qualification.

9.3 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 that is used to analyze samples from the same preparation batch. See QC Policy DV-QA-003P for further details.

9.4 Method Blank (MB)

9.4.1 At least one method blank must be processed with each preparation batch.

9.4.2 The method blank for batches of soil samples consists of 30 grams of baked Ottawa sand, which is free of any of the analyte(s) of interest.

9.4.3 TestAmerica Denver typically provides clients with clean filter paper or sterile gauze to use as wipes. In these cases, the laboratory prepares wipe-matrix MBs by spiking clean filter paper or gauze (of the same type that is provided to the client) with the surrogate compounds to be used for analysis. If the client uses a different type of material for the wipes, the client should provide a clean specimen of that material to be used for the MB. If the client does not provide a blank wipe in this case, the laboratory will prepare the MBs from filter paper or gauze, spiked with the surrogate compounds.

9.5 Laboratory Control Sample (LCS)

9.5.1 At least one LCS must be processed with each preparation batch. Some projects require two LCSs (LCS and LCSD) in every batch, therefore it is important to check special project instructions for each sample. Specifically, Alaska Methods AK102 and AK103 require an LCS and LCSD.

9.5.2 For soil sample batches, the LCS consists of 30 g of reagent sand to which the analyte(s) of interest are added at a known concentration.

9.5.3 LCSs for wipe-matrix samples are prepared by spiking the compounds of interest and surrogate compounds onto a piece of clean filter paper or sterile gauze. If the client uses a different type of material for the wipes, the client should provide blank wipe material to the laboratory for use in preparing the LCS. If the client does not provide blank wipe material, the laboratory will prepare LCS using clean filter paper or sterile gauze spiked with the compounds of interest and surrogate compounds.

9.5.4 The LCS is carried through the entire analytical procedure just as if it were a sample.

9.6 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

9.6.1 One MS/MSD pair must be processed with each preparation batch. A matrix spike (MS) is a field sample to which known concentrations of target analytes have been added. It is prepared in a manner similar to the LCS, but uses a real sample matrix in place of the blank matrix. A matrix spike duplicate (MSD) is a second aliquot of the same sample (spiked exactly as the MS) that is prepared and analyzed along with the sample and matrix spike. Some programs allow spikes to be reported for project-related samples only. Samples identified as field blanks cannot be used for the MS/MSD analysis. MS/MSDs are not performed on wipe samples.

9.6.2 If insufficient sample volume is available for MS/MSD, an NCM must be written. For SW-846 methods a LCS/LCSD will be required in this case with the exception of work done under the AFCEE program which allows precision to be calculated using LCSs from different batches over the duration of the project.

9.7 Surrogate Spikes

Every calibration standard, field sample, and QC sample (i.e. method blank, LCS, LCSD, MS, and MSD) is spiked with surrogate compounds.

9.8 Sample Duplicates

A sample duplicate is a second aliquot of an environmental sample that is processed with the first aliquot of that sample. Sample duplicates are processed as independent samples within the same batch. The sample and duplicate results are compared to determine the effect of the sample matrix on the precision of the analytical process. As with the MS/MSD results, the sample duplicate precision results are not necessarily representative of the precision for other samples in the batch. Sample duplicates are performed when requested by the client. Sample duplicates do not count towards the 20 sample batch limit.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

10.3 Critical Procedural Considerations

10.3.1 As stated throughout this SOP, analysts must review the Method Comments and any applicable QASs before starting work. This review is also documented on the Organic Extraction Checklist (see WI-DV-0009).

10.3.2 Analysts must focus on using clean technique throughout this procedure. Any parts or pipettes that come into direct contact with dirty surfaces or any other beaker or media bottle than the designated one should be cleaned or disposed of before coming into contact with the sample. Gloves should never come into contact with the inside of beakers, media jars, or steel funnels.

10.3.3 Sodium sulfate should be kept in closed containers when not in use. It is important to close the container when not actively using the sodium sulfate.

10.4 Sonicator Tuning and Horn Inspection

10.4.1 Every week the sonicator horns are inspected for pitting and are replaced if excessive wear is observed.

10.4.2 If the sonicator is not self-tuning, the sonicator must be tuned once a week or whenever a new horn is installed. Tuning is documented in the sonicator maintenance log.

10.4.3 Starting at a power setting of 1, tune the sonicator so that the output is less than 20%.

10.4.4 Repeat the tune at a power setting of 5 and 10. At each power setting, tune the sonicator so that the output is less than 20%.

10.4.5 If the output is over 20%, consult your supervisor and the manufacturer's manual for troubleshooting help.

10.5 Assemble and clean the glassware immediately before use.

10.5.1 Rinse 400-mL thick-walled beakers with methylene chloride.

NOTE: In order to prevent phthalate contamination, never touch the inside of a beaker with gloves on. When rinsing beakers be sure to keep gloves away from the mouth of the beaker.

10.5.2 Without gloves on, fold a 18 cm diameter cellulose filter paper in quarters. Open the folds to create a cone. Place the filter paper in the bottom of a conical stainless steel funnel. Place the funnel on a 250-mL media bottle.

NOTE: For low-level phthalate analysis by 8270 SIM, use glass wool. Check the Method Comments to determine if this is necessary and see Section 4.6.

10.5.3 Place approximately 1 tablespoon of baked sodium sulfate in the funnel. Rinse all surfaces of the funnel, the filter and the sodium sulfate with methylene chloride or acetone/methylene chloride (depending on the extraction solvent, see Section 10.7) so all surfaces of the funnel, filter, and sodium sulfate are rinsed.

NOTE: When preparing glassware for the extraction of wipe samples, sodium sulfate is not necessary and the solvent used in the rinse should be the solvent used in the extraction of the wipe samples. (Normally hexane for methods 8081 and 8082).

10.5.4 Allow the solvent to drain completely into the media bottle. Swirl the media bottle to ensure all surfaces come into contact with the solvent. Add additional solvent to the rinse if necessary.

10.5.5 Pour the solvent out of the media bottle over the stem of the stainless steel funnel to rinse the funnel stem.

10.5.6 Discard the solvent in the correct waste stream.

10.6 Aliquot Samples

10.6.1 If the sample is a wipe, the sonication can be performed with the wipe in its original container if the original container is large enough. Otherwise, transfer the wipe and any solvent from the original container to a clean beaker.

10.6.2 For each MB and LCS, place a clean wipe into a labeled beaker and proceed to section 10.7.

10.6.3 If the sample is a soil, mix and homogenize samples according to the instructions provided in SOP DV-QA-0023, Subsampling. Use a disposable wooden spatula or a metal spatula that has been rinsed with methylene chloride and dried with a lab tissue.

10.6.4 Break the sample aliquot up into small pieces. The aliquot must not contain particles or clumps bigger than ½ inch in diameter in order to facilitate a complete extraction.

10.6.5 Label a 400-mL beaker with the sample ID, method, and batch number.

10.6.6 Weigh 30 to 33 g of sample into the labeled beaker. Record the weight to the nearest 0.1 g directly into the LIMS or hand record the weight on the benchsheet.

NOTE: Some clients may require the initial aliquot to be adjusted based on the percent moisture of the sample. In those cases, it might be necessary to aliquot more than 33 g of sample. If this is required, the Method Comments will state “Perform Calculation”. The laboratory’s LIMS (TALS) will calculate the required initial weight of wet sample needed to ensure at least 30 g of dry sample is included in the initial aliquot. In TALS, under the Batch Notes, enter a “1” in the “Perform Calculation” field.

TALS will then calculate the required initial weight of wet sample needed under the “Target Amount” field in the Worksheet tab. Weigh out at least that mass of wet sample.

10.6.7 Add approximately 1 tablespoon of baked sodium sulfate to the beaker and mix well. If the sample is especially wet, more sodium sulfate will be needed to ensure the sample is free-flowing. If the sample is extremely wet, the initial sample weight might have to be reduced in order to keep the volume of sample and sodium sulfate in the beaker to a level that the horn can still thoroughly disrupt.

10.6.8 For each MB and LCS sample, weigh 30 to 33 g of baked Ottawa sand into labeled beakers. Add 1 tablespoon of baked sodium sulfate to the beaker and mix well.

10.6.9 Cap the beaker tightly with aluminum foil.

10.6.10 Place the beaker on a cart next to the sample container so that a second analyst can check the labels. This is documented on the Organic Extraction Worksheet (See WI-DV-0009).

10.7 Prepare a bottle with a bottle-top dispenser with the appropriate solvent.

10.7.1 Methylene Chloride is used for soil and wipe samples for the following methods:

- SW-846 8015B
- SW-846 8015C
- SW-846 8015D
- Alaska Methods AK102 and AK103
- NWTPH-Dx
- Oklahoma DRO Method

10.7.2 For soil extraction for all other methods, the solvent used is a 1:1 mixture of methylene chloride and acetone.

10.7.3 For wipe samples by method 8081 and 8082, the solvent used is hexane.

10.7.4 For wipe samples by method 8270, the solvent used is a 1:1 mixture of methylene chloride and acetone.

10.8 Add Surrogate, Spikes, and Solvent to Field Samples and all QC samples.

10.8.1 The standards should be allowed to come to room temperature before spiking the samples. Record the ID of the standard used on the benchsheet.

NOTE: The addition of spikes and surrogates to samples must be done only immediately after a second analyst has reviewed the batch. Reference work instruction WI-DV-009.

10.8.2 Only one batch should be surrogated at a time to ensure the correct standards are used and to ensure the solvent is added as soon as possible to the samples.

10.8.3 Using a calibrated pipette, add the appropriate volume of the appropriate working surrogate standard to the beaker for each field sample and method blank. Do this by punching a hole in the aluminum foil cap with the pipette tip.

10.8.4 Using a calibrated pipette, add the appropriate volume of the appropriate working spike standard to the beaker for each LCS, LCSD and MS/MSD. Do this by punching a 2^{nd} hole in the aluminum foil cap with the pipette tip.

10.8.5 Immediately after the addition of the spike standard to the LCS, MS, & MSD sample, add approximately 100 mL of the appropriate solvent. Note that the solvent should be added as soon as possible after the addition of the spiking standards to prevent loss of the more volatile extractables. Sufficient solvent should be added so that the solvent level is at least ¾ inch above the solids.

NOTE: When hexane is used as the extraction solvent, use only enough to cover the wipe, i.e., approximately 50 mL. This will help facilitate the concentration of the extract later.

10.9 Rinse the disrupter horn with methylene chloride and wipe down with a clean laboratory tissue.

10.10 Place the bottom surface of the disrupter horn tip just below the surface of the solvent, but above the sediment layer.

10.11 Sonicate for three minutes, making sure the entire sample is agitated. The output should be set at 10 for the ¾-inch standard horn. The mode switch should be set on pulse, and the percent-duty cycle knob at 50%.

10.12 Decant and filter the extract through the prepared stainless steel funnel into the media bottle. Immediately rinse the sodium sulfate in the funnel with at least 50 mL of solvent. **This is a critical step and must be performed as soon as the extract has drained from the funnel and must be done with at least 50 mL of**

solvent.

10.13 Repeat the extraction two more times with the appropriate solvent. Each time add sufficient solvent so that the solvent level is at least ¾ inch above the solids. If wipes are being extracted with hexane, then repeat two or more times with additional 50-mL portions of solvent.

10.14 Decant off the solvent after each sonication. After the third and final sonication, pour the entire extract into the funnel. Do not attempt to decant at this step but make every effort to recover all solvent from the beaker. If sufficient room in the media jar exists, rinse the beaker and/or the funnel with an additional 10 to 20 mL of solvent and add the rinse to the funnel.

10.15 Once the solvent has completely drained into the media bottle, dispose of the solid sample and the sodium sulfate into Waste Stream D and cap the media bottle containing the extract with a Teflon-lined lid or with aluminum foil.

10.16 Be sure to rinse the disrupter horn between samples following the procedure in Section 10.9.

10.17 If the extract contains visible solids, it will be necessary to filter the extract again. This filtration can be performed immediately before the concentration step by filtering the extract through another filter paper and funnel directly into the K-D apparatus. If the extract clogs the filter or filtration is extremely slow, the filter and funnel can be placed on a filter flask and a vacuum can be applied.

10.18 Place the extract in a refrigerator until concentration. Document on the benchsheet in which refrigerator the extracts are stored and the total extract count for the batch.

10.19 Handwritten notes on the benchsheet are entered into LIMS, and the transcribed data must be verified by a second person. This verification is documented on the Organic Extraction Checklist (see WI-DV-009).

10.20 Maintenance

10.20.1 Unless self tuning, the sonicators must be tuned once a week. See Section 10.4.

10.20.2 The probes must be inspected once a week and replaced if excessively worn.

10.21 Troubleshooting

10.21.1 If the sonicator is not working properly, (either not disrupting the soil sufficiently or over-loading) separate the converter from the horn and the horn from the probe. Always use the special wrenches to avoid damaging the parts. Clean all points of contact with either acetone or isopropyl alcohol and then re-assemble and tighten down with the wrenches.

10.21.2 If after following the steps in Section 10.21.1, the sonicator is still not working properly, try to isolate the problem by plugging the converter into a different control box. If the problem goes away, then the control box needs to be sent off for service. If the problem does not go away, proceed to Section 10.21.3.

10.21.3 If after following the steps in Sections 10.21.1 and 10.21.2 the sonicator is still not working properly, then the problem must be in the converter or the horn or probe. Switch the converter to determine if the converter needs to be sent off for repair. If the converter operates properly with a different horn and probe, then the probe needs to be replaced.

11.0 Calibration

Not applicable to this procedure.

12.0 Calculations / Data Reduction

Not Applicable.

13.0 Method Performance

13.1 Method Detection Limit Study (MDL)

Before analyzing samples, the laboratory must establish a method detection limit (MDL). See DV-QA-005P, Determination of Method Detection Limits, for more information on the method detection limit studies.

13.2 Demonstration of Capabilities

An initial demonstration of capability (IDOC) must be performed by each analyst. On-going proficiency must be demonstrated by each analyst on an annual basis. See M-Q-001, TestAmerica Quality Management Plan, and the TestAmerica Denver Laboratory Quality Assurance Manual (QAM) for more information on the IDOCs.

13.3 Training Requirements

The group/team leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience. Further details concerning the training program are described in SOP DV-QA-0024.

14.0 Pollution Control

The volume of spike solutions prepared is minimized to reduce the volume of expired standard solutions requiring hazardous waste disposal.

15.0 Waste Management

15.1 All waste will be disposed of in accordance with Federal, State, and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method, the policies in section 13 of the Environmental Health and Safety Manual for "Waste Management and Pollution Prevention", and the Waste Management procedure, DV-HS-001P.

15.2 Waste Streams Produced By This Method

15.2.1 Methylene chloride – Waste Stream B

15.2.2 Flammable solvent – Waste Stream C

15.2.3 1:1 MeCl2:Acetone – Waste Stream CA

15.2.4 Solid waste/sodium sulfate – Waste Stream D

15.2.5 Expired Standards/Reagents – Contact Waste Coordinator for guidance

NOTE: Radioactive waste, mixed waste, and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of these materials.

16.0 References / Cross-References

16.1 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 3550C Ultrasonic Extraction, Revision 3, February 2007.

16.2 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 3550B Ultrasonic Extraction, Revision 3, December 1996.

16.3 Alaska Method AK102, "For the Determination of Diesel Range Organics", Version 04/08/02.

16.4 Alaska Method AK103, "For the Determination of Residual Range Organics", Version 04/08/02.

16.5 Oklahoma Department of Environmental Quality, Methods 8000/8100 (modified) Diesel Range Organics (DRO), October 22, 1997 Rev. 4.1.

16.6 NWTPH-HCID "Hydrocarbon Identification Method for Soil and Water," Manchester Environmental Laboratory, Dept. of Ecology, State of Washington.

17.0 Method Modifications:

17.1 SW-846 Method 3550C Section 11.3 instructs that the surrogate and spike compounds should be added to the sample before the sample is mixed with sodium sulfate. This SOP calls for the sample to be mixed thoroughly with sodium sulfate before the surrogate and spike compounds are added. This is done per EPA Memo dated August 5, 2010 titled "Spiking (Prior To vs. After Sample Drying) Issue in SW-846 Organic Extraction Methods."

17.2 SW-846 Method 3550C calls for the use of Büchner funnels and vacuum filtration of all extracts. This SOP calls for the use of conical funnels. This was done to prevent the extract from becoming trapped in the sodium sulfate in the Büchner funnel and specifically to improve the recoveries of benzoic acid, 2,4-dinitrophenol, and 4,6-dinitro-2-methylphenol.

17.3 Oklahoma Department of Environmental Quality method calls for the aliquot not to exceed 20 g. This procedure calls for the soil aliquot to be 30 g to 33 g.

17.4 Oklahoma Department of Environmental Quality DRO method calls for solvent to be added to the sample in a 1:1 ratio (milliliters of solvent to grams of sample). This procedure calls for 100 mL of solvent to be added to 30 g of sample.

17.5 Method from the state of Washington uses a 10 g soil sample that is shaken and processed in a sonic bath. This procedure calls for the soil aliquot to be 30 g to 33 g and is processed directly with a sonicator horn.

17.6 Methods 3550B and 3550C instruct the lab to determine the dry weight of the sample. This is performed according to SOP DV-WC-0023 and is not included in this SOP.

17.7 The medium/high concentration extraction procedure described in Methods 3550B and 3550C is not addressed in this SOP.

18.0 Revision History

18.1 Rev 6, dated 31 January 2015

- Annual Technical Review
- Reformatted SOP
- Revised Section 7.1.4 to remove the requirement to test the sodium sulfate before use. This was done to reflect current practice in CA-Q-S-001 DV-1
- Removed references to low-level NDMA method 8270D_SIM_LL. Soils are extracted by method 3546 instead of 3550C.
- Updated Table 1 with methods listed in this SOP and current analytical SOPs.

18.2 Rev 5, dated 15 January 2014

- Expanded footnote for HT table in Section 8

- Updated Section 10.6.1 to match the current TALS method for Low-level NDMA.
- Added Section 10.2
- Added Section 10.20 Maintenance.
- Added Section 10.21 Troubleshooting.
- Table 1 was updated to reflect the current SOPs.
- Revised Sections 9 and 10.1 to reflect current practice.
- Section 9 was revised to state this procedure meets all DoD QSM 5 criteria.
- Section 9.11 was revised to clarify that sample duplicates do not count toward the 20 sample batch limit.

18.3 Rev 4, dated 30 November 2012

- Updated Section 8 to indicate per SW-846 Revision 4, soils and wipes for analysis under Method 8082A do not have a holding time.
- Updated Section 9.9 to indicate that the DoD does not require LCSD.
- Updated Section 10.5.7 to indicate that the initial sample weight might have to be reduced for extremely wet samples.
- Section 10.5.5 was revised to remove the requirement to document the extraction date on the extract label.
- Updated Section 15 to include Waste Stream CA.

18.4 Rev 3.1, dated 30 November 2011

- Source method review
- Removed references to Method 8070; method no longer active at lab.
- Updated Section 9 to state that MBs and LCSs for wipe samples are created either from filter paper or sterile gauze.
- Added Section 9.11 to include definition and requirements for sample duplicate.
- Added a Note to Section 10.5.6 to describe how to adjust the initial aliquot mass to compensate for percent moisture.
- Updated Section 17 to exclude dry weight determination, high concentration method and Method NWTPH-HCID.
- Updated method references to include NWTPH-HCID.
- Updated SOP references in Table 1 to reflect active SOPs.
- Formatting and grammatical changes throughout

18.5 Rev 3 Dated 29 October 2010

- The procedure was revised to reference both method 3550B and 3550C.
- Section 4.6 was revised to change the requirement for binder free filter paper to glass wool when performing the extraction for low-level phthalate analysis by 8270 SIM. A note was added to Section 10.4.2 as well.
- Section 4.7 was added and Section 10 was revised to call for the use of stainless steel conical funnels and cellulose filter paper instead of Büchner funnels and glass fiber filter paper. This was done to prevent the extract from becoming trapped in the sodium sulfate in the Büchner funnel and specifically to improve the recoveries of benzoic acid, 2,4-dinitrophenol, and 4,6-dinitro-2-methylphenol.
- Instructions were added to Section 10.11 to emphasize the importance of rinsing the funnel and sodium sulfate immediately after the first sonication.

- Section 10.3 was revised to include requirements for inspecting the horns on a weekly basis.
- This procedure was revised to instruct the analyst to mix the sample thoroughly with sodium sulfate before adding the surrogate and spike compounds. This change was made per EPA Memo dated August 5, 2010 titled "Spiking (Prior To vs. After Sampling Drying) Issue in SW-846 Organic Extraction Methods.
- Details about the surrogate and spike standards used in this procedure have been moved to SOP DV-OP-0020

18.6 Rev 2 Dated 14 December 2009

- Section 1.2 was revised to state that this procedure can be used for additional methods when appropriate solvents and spiking mixtures are used instead of different pH and spiking mixtures as this procedure does not require any pH adjustments.
- Section 4 was revised to include notes about phthalate contamination.
- Section 6 was revised to include special glass fiber filter paper that should be used for the extraction of low-level phthalates.
- Section 7 was revised to remove the reference to the AFCEE spike mix for method 8270. The laboratory now only maintains one standard spike mix for method 8270.
- Section 7 was revised to include the benzidine LCS standard.
- Section 7 was revised to correct the expiration date for standards for NDMA by GC/CI/MS/MS from 6 months to 1 year. This was done to match the requirements in DV-QA-0015
- Section 10.5 was revised to change the initial aliquot from 30 +/- 2.0 grams to 30 to 33 grams. This was done to ensure that all samples have reporting limits and method detection limits no higher than the laboratory's standard reporting limits and method detection limits.
- Section 10 was revised to stress how important it is that the solvent is added to the sample as soon as possible after the addition of the surrogate and spike compounds. This was done by only requiring samples to be stirred with a spatula if they were too wet to form a free-flowing mixture with the sodium sulfate after swirling the beaker.

18.7 Rev 1 Dated 31 January 2009

- Section 7.10.11 was corrected. This section had incorrectly described the making of the SIM PAH working standards.

19.0 Attachments

Table 1: Determinative Methods Using Ultrasonic Extraction

TABLE 1.

Determinative Methods Using Ultrasonic Extraction

Method Description	Determinative Method	SOP
Diesel Range Organics, Jet Fuels, Motor Oil, Residual Range Organics	SW-846 8015B SW-846 8015C SW-846 8015D Alaska Methods AK102 & AK103 NWTPH-Dx Oklahoma DRO Method	DV-GC-0027
Chlorinated Pesticides	SW-846 8081A SW-846 8081B	DV-GC-0020
Polychlorinated Biphenyls	SW-846 8082 SW-846 8082A	DV-GC-0021
Polynuclear Aromatic Hydrocarbons	SW-846 8310	DV-LC-0009
Semi-volatiles by GC/MS	SW-846 8270C SW-846 8270D	DV-MS-0011 DV-MS-0012
Polynuclear Aromatic Hydrocarbons by GC/MS	SW-846 8270C SIM SW-846 8270D SIM	DV-MS-0002

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TestAmerica Denver

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Electronic Copy Only

Title: Soil and Waste pH [SW9045C & SW9045D]

Approvals (Signature/Date):

10/22/15
Andrew Allen — Date
Wet Chemistry Supervisor

Adam W Alban 28Oct15
Adam Alban — Date
Health & Safety Manager / Coordinator

Margaret S. Sleevi 10/28/15
Margaret S. Sleevi — Date
Quality Assurance Manager

10/28/15
William S. Cicero — Date
Laboratory Director

Facility Distribution No. ___________ **Distributed To:** ______________________

1.0 Scope and Application

1.1 This is an electrometric procedure for measuring pH in solid samples. This method is applicable to the analysis of soils, sediments, sludges, or non-aqueous liquids. It does not apply to multiphase wastes where the aqueous phase constitutes more than 20% of the sample. See DV-WC-0031 for the determination of pH in multiphase wastes

1.2 A detection limit (MDL) for pH has not been defined, however, for reporting purposes this laboratory uses 0.1 pH units as the RL and MDL.

1.3 This method is applicable to all ranges of pH.

2.0 Summary of Method

The sample is mixed with reagent water. The pH meter, glass electrode, and reference electrode (or single combination electrode) are standardized against five reference buffer solutions of known pH bracketing the pH expected to be found in the sample. The sample measurement is made by immersing the electrodes into the sample solution and taking a reading from the meter.

3.0 Definitions

3.1 **pH -** At a given temperature, the intensity of the acidic or basic character of a solution is indicated by pH or hydrogen ion activity. Because of ionic interactions in all but very dilute solutions, it is necessary to use the “activity” of an ion and not its molar concentration. The use of the term pH assumes that the activity of the hydrogen ion is being considered. The approximate *equivalence* to molarity can be presumed only in very dilute solutions. A logarithmic scale is used to accommodate the wide range of ionic activities.

3.2 Refer to the Glossary of the TestAmerica Denver Quality Assurance Manual (QAM) and policy DV-QA-003P, “Quality Assurance Program,” for definitions of general analytical and QA/QC terms.

4.0 Interferences

4.1 The pH response of most glass electrodes is imperfect at both ends of the scale. The indicated pH value of highly alkaline solutions, as measured with the glass electrode, will be too low. The indicated pH value of salts and strong acids, which have a pH less than 1, will often be higher than the true pH value. Interferences can be minimized by the selection of the proper electrodes for these conditions. For example, sodium may interfere at pH > 10, and is controlled by using a “low sodium error” electrode.

4.2 Temperature fluctuations will cause measurement errors.

4.3 Coatings of oil and particulate matter may impair electrode response.

5.0 Safety

5.1 Employees must abide by the policies and procedures in the Corporate Safety Manual, Radiation Safety Manual and this document.

5.2 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, nitrile or latex gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.3 Specific Safety Concerns or Requirements

Eye protection that satisfies ANSI Z87.1 (as per the Corporate Environmental Health and Safety Manual), laboratory coat, and nitrile or latex gloves must be worn while samples, standards, solvents, and reagents are being handled. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.4 Primary Materials Used

There are no materials used in this method that have a serious or significant hazard rating. 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.

6.0 Equipment and Supplies

6.1 Instrumentation

6.1.1 pH Meter with temperature compensation ability.

6.1.2 Glass electrode with reference electrode--a calomel, silver-silver chloride or other reference electrode of constant potential may be used; or use a combination electrode that incorporates both measuring and reference functions.

6.1.3 Analytical balance capable of weighing to the nearest 0.1 gram. The balance is checked for accuracy each day it is used in accordance with DV-QA-0014.

6.1.4 Shaker table.

6.2 Supplies

6.2.1 50 dram vials with snap cap or a container large enough to hold sample and cover electrodes.

6.2.2 Glass wool, if oily wastes are to be tested.

6.2.3 50 mL graduated cylinder

6.3 Computer Software and Hardware

Please refer to the master list of documents, software and hardware located on R:\QA\Read\Master List of Documents\Master List of Documents, Software and Hardware.xls or current revision for the current software and hardware to be used for data processing.

7.0 Reagents and Standards

7.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 **Reagent water:** ASTM Type II water or equivalent.

7.3 **pH Buffers: 2, 4, 7, 10 and 12:** Use commercially available solutions that have been validated by comparison to NIST standards. The solution aliquots used to calibrate the pH meter must be replenished each day of use.

7.4 **ICV Buffer Solution:** A pH 7 buffer solution from a second source provider, obtained commercially and traceable to NIST standards. The ICV solution aliquot used must be replenished each day of use.

7.5 **Laboratory Control Sample (LCS) Solution:** The LCS solution must be certified for pH and is commercially available. The pH 7 buffer from section 7.2 is normally used as the LCS. Due to the nature of pH determination, a solid matrix is not used.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time[1]	Reference
Solid	4 oz Glass or plastic	50 g	Cool, $\leq 6^{\circ}$C	None	SW-846

[1] Samples must be analyzed the same day that the extraction is performed.

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the LIMS Method Comments to determine specific QC requirements that apply. For

SOPs that address only preparation, QC acceptance limits on the analytical results are not included. Refer to the appropriate SOP that describes the determinative method.

9.1.1 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in TestAmerica Denver policy DV-QA-003P, Quality Control Program.

9.1.2 Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), AFCEE, etc., are described in TestAmerica Denver policy DV-QA-024P, Requirements for Federal Programs. This procedure meets all criteria for DoD QSM 5.0 unless otherwise stated. Any deviation or exceptions from QSM 5.0 requirements must have prior approval in the project requirements.

9.1.3 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 Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4 Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031. This is in addition to the corrective actions described in the following sections.

9.2 **Sample QC** - The following quality control samples are prepared with each batch of samples.

9.2.1 Laboratory Control Sample (LCS/LCSD)

One LCS/LCSD is required with each batch of samples processed not to exceed 20 samples. See Section 7.5.

Acceptance Criteria: The LCS must be within ± 0.05 pH units of the true value.

Corrective Action: If the LCS is not within the control limits, rerun all associated samples.

9.2.2 Duplicate Samples

One duplicate sample must be analyzed with each batch of samples processed not to exceed 20 samples.

Acceptance Criteria: The two results should agree within ± 0.10 pH units.

Corrective Action: If the difference is greater than ± 0.10 repeat the analysis. If the difference still exceeds the control limit the data will be flagged as outside of the limit.

9.2.3 Method blanks and matrix spikes are not applicable to pH.

9.3 Instrument QC

9.3.1 Initial Calibration Verification

Record the expected pH, manufacturer, and lot number of the verification buffer used for a second source pH 7.0 buffer solution. If this criterion is not met, the problem should be identified, corrected, and the meter recalibrated.

Acceptance Criteria: It should read within ± 0.05 pH units of the true value.

Corrective Action: If this criterion is not met, the problem should be identified, corrected, and the meter recalibrated.

9.3.2 Continuing Calibration Verification

A pH 7.0 buffer check is required after every 10 or fewer samples and at the end of the run.

Acceptance Criteria: The pH buffer checks must be within ± 0.05 units of the true value.

Corrective Action: If the pH 7.0 buffer check is outside of the control limits, rerun all samples since the last acceptable pH 7.0 buffer check.

10.0 Procedure

10.1 One-time procedural variations are allowed only if deemed necessary in the professional judgment of supervision to accommodate variation in sample matrix, radioactivity, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an NCM. The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP # DV-QA-0031. The NCM shall be filed in the project file and addressed in the case narrative.

10.2 Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective described.

10.3 Sample Preparation

10.3.1 Weigh a minimum of 40 g sample into a beaker, add 40 mL deionized water using a graduated cylinder and cap the vial. A sample which is not a soil but another material may possibly react violently on the addition of water. In such cases, add the water to the solid in a hood. If the sample shows any signs of heat or gas evolution, do not cap the vial as pressure may build up

10.3.1.1 If the samples are oily, filter through glass wool to remove oil. Retain the aqueous phase for analysis.

10.3.1.2 If the sample is hygroscopic and absorbs all the deionized water, add an additional 20 mL of DI water to the extraction vessel and mix to incorporate. Note the increased water volume on the benchsheet.

10.3.1.3 If the sample is a waste and additional water is needed, add an additional 40 mL of water.

10.3.2 Mix on shaker table for the next 5 minutes.

10.3.3 Let the sample settle undisturbed for a minimum of one hour.

10.4 Sample Analysis

10.4.1 Follow the operating instructions supplied by the manufacturer of the pH meter.

10.4.2 Record instrument ID, pH probe ID, thermometer probe ID, and reagent IDs in the batch record in TALS.

10.4.3 When using the Thermo Five Star pH meter, all results are to be temperature corrected to 25oC using the Automatic Temperature Compensation function available with the instrument.

NOTE: Methods 9045C and 9045D state: “The sample temperatures must be within ± 2 °C of the calibrated buffers or temperature corrected.” All samples are automatically corrected for temperature by the instrument.

10.4.4 Calibrate the pH meter using five buffers at pH 2.0, 4.0, 7.0, 10.0 and 12.0. The buffers should be fresh for each day of use.

10.4.4.1 Record the pH, pH result, manufacturer, and lot number of the buffers used. See Attachment 1.

10.4.4.2 The reading of the buffer solutions must be within ± 0.05 pH units of the certified buffer solution values. If they are not, recalibrate.

10.4.4.3 Record the slope in the instrument logbook. The source methods do not provide criteria for acceptance of the slope. If there is a significant variation from previous values, maintenance may be required.

10.4.5 Verify the calibration using a buffer solution (ICV). See Sections 7.4 and 9.3.1.

10.4.5.1 Record the pH, manufacturer, and lot number of the verification buffer used.

10.4.5.2 The reading of the buffer solution should be within ± 0.05 pH units of the true value. If this criterion is not met, the problem should be identified, corrected, and the meter recalibrated.

10.5 Sample Analysis

10.5.1 Samples must be analyzed on the day they are prepared.

10.5.2 Analyze one LCS and one sample duplicate per batch of 20 samples.

10.5.3 Insert the electrode into the aqueous layer just far enough to cover the electrode bulb and junction. Do not allow the electrode to come into direct contact with oil.

10.5.4 Allow the reading to stabilize.

10.5.5 The pH reading, temperature, and time are recorded in the LIMS.

NOTE: Methods 9045C and 9045D require the sample temperature to be reported with each pH result. All sample temperatures are recorded on the instrument raw data. The LIMS reports the pH as pH adj. to 25°C to account for the temperature correction performed by the instrument.

10.5.6 Rinse the electrodes well between measurements.

10.5.7 A pH 7.0 buffer check (CCV) is required after every 10 or fewer samples (excluding the LCS/LCSD) and at the end of the run. See Section 9.3.2.

10.5.8 Record the balance ID, pH meter ID, the pH probe ID and the pH thermometer ID in the batch record.

10.5.9 Follow the instructions supplied with the electrodes for storage after use. Record daily maintenance in the pH Calibration and Maintenance Log. See Attachment 1.

10.6 Troubleshooting

10.6.1 Slow response or a wavering response is indicative of a dirty or oil-coated pH probe or that the probe is not properly connected to the meter. Samples high in dissolved CO_2 can cause the pH to change as the sample is stirred.

10.6.2 No temperature displayed may be a result of the temperature probe not being properly connected to the meter.

10.6.3 Using plastic disposable beakers and a magnetic stir plate and stir bar may generate static electricity that could affect stability. Turn off the stir plate, unplug and allow to sit for a few minutes.

10.7 Maintenance

Clean the electrode as needed following manufacturer's instructions.

11.0 Calculations / Data Reduction

11.1 There are no calculations. This is a direct reading method. Data are manually entered in TALS at time of measurement.

11.2 The initial data review is performed by the analyst and a second-level review is performed by the area supervisor or designee. Both reviews are documented on a Data Review Checklist. See SOP DV-QA-0020 for a copy of the checklist and for more detail on the review process.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

There is no MDL study for pH

12.2 Demonstration of Capabilities

All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows"

12.2.1 Four aliquots of the QC check sample are analyzed using the same procedures used to analyze samples, including sample preparation. The concentration of the QC check sample should be equivalent to a mid- level calibration. The pH 7 Buffer solution (Section 7.5) is typically used.

12.2.2 The pH of each aliquot must be within 0.05 units of the true value.

12.2.3 If the analyte does not meet the acceptance criteria, the test must be repeated. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

12.2.4 Further details concerning demonstrations of proficiency are described in DV-QA-0024.

12.3 Training Requirements

The group leader has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use, has the required experience, and has successfully analyzed initial demonstration samples (see SOP DV-QA-0024 for details).

13.0 Pollution Control

13.1 It is TestAmerica's 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).

13.2 This method does not contain any specific modifications that serve to prevent or minimize pollution.

14.0 Waste Management

14.1 All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in section 13, "Waste Management and Pollution Prevention", of the Environmental Health and Safety Manual, and DV-HS-001P, "Waste Management Program."

14.2 The following waste streams are produce when this method is carried out:

14.2.1 Acidic sample waste generated by the analysis – Aqueous Acidic (F).

14.2.2 Alkaline sample waste generated by the analysis – Aqueous Alkaline (E).

14.2.3 Exhausted soil samples utilized in the analysis – Soils (S)

14.2.4 Exhausted acidic and/or alkaline buffer solutions utilized in the analysis and expired standards and reagents – Contact the Waste Coordinator for guidance.

NOTE: Radioactive, mixed waste and potentially radioactive waste must be segregated from non-radioactive waste as appropriate. Contact the Radioactive Waste Coordinator for proper management of radioactive or potentially radioactive waste generated by this procedure.

15.0 References / Cross-References

15.1 SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition and all promulgated updates, EPA Office of Solid Waste, January 2005.

15.1.1 Method 9045D, "Soil and Waste pH", Revision 4, November 2004.

15.1.2 Method 9045C, "Soil and Waste pH", SW-846, Revision 3, 1995.

15.2 "Soil pH (Hydrogen Ion Activity)", Methods of Soil Analysis, Second Edition, American Society of Agronomy, 1982.

16.0 Method Modifications

Item	Method	Modification
1	9045C/9045D	Temperature is not reported with the pH result. Sample pH is reported as pH adj. to 25°C.
2	9045C/9045D	Sample size used in this SOP is 40 g solid sample to 40 mL reagent water. This is the same proportion, though larger, than that stated in the source methods. The larger sample size helps ensure a more representative result. The source methods further state that additional dilutions may be made if the sample is hygroscopic. Additional water is added to the sample rather than starting with a new sample aliquot.
3	9045C/9045D	The source method has conflicting statements regarding use of additional dilutions for waste and starting with new aliquot and added double the volume of water. The laboratory adds additional reagent water starting with sample to water ratio of 1:3 rather than 1:2.

17.0 Attachments

Attachment 1: Example pH Calibration and Maintenance Log
Attachment 2: Example Benchsheet

18.0 Revision History

- Revision 11, dated 13 October 2015
    - Updated Section 1.2 to reflect pH RL and MDL used by the laboratory
    - Updated Section 7.4 to include a comment regarding daily replenishment
    - Updated Section 9.1 to be consistent verbiage across SOPs as applicable
    - Added requirement 10 section 10.4.4.1 to record pH result of calibration
    - Updated Attachment 1 to reflect current pH logbook

- Revision 10, dated 31 January 2015
    - Moved Sections 10.5.2 and 10.5.3 to 10.4.2 and 10.4.3
    - Added Section 10.4.4.3 to require recording of slope to meet ORELAP requirement
    - Updated Attachment 1

- Revision 9, dated 31 July 2014
    - Revised Section 6 to reflect current practice
    - Revised Section 10.3 to add additional water when sample is hygroscopic rather than starting with new sample aliquot and to record the volume of water added.
    - Removed reference to recording slope from the calibration in Section 10.4.1.1. The source method does not address this and there is no established acceptance limit for the slope. Revised Attachment 1 to reflect change in documentation requirements.
    - Added Sections 10.6 and 10.7, Troubleshooting and Maintenance, respectively.
    - Revised Section 12.2 to reflect use of pH 7 Buffer solution as QC sample.
    - Expanded Method Modification #2 with more detail and added Method Modification #3.
    - Source method review.

- Revision 8, dated 31 July 2013
    - Added section 3.2
    - Added section 10.5.9
    - Revised section 11.1 to note data are manually entered
    - Annual Review

- Revision 7, dated 27 July 2012
    - Removed HCl and cleaning procedure for probe.
    - Revised Section 5 based on removal of HCl.
    - Replaced magnetic stirrer with shaker table and removed magnetic stirrers in Section 6.
    - Updated Section 7 to include reagent water and second source ICV buffer at pH 7.0.
    - Revised Section 8
    - Revised Section 9.1, 10.1, 10.2 to reflect current practice
    - Revised calibration procedure (Section 10.4)
    - Moved procedural note for cleaning electrode in Section 4 to Section 10.5.3
    - Removed Attachment 2 and added statement about data review with reference to removed checklist. (Section 11.2)
    - Source method review
    - Formatting and editorial changes throughout

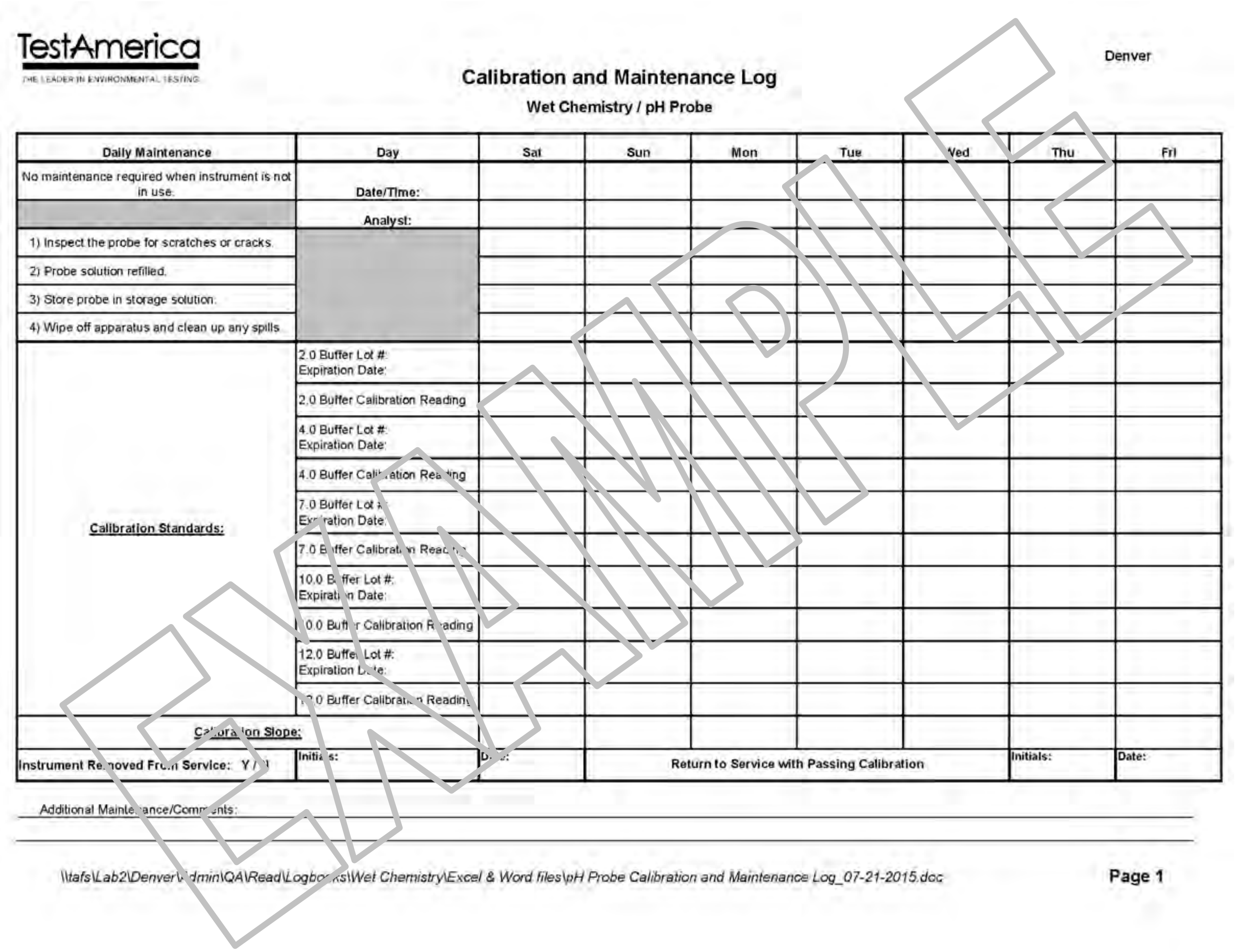
- Revision 6.5 dated 31 January 2012
    - Annual Technical review
    - Updated Section 9.1.1 to read LCS/LCSD

- Revision 6.4 dated 11 February 2011
    - Annual Technical review
    - Updated Attachments 1 & 2

Earlier revision histories have been archived and are available upon request.

Attachment 1.

Example pH Calibration and Maintenance Log



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Denver

Calibration and Maintenance Log

Wet Chemistry / pH Probe

Daily Maintenance	Day	Sat	Sun	Mon	Tue	Wed	Thu	Fri
No maintenance required when instrument is not in use.	Date/Time:							
▨	Analyst:							
1) Inspect the probe for scratches or cracks.	▨							
2) Probe solution refilled.	▨							
3) Store probe in storage solution.	▨							
4) Wipe off apparatus and clean up any spills.	▨							
Calibration Standards:	2.0 Buffer Lot #: Expiration Date:							
	2.0 Buffer Calibration Reading							
	4.0 Buffer Lot #: Expiration Date:							
	4.0 Buffer Calibration Reading							
	7.0 Buffer Lot #: Expiration Date:							
	7.0 Buffer Calibration Reading							
	10.0 Buffer Lot #: Expiration Date:							
	10.0 Buffer Calibration Reading							
	12.0 Buffer Lot #: Expiration Date:							
	12.0 Buffer Calibration Reading							
Calibration Slope:								
Instrument Removed From Service: Y / N	**Initials:**	**Date:**	**Return to Service with Passing Calibration**				**Initials:**	**Date:**

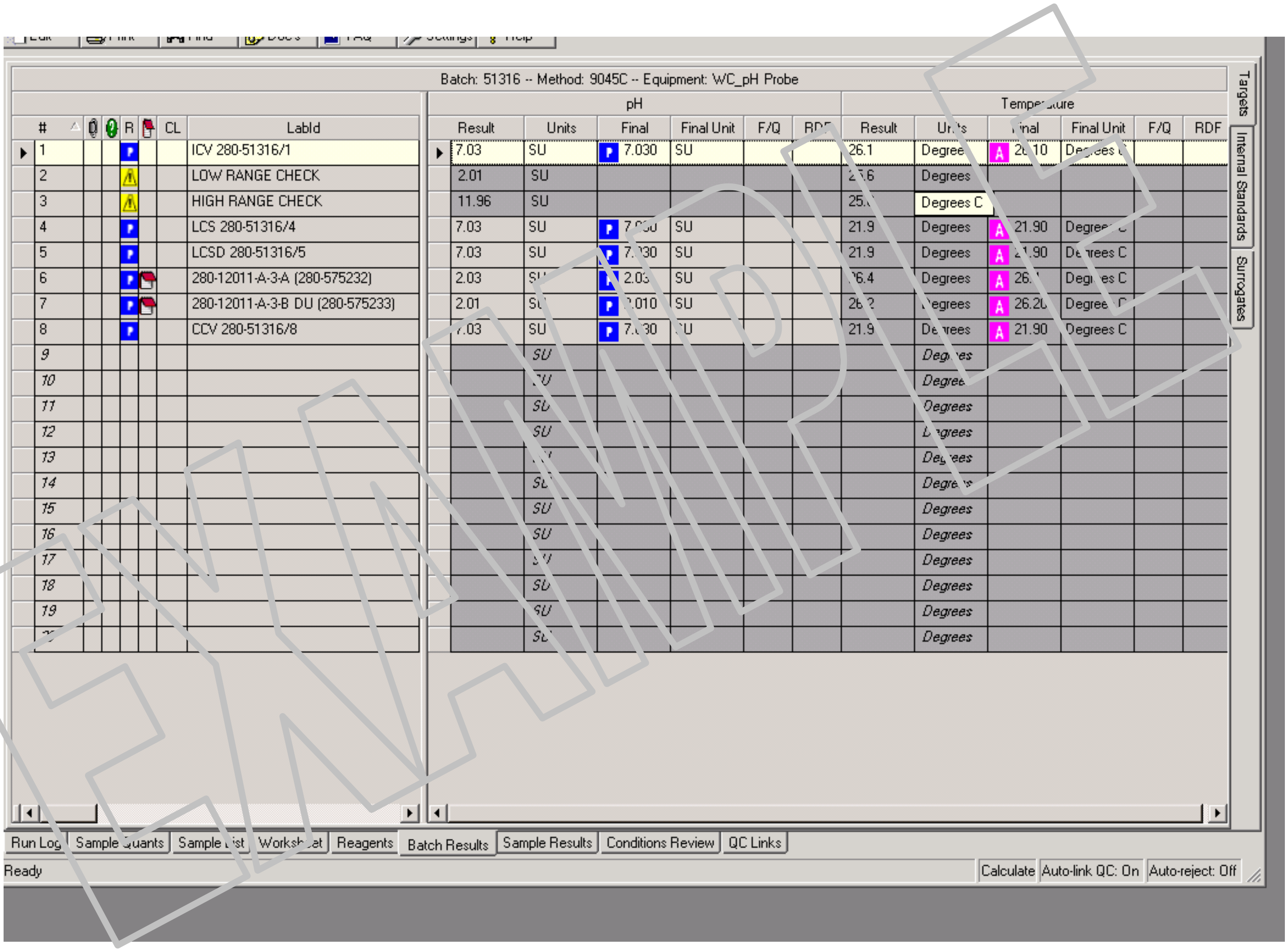
Additional Maintenance/Comments:

\\tafs\Lab2\Denver\Admin\QA\Read\Logbooks\Wet Chemistry\Excel & Word files\pH Probe Calibration and Maintenance Log_07-21-2015.doc

Page 1

Attachment 2.

Example Benchsheet



Batch: 51316 -- Method: 9045C -- Equipment: WC_pH Probe

					pH						Temperature					
#	R		CL	LabId	Result	Units	Final	Final Unit	F/Q	RDF	Result	Units	Final	Final Unit	F/Q	RDF
1	P			ICV 280-51316/1	7.03	SU	P 7.030	SU			26.1	Degrees	A 26.10	Degrees C		
2	⚠			LOW RANGE CHECK	2.01	SU					25.6	Degrees				
3	⚠			HIGH RANGE CHECK	11.96	SU					25.[illegible]	Degrees C				
4	P			LCS 280-51316/4	7.03	SU	P 7.030	SU			21.9	Degrees	A 21.90	Degrees C		
5	P			LCSD 280-51316/5	7.03	SU	P 7.030	SU			21.9	Degrees	A 21.90	Degrees C		
6	P	⚑		280-12011-A-3-A (280-575232)	2.03	SU	P 2.030	SU			26.4	Degrees	A 26.40	Degrees C		
7	P	⚑		280-12011-A-3-B DU (280-575233)	2.01	SU	P 2.010	SU			26.2	Degrees	A 26.20	Degrees C		
8	P			CCV 280-51316/8	7.03	SU	P 7.030	SU			21.9	Degrees	A 21.90	Degrees C		
9						SU						Degrees				
10						SU						Degrees				
11						SU						Degrees				
12						SU						Degrees				
13						SU						Degrees				
14						SU						Degrees				
15						SU						Degrees				
16						SU						Degrees				
17						SU						Degrees				
18						SU						Degrees				
19						SU						Degrees				
20						SU						Degrees				

Title: DETERMINATION OF VOLATILE ORGANICS BY GC/MS [SW-846 8260; EPA 624; DW 524.2]

Approvals (Signature/Date):

Andrew Buettner 11-20-14
Andrew Buettner Date
Volatiles Organics Manager

11/20/14
Michael Ridenhower Date
Health & Safety Manager / Coordinator

11-20-14
Marti Ward Date
Quality Assurance Manager

Elaine Wild 11/20/14
Elaine Wild Date
Laboratory Director

This SOP was previously identified as SOP No. ST-MS-0002 Rev. 22

Facility Distribution No.: 0 **Distributed To: See Electronic Distribution Sheet**

[THIS IS A CONTROLLED DOCUMENT. WHEN PRINTED IT BECOMES UNCONTROLLED]

1.0 SCOPE AND APPLICATION

1.1 This SOP is applicable to the determination of Volatile Organic Compounds in waters, wastewater, soils, sludges and other solid matrices.

1.2 This SOP is applicable to SW-846 method 8000B, 8000C, 8260B, 8260C, Drinking water method 524.2, and EPA 624.

1.3 This method can be used to quantify most volatile organic compounds that have boiling points below 200 °C and are insoluble or slightly soluble in water. Volatile water soluble compounds can be included in this analytical technique; however, for more soluble compounds, quantitation limits are approximately ten times higher because of poor purging efficiency.

1.4 The method is based upon a purge and trap, gas chromatograph/mass spectrometric (GC/MS) procedure. The approximate working range is 1 to 200 µg/L for 5 mL waters, 0.5 to 40 µg/L for 25 mL purge waters, 5 to 200 µg/kg for low-level soils, and 250 to 25,000 µg/kg for high-level soils.

1.5 The laboratory target analytes supported by this method, the reporting limits, method detection limits and QC limits are maintained in the Laboratory Information Management System (LIMS).

1.5.1 Additional compounds may be amenable to this method. The minimum requirement for non-standard analytes is that the reporting limit be set at the lowest required concentration that can actually be detected by the instrument, and when an MDL study can not be conducted, the MDL be set equal to the reporting limit.

2.0 SUMMARY OF METHOD

2.1 Volatile compounds are introduced into the gas chromatograph by the purge and trap method. The components are separated via the chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information.

2.2 In the purge and trap process, an inert gas is bubbled through the solution at ambient temperature or at 40^{o}C (40^{o}C required for low level soils) and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbant column where the volatile components are trapped. After purging is completed, the sorbant column (trap) is heated and flushed with inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is then heated to elute the components that are detected with a mass spectrometer.

2.3 Qualitative identification of the parameters in the extract is performed using the retention time and the relative abundance of characteristic ions. Quantitative analysis is performed using the internal standard technique with a single characteristic ion.

2.4 The use of selected ion monitoring (SIM) is acceptable for applications requiring quantitation limits below the normal range of electro impact mass spectrometry. However, SIM may provide a lesser degree of confidence in the compound identification, since less mass spectral information is available. Instead of scanning everything in a retention time range, SIM looks for specific ions (qualitative and quantitative) that are placed in retention time groups. The ions used for qualitative and quantitative purposes are the same for scan and SIM analysis. In additiona to using the Scan mode, the laboratory also runs a SIM method for 1,4 dioxane. Details are available in Appendix 1 of this SOP. The SIM method is currently not allowed for South Carolina compliance work, as certification is required and the lab does not yet hold that certification.

3.0 DEFINITIONS

3.1 See the TestAmerica St. Louis Quality Assurance Manual (ST-QAM) for a glossary of common laboratory terms and data reporting qualifiers.

3.2 SIM – selected ion monitoring

4.0 INTERFERENCES

4.1 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, pre-purged purified reagent water or purchased HPLC water, and approved lots of purge and trap grade methanol will greatly reduce introduction of contaminants.

4.2 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. Trip Blanks, prepared from reagent water, can serve as a check on conditions during transportation from the field to the laboratory.

4.3 Matrix interferences may be caused by non-target contaminants that are coextracted 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.

4.4 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.

4.5 Some samples may foam when purged due to surfactants present in the sample. When this kind of sample is encountered an antifoaming agent can be used. A blank spiked with this agent must be analyzed with the sample because of the non-target interferences associated with the agent.

4.6 Methylene Chloride, Acetone, and 2-Butanone are potential laboratory contaminants. Concentrations up to five times the level observed in the method blank, in associated laboratory samples, may be attributed to the presence of these compounds in the laboratory.

5.0 SAFETY

5.1 Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001), Radiation Safety Manual 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.

5.2 SPECIFIC SAFETY CONCERNS OR REQUIREMENTS

5.2.1 The 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.

5.2.2 The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

5.2.3 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.

5.3 PRIMARY MATERIALS USED

5.3.1 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 MSDS 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 MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Methanol	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 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			
TWA – Time Weighted Average			

6.0 EQUIPMENT AND SUPPLIES

6.1 Micro syringes- 1.0 µL, 10 µL, 25 µL, 50 µL, 100 µL, 250 µL, 500 µL, 1000 µL. Hamilton 1700 series

6.2 Volumetric flasks, Class A

6.3 Analytical Balance, capable of weighing ± 0.001 g

6.4 Syringe: 5 or 25 mL glass with Luerlok tip, if applicable to the purging device.

6.5 Vials: 20 and 40 mL with Teflon lined screw caps

6.6 Spatula: Disposable wooden tongue depressors

6.7 Disposable pipettes

6.8 pH paper: Wide range and 0.3 to 2.3

6.9 Glass beads: Store in a drying oven.

6.10 Gas Chromatograph/Mass Spectrometer System:

6.10.1 Gas Chromatograph: Hewlett Packard GC 5890 and Agilent 6890 system with temperature programming.

6.10.2 Purge and Trap Device: The purge and trap device consists of the sample purger, the trap, and the desorb heater.

6.10.3 Gas Chromatographic Capillary Columns:

6.10.3.1 Mass Spectrometer: Hewlett Packard 5970, 5972 and 5973 mass spectrometers capable of scanning 35-300 AMU every two seconds or less, using 70 volts electron energy in the electron impact mode.

6.10.3.2 Columns used: Restek RTX-VMS, 30 meters, 0.25mm inside diameter, 1.4 µm film thickness; Restek RTX-VMS, 40 meter, 0.18mm insdie diameter, 1 µm film thickness

6.10.4 GC/MS interface: In general split/splitless injector are used but any interface (including direct introduction to the mass spectrometer) that achieves all acceptance criteria may be used.

6.10.5 Instrument setup and operating conditions are maintained in each instruments daily maintenance calendar.

6.10.6 Data System:

6.10.6.1 ChemStation software system that allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program.

6.10.6.2 Target software system 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 allows integrating the abundances in any EICP between for a specified time or scan-number limit. Also, for the non-target compounds, software a mass spectrum that meets the required criteria when 50ng of 4-Bromofluorobenzene (BFB) are must be available that allows for the comparison of sample spectra against reference library spectra. The most recent release of the NIST/EPA mass spectral library should be used as the reference library.

6.10.5.2.1 Data Library: NIST 98

6.11 Carrier gas: Ultra high purity helium

6.12 Make up gas: Ultra high purity helium

7.0 REAGENTS AND STANDARDS

7.1 All standards and reagent preparation, documentation and labeling must follow the requirements of SOP ST-QA-0002, current revision.

7.2 Methanol: Purge and Trap Grade

7.3 Water: HPLC grade or equivalent.

7.4 See recipes for standards and QC samples in the Reagents section of TALS.[Also examples included in Appendix 2 and 3.

7.5 Calibration Standards and Surrogates

7.5.1 Stock Solutions: 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 0 to -20 °C.

7.5.2 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 or as recommended by the manufacturer.

7.5.2.1 See SOP: ST-QA-0002 for expiration date criteria.

7.6 Initial calibration verification (ICV) standards are similar to calibration standards, but are from a completely different source.

7.7 Internal standards: Internal standards are added to all samples, standards, and blank analyses.

7.8 Tuning standard: A 25 ng/µL 4-Bromofluorobenzene standard is made up that will deliver 50 ng (or 25 ng) on column upon injection.

7.9 Sodium bisulfate, crystal

7.10 Ottawa sand

7.11 Ascorbic acid, ACS Reagent Grade, granular

7.12 Sodium Thiosulfate, ACS Reagent Grade, granular

8.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE

8.1 TestAmerica St. Louis supplies sample containers and chemical preservatives in accordance with the method. TestAmerica St. Louis does not perform sample collection. Samplers should review the methods referenced and other applicable sample collection documents for detailed collection procedures. Sample volumes and preservative information is given in ST-PM-0002.

8.2 Aromatic volatiles water samples are preserved with 1:1 HCl and stored at 4 ± 2 °C. Analysis hold time is 14 days from collection.

8.3 Aqueous samples are stored in glass containers with Teflon lined septa at 4 ± 2 ^{o}C, with minimum headspace.

8.4 Soil samples are refrigerated at 4 ± 2 °C. Analysis hold time is 14 days from collection.

8.4.1 Medium level solid extracts are aliquoted into 2 - 5 mL glass vials with Teflon lined caps and stored at 4 ±2 ^{o}C. The extracts are stored with minimum headspace.

8.5 For 5035 analysis

8.5.1 Solid samples, for low level analysis, may be field preserved with sodium bisulfate solution, or collected unpreserved using the Encore™ (or equivalent) sampler and shipped to the laboratory within 48 hours of sampling.

8.5.1.1 Following shipment back to the lab the soil is preserved with sodium bisulfate or the sample is extruded into an empty, clean sealed vial and frozen within 48 hours of sampling.

8.5.1.2 It is recommended that two Encore (or equivalent) samplers be used for each field sample position, to allow for any reruns than may be necessary.

8.5.2 Solid samples, for medium level analysis, may be field extracted with methanol, or collected unpreserved using the Encore (or equivalent)™ sampler and shipped to the laboratory within 48 hours of sampling.

8.5.2.1 It is recommended that two Encore (or equivalent) samplers be used for each field sample position, to allow for any reruns than may be necessary.

8.5.2.2 Solid samples – field extracted with methanol

8.5.2.2.1. Prepare a 2 oz sample container by adding 25 mL purge and trap grade methanol. (If a 5 g sample is to be used, add 5 mL methanol to a 2 oz container or VOA vial).

8.5.2.2.2. Seal the bottle and attach a label.

8.5.2.2.3. Weigh the bottle to the nearest 0.01 g and note the weight on the label.

8.5.2.2.4. Ship with appropriate sampling instructions.

8.5.2.2.4.1. At client request, the methanol addition and weighing may also be performed in the field.

8.5.2.2.4.2. When the samples are returned to the lab, obtain the weight of the soil added to the vial and note on the label.

8.5.2.3 Solid samples – field extracted with methanol

8.5.2.3.1. When the samples are returned to the lab, extrude the (nominal) 5 g (or 25 g) sample into a pre-weighed VOA vial containing 5 mL methanol (25 mL methanol for the 25 g sampler). Obtain the weight of the soil added to the vial and note on the label.

8.6 An additional sample is collected for percent moisture determination.

8.7 EPA 524.2 Sample Dechlorination and Preservation

8.7.1 If specified by the client that actual drinking water samples containing residual chlorine are to be analyzed by the laboratory, the following procedure shall be used:

8.7.1.1 Finished drinking water samples suspected of containing residual chlorine shall have 25 mg of ascorbic acid added to each 40 mL VOA vial prior to filling. If the requested target analytes are not gases at room temperature or are not listed in Table 7 of EPA Method 524.2, sodium thiosulfate is recommended to reduce residual chlorine (3 mg sodium thiosulfate for each 40 mL VOA vial).

8.7.1.2 If the sample containers are prepared by the laboratory for filling by the sample collector, the ascorbic acid or sodium thiosulfate will be placed into unpreserved VOA vials (do not mix the ascorbic acid or sodium thiosulfate with the HCl used for preservation).

8.7.1.3 It will be the sample collector’s responsibility to add additional ascorbic acid or sodium thiosulfate if a diethyl-p-phenylenediamine (DPD) test kit indicates residual chlorine in excess of 5 mg/L (25 mg ascorbic acid or 3 mg sodium thiosulfate per each 5 mg/L of residual chlorine).

8.7.1.4 After filling the VOA vial, the sample collector should adjust the sample to pH < 2 by carefully adding two drops of 1:1 HCl for each 40 mL of sample. Samples should be sealed and mixed for one minute. (Note: If the sample is to be analyzed for trihalomethanes (THMs) only, the HCl preservation step may be omitted if sodium thiosulfate was used for dechlorination.)

8.7.1.5 If a sample foams vigorously when HCl is added, the sample should be discarded. Fill fresh VOA vials containing ascorbic acid or sodium thiosulfate, but do not acidify. A note should be placed on the chain-of-custody that is submitted with the samples that they were “not acidified”. These samples have a 24 hold time if target analytes other than THMs are to be analyzed.

8.7.1.6 Samples should be maintained at 4 ± 2 ^{o}C until analysis.

8.8 At specific client request, unpreserved soils packed into glass jars or brass tubes may be accepted and sub-sampled in the lab.

8.8.1 This is an older procedure based on method 5030.

9.0 QUALITY CONTROL

9.1 Batch

9.1.1 A sample batch is a maximum of 20 environmental samples, which are prepared together using the same process and same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of a similar matrix, meeting the above mentioned criteria. Where no preparation method exists (example, volatile organics, water) the batch is defined as environmental samples that are analyzed together with the same process and personnel, using the same lots of reagents, not to exceed 20 environmental samples. An analytical batch is composed of prepared environmental samples, extracts, digestates or concentrates that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

9.1.2 Instrument conditions must be the same for all standards, samples and QC samples.

9.1.3 For this analysis, batch QC consists of a method blank, a Laboratory Control Sample (LCS), Matrix Spike (MS) and Matrix Spike Duplicate (MSD). In the event that there is insufficient sample to analyze a MS/MSD, an LCS Duplicate (LCSD) is prepared and analyzed.

9.1.4 Samples having different QC codes, due to non-standard client specific QC requirements, must be batched separately in the LIMS. A method blank and LCS may be shared across QC codes provided the actual “sample batch” does not exceed 20 environmental samples. MS/MSD must be performed for each separate QC code.

9.1.5 Unless medium level (i.e. an extraction batch) the blank, LCS and MS/MSD MUST run in the same 12 hour clock. The definition of a non-extraction batch is a maximum of 20 samples run in a 12 hr clock.

9.2 Method Blank

9.2.1 A method blank is a blank matrix processed simultaneously with, and under the same conditions as, samples through all steps of the procedure.

9.2.2 For Water analyses, the method blank is comprised of HPLC water.

9.2.3 For Soil analyses, the method blank is comprised of glass beads, or Ottawa sand (required by South Carolina)

9.2.4 **For water and low soil method 8260 and 524.2 analyses**

9.2.4.1 A method blank must be analyzed with every 12 hour analytical clock and/or with each batch of 20 samples, whichever occurs first.

9.2.5 **For water method 624 analyses**

9.2.5.1 A method blank must be analyzed with every 24 hour analytical clock and with each batch of 20 samples, whichever occurs first..

9.2.6 **For medium level soil method 8260 analyses**

9.2.6.1 A method blank must be prepared with every medium level soil batch (20 or fewer samples of the same matrix). The medium level method blank is tied to an extraction and does not require repeated analysis with each sample analysis batch.

9.2.7 Method blank population studies shall be performed periodically. The data from such studies shall be used to identify systemic contamination issues.

9.3 Laboratory Control Sample

9.3.1 An LCS is a blank matrix spiked with a known amount of analyte(s), processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

9.3.2 For Water analyses, the LCS is comprised of HPLC water fortified with Volatiles.

9.3.2.1 Under current methodology, the CCV may also serve as the LCS; however, due to limitations in the LIMS, the CCV and LCS should **never** be generated from the same injection.

9.3.3 For Soil analyses, the LCS is comprised of glass beads or Ottawa sand fortified with Volatiles. South Carolina requires the use of Ottawa sand.

9.3.4 **For method 8260 and 524.2 analyses**

9.3.4.1 A LCS must be analyzed with every 12 hour analytical clock and with each batch of 20 samples, whichever occurs first..

9.3.5 **For method 624 analyses**

9.3.5.1 A LCS must be analyzed with every 24 hour analytical clock and with each batch of 20 samples.

9.3.5.2 A LCS must be prepared with every high level soil batch (20 or fewer samples of the same matrix).

9.3.6 **For medium level soil method 8260 analyses**

9.3.7 An LCS must be prepared with every medium level soil batch (20 or fewer samples of the same matrix).

9.3.7.1 The medium level LCS is tied to an extraction and does not require repeated analysis with each sample analysis batch.

9.4 **Matrix Spike/Matrix Spike Duplicate**

9.4.1 A Matrix Spike is an aliquot of a field sample to which a known amount of target analyte(s) is added, and is processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

9.4.2 **8260** – A MS/MSD must be analyzed with every 12 hour analytical clock and with each batch of 20 samples, whichever occurs first..

9.4.3 **524.2** – Method 524.2 does not require a MS/MSD be performed though it may be requested by the client. In the absence of client QC criteria for this MS/MSD, the laboratory will use 70 – 130% recovery limits, and RPD of 20%, as advisory criteria.

9.4.4 **624** - A MS/MSD must be analyzed with every 24 hour analytical clock and with each batch of 20 samples, whichever occurs first.

9.5 **Surrogate**

9.5.1 A surrogate is a non-target analyte similar in chemical composition and behavior, which mimics the target analytes during preparation, extraction and analysis.

9.5.2 Surrogate(s) is added to every field sample, method blank, LCS and MS/MSD for analysis at the beginning of the sample preparation process.

9.6 **Procedural Variations/ Nonconformance and Corrective Action**

9.6.1 Any variation shall be completely documented using a Nonconformance Memo and approved by the Supervisor and QA Manager. See SOP ST-QA-0036 for details regarding the NCM process.

9.6.2 Any deviations from QC procedures must be documented as a nonconformance, with applicable cause and corrective action approved by the Supervisor and QA Manager. See SOP ST-QA-0036 for details regarding the NCM process.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Internal standard calibration is used.

10.1.1 Internal standard calibration is used. The internal standards are listed in this SOP. 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.

10.2 **Instrument Tuning**

10.2.1 Each GC/MS system must be hardware-tuned to meet the abundance criteria, listed in this SOP, for a maximum of a 50 ng (8260 and 624) and 25 ng (524.2) injection or purging of BFB. These criteria must be met

10.2.1.1 **8260** – for each 12 hour time period

10.2.1.2 **524.2** – for each 12 hour time period

10.2.1.3 **624** – for each 24 hour time period

10.2.1.3.1. The time period begins at the moment of injection of BFB.

10.2.2 Inject the method appropriate amount of GC/MS tuning standard into the GC/MS system. Obtain a background-corrected mass spectra of BFB and confirm that all the key m/z criteria in Table 2 are achieved. If all the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are achieved. The performance criteria must be achieved before any samples, blanks, or standards are analyzed.

10.3 Initial Calibration

10.3.1 Prepare a multi-point calibration curve by fortifying 5 mL, or 25 mL depending on the required analysis, of HPLC water with incrementing concentrations of Volatiles standard.

10.3.2 The initial calibration contains a minimum of 5 points, for each target analyte (6 points are required for a quadratic fit). The low level standard must be at or below the reporting limit. The other standards define the working range of the detector, with the highest level standard establishing the linear range of the instrument.

10.3.2.1 Note 624 requires a minimum 3 point calibration. The low level standard must be at or below the reporting limit. The other standards define the working range of the detector, with the highest level standard establishing the linear range of the instrument.

10.3.3 A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include new columns, any significant changes in instrument operating parameters, and major instrument maintenance.

10.3.4 Except in specific instances, it is NOT acceptable to remove points from a calibration curve for the purpose of meeting criteria. Refer to the TestAmerica Policy CA-T-P-0002, Selection of Calibration Points

10.3.5 Sample peak areas are compared to peak areas of the standards. The ratio of the detector response to the amount concentration of analyte in the calibration standard is defined as the response factor (RF) or calibration factor (CF).

10.3.6 **Initial Calibration Criteria (SW 8000B/8260B)**:

10.3.6.1 The % RSD of the calibration check compounds (CCC) must be less than 30%. CCC are as follows:

- Vinyl Chloride
- 1,1-Dichloroethene
- Chloroform
- 1,2-Dichloropropane
- Toluene
- Ethylbenzene

10.3.6.2 If none of the CCCs are required analytes, project specific calibration specifications must be agreed with the client.

10.3.6.3 The average RF must be calculated for each compound. A system performance check is made prior to using the calibration curve. The five system performance check compounds (SPCC) are checked for a minimum average response factor.

10.3.6.3.1. A **minimum response factor of 0.01** must be achieved for all other volatile target analytes.

Compound	Min. RF
Chloromethane	0.100
1,1-Dichloroethane	0.100
Bromoform	>0.100
1,1,2,2-Tetrachloroethane	0.300
Chlorobenzene	0.300

10.3.6.4 If all %RSDs in the initial calibration are ≤ 15%, then all analytes may use average response factor for calibration.

10.3.6.5 The analyst should evaluate analytes with %RSD > 15%.

10.3.6.5.1. Evaluate whether the problem is related to the analytical range. The low standard or the high standard having a response that is out of line with the others typically expresses this. For criteria regarding the removing calibration points from the curve, refer to STL policy P-T-001, Selection of Calibration Points.

10.3.6.6 For SW846 Method 8000B

10.3.6.6.1. If the average of all %RSDs in the calibration is > 15%, the analyst should consider instrument maintenance to improve the linearity of response.

10.3.6.6.2. When a linear regression curve is used, the intercept of the curve at zero response must be less than ± the reporting limit for the analyte. Client requirements may be tighter.(see Section 10.3.7.6.1).

10.3.6.6.3. If a linear regression curve is used, r must be ≥ 0.995.

10.3.6.6.4. When a linear model is employed use of 1/Concentration^2 weighting is recommended to improve the accuracy of quantitation at the low end of the curve and to better control the intercept at zero response.

10.3.6.6.5. The regression may be forced through zero when using a linear model. South Carolina compliance work does NOT allow forcing through zero. See specific client requirements to determine if this technique is allowed for specific sample groups.

10.3.7 **Initial Calibration criteria (8000C/8260C and 524.2)**:

10.3.7.1 Minimum Response Factors (SW 8260C only)

10.3.7.1.1. See Table 4 in this SOP for recommended minimum response factors prescribed by method 8260. For analytes not given a minimum response factor by the method, TestAmerica St. Louis has established a default of 0.01 and 0.001 depending on the nature of the compound.

10.3.7.2 SW-846 8260C and 524.2 chromatographic methods allow the use of both linear and non-linear models for the calibration data.

10.3.7.3 The first way is to begin with the simplest approach, the linear model through the origin, and then progress through other options until the calibration acceptance criteria are met. The second way is to use technical knowledge of the detector response to the target compound to choose the calibration model.

10.3.7.4 The option for non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to be used to compensate for detector saturation or to avoid proper instrument maintenance.

10.3.7.5 **Linear calibration using the average response factor**

10.3.7.5.1. The Relative Standard Deviation (RSD) of the calibration points from the curve used must be ≤ 20% for each target analyte.

10.3.7.5.2. If the %RSD in the initial calibration is > 20%, then calibration using a linear regression may be employed.

10.3.7.6 **Linear calibration using a least squares regression**

10.3.7.6.1. The intercept of a linear calibration at zero response (i.e. the y-intercept) must have an absolute value less than the reporting limit for each analyte. Client requirements may be tighter, please check Client Requirement Memorandum (CRM) if identified in comments. Note, for analyses utilizing an internal standard the Target variable “b” does NOT equal the y-intercept. For analyses utilizing an internal standard, the Target variable “b” must be multiplied by the associated internal standard concentration to derive the concentration at the y-intercept.

10.3.7.6.2. r (correlation coefficient) must be ≥ 0.995 OR r^2 (coefficient of difference) must be ≥ 0.990.

10.3.7.6.3. 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.

10.3.7.6.4. It is not necessary to re-analyze a low concentration standard, rather the data system can recalculate the concentrations.

10.3.7.6.5. The recalculated concentration of the low calibration point should be within ± 30% of the standard’s true concentration.

10.3.7.6.5.1. Analytes which do not meet the minimum quantitation calibration re-fitting criteria should be considered “out of control” and corrective action should be taken.

10.3.7.7 **Linear calibration using a least squares regression, forcing thru zero**

10.3.7.7.1. Forcing the curve through zero is not the same as including the origin as a fictitious point in the calibration. In essence, if the curve is forced through zero, the intercept is set to 0 *before* the regression is calculated, thereby setting the bias to favor the low end of the calibration range by “pivoting” the function around the origin to find the best fit and resulting in one less degree of freedom. It may be appropriate to force the regression though zero for some calibrations.

10.3.7.7.2. Curve must still meet criteria in 10.3.7.6.1 and 10.3.7.6.2

10.3.7.8 **Linear calibration using a least squares regression, weighting of data points**

10.3.7.8.1. In a linear model, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. For this reason it may preferable to increase the weighting of the lower concentration points. $1/\text{Concentration}^2$ weighting (often called $1/X^2$ weighting) to improve accuracy at the low end of the curve.

10.3.7.8.2. Curve must still meet criteria in 10.3.7.6.1 and 10.3.7.6.2.

10.3.7.9 **Non-linear calibration**

10.3.7.9.1. In situations where the analyst knows that the instrument response does not follow a linear model over a sufficiently wide working range, or when the other approaches have not met the acceptance criteria, a quadratic model may be employed. All quadratic curves require a minimum of 6 pts.

10.3.7.9.2. It is not EPA's intent to allow non-linear calibration to be used to compensate for detector saturation or to avoid proper instrument maintenance. Thus, non-linear calibrations are not to be employed for analytes shown to consistently exhibit linear calibration for the analytes of interest.

10.3.7.9.3. The intercept of the curve at zero response must be less than ± the reporting limit for the analyte. (Some clients may have tighter criteria; check Client Requirement Memos)

10.3.7.9.4. r (correlation coefficient) must be ≥ 0.995 OR r^2 (coefficient of difference) must be ≥ 0.990.

10.3.7.9.5. The regression may be forced through zero when using a non-linear model. See specific client requirements to determine if this technique is allowed for specific sample groups.

10.3.7.9.6. The use of quadratic curves is not allowed for South Carolina compliance samples.

10.3.8 **624 Criteria**

10.3.8.1 Method 624 only requires a 3 point calibration. We routinely perform a 5 point calibration; however, 2 points may be removed from the curve if necessary to meet 624 calibration criteria. Refer to the TestAmerica Policy CA-T-P-0002, Selection of Calibration Points

10.3.8.2 The Relative Standard Deviation (RSD) of the calibration points from the curve used must be < 35%.

10.3.8.3 If the %RSD in the initial calibration is ≥ 35%, then calibration using a linear regression may be employed.

10.3.8.3.1. If a linear regression curve is used, the intercept of the curve at small zero response must be less than ± the reporting limit for the analyte. It is recommended that for linear regression curves the line be set through the origin.

10.3.8.4 Use of 1/Concentration^2 weighting is recommended to improve the accuracy of quantitation at the low end of the curve. The analyst should consider instrument maintenance to improve the linearity of response.

10.3.8.4.1. Weighting of data points

10.3.8.4.2. The points at the lower end of the calibration curve have less weight in determining the curve generated than points at the high concentration end of the curve. However, in environmental analysis, accuracy at the low end of the curve is very important. For this reason it is preferable to increase the weighting of the lower concentration points. 1/Concentration^2 weighting (often called 1/X^2 weighting) will improve accuracy at the low end of the curve and should be used if the data system has this capability.

10.4 **Initial Calibration Verification (ICV)**

10.4.1 The initial calibration verification standard is a different standard source than the one used for the initial calibration

10.4.2 An ICV must be performed with each initial calibration.

10.4.3 The ICV performance must be within ± 30% D criteria for each analyte.

10.4.3.1 Not meeting this requirement may be indicative of serious system malfunction or inaccuracies in the standards used for the initial calibration curve or ICV standard.

10.4.4 Corrective action must be taken (including reanalysis of the ICV or analysis of a different ICV).

10.4.4.1 Any decision to proceed with analysis of samples when the ICV is out-of-control must be taken with great care and in consultation with the QA department and the laboratory director. Any such action must be documented in an NCM.

10.4.4.2 Variance among vendor supplied standards for a few compounds is not atypical for long analyte lists. All ICV failures that cannot be associated to laboratory error will require the immediate analysis of a third standard in an attempt to characterize the bias. If a third standard is not in the laboratory it must be ordered immediately.

10.5 Continuing Calibration Verification.(CCV)

10.5.1 At the start of each 12 hour period (8260) or 24 hour period (624) the GC/MS tuning standard must be analyzed. A 50ng injection of BFB must result in a mass spectrum for BFB which meets the criteria. See Table 2 in this SOP.

10.5.2 Following a successful BFB analysis, the continuing calibration standard(s) are analyzed. The standards must contain all volatile analytes, including all required surrogates. A mid level calibration standard is used for the continuing calibration

10.5.3 A CCV standard is analyzed every analysis tune clock immediately following the BFB tune.

10.5.3.1 **8260 and 524.2** – for each 12-hour tune time period

10.5.3.2 **624** – for each 24-hour tune time period

10.5.4 The CCV can be the same source or a second source from the calibration.

10.5.5 The internal standard response must be within -50 – 100% of the response in the mid level of the initial calibration. The internal standard retention times must be within 30 seconds of the retention times in the mid-level of the initial calibration.

10.5.6 8000B/8260B criteria:

10.5.6.1 The SPCC compounds must have a minimum response factor (see Initial Calibration SPCC criteria)

10.5.6.2 The percent difference of the CCC compounds compared to the the initial calibration must be $\leq$ 20%.

10.5.6.3 In addition, if CCC compounds are not part of the target list, the percent difference or drift of all analytes must be $\leq$ 20%, with allowance being made for up to six target compounds to have percent drift greater than 20%. Due to poor responses, the following compounds are allowed to have a %D > 60%, but less than 100%: Cyclohexane, 2-Chloroethyl vinyl ether, 2-Nitropropane, 1,4-Dioxane, Tetrahydrofuran, n-butanol and Isobutanol.

10.5.6.3.1 South Carolina does not allow this exception for poor responders. If the CCCanalytes are not in the target compound list all analytes must be with 30% difference or drift for calibration verification.

10.5.6.4 In addition, if any target analyte's %D is > 20%, the entire target analyte list must be averaged. The average %D must be ≤ 20%. [NOTE: Averaging the entire target analyte list (or using the "Gand Mean") is not allowed for South Carolina compliance work.]

10.5.6.5 If none of the identified CCCs are in the special calibration, the project specific target analytes %D must be < 20% or a maximum %D as agreed with the client. If there is a special project/client %D criteria it is noted on the client requirement sheet; otherwise a maximum 20% D is applied.

10.5.6.6 There are instances where a small subset of the routinely calibrated analytes are needed for analysis (e.g. dilutions or project with abbreviated target analyte lists). In cases where the target analytes for analysis constitutes less than half of the total number of analytes in the calibration standard, apply the following:

10.5.6.6.1. The SPCC compounds must have a response factor (see initial calibration SPCC criteria) if the SPCC is a target of interest.

10.5.6.6.2. The percent difference of the CCC compounds from the initial calibration must be < 20%, if the CCC is a target of interest. In addition, the percent difference or drift of all analytes of concern must be < 60%, with allowance being made for, Cyclohexane, 2-Chloroethyl vinyl ether, 2-Nitropropane, 1,4-Dioxan, Tetrahydrofuran, n-butanol and Isobutanol. These compounds are allowed to have a %D > 60% but less than 100%.

10.5.6.6.2.1. South Carolina does not allow this exception for poor responders. If the CCC analytes are not in the target compound list all analytes must be with 30% difference or drift for calibration verification.

10.5.6.6.3. For target analyte lists with more than 20 compounds: if any target analyte's %D is > 15%, the entire target analyte list must be averaged. The average %D must be ≤ 15%. [NOTE: This averaging is not allowed for South Carolina compliance work.]

10.5.6.6.4. For target analyte lists with less than 20 compounds: each target analyte %D must be < 15% or a maximum %D as agreed with the client.

10.5.7 **8260C criteria:**

10.5.7.1 The CCV performance must be with ± 20% D criteria.

10.5.7.2 If a CCV has failed and the analyst can document the reason for failure (e.g. broken vial, carryover from the previous sample etc.) then a second CCV may be analyzed without any adjustments to the instrument. If this CCV meets criteria then sample analysis may continue. If this second CCV does not meet criteria, the analysis run is terminated. Instrument maintenance is performed and the instrument may require re-calibration (i.e. initial calibration)

10.5.8 **624 criteria**

10.5.8.1 Continuing calibration %D criteria is given in Table 5 of the Method. The column "Range for Q" is used to determine if CCV target analytes meet acceptance.

10.5.8.2 All target analytes must be within the limits prescribed.

10.5.9 **524.2 criteria**

10.5.9.1 For each target analyte %D must be less than or equal to 30%.

10.5.10 Calibration excursions are to be documented via a NCM.

10.6 Retention Time (RT) windows

10.6.1 Relative Retention Time (RRT)

10.6.1.1 In addition to normalizing the response (peak area) of the target compound to the response of the internal standard in that sample or extract for that injection, the retention times of the target compound and the internal standard may be used to calculate the relative retention time (RRT) of the target compound.

10.6.1.2 The RRT is expressed as a unit-less quantity:

$$\text{RRT} = \frac{\text{Retention time of the analyte}}{\text{Retention time of the internal standard}}$$

10.6.1.3 The RRT of each target analyte in each calibration standard should agree within ± 0.06 RRT units.

10.6.1.4 It is recognized here that with increasing retention times of the internal standard, target analytes will be able to more easily meet this criterion. Thus, care should be exercised when selecting the appropriate internal standards by retention times. The process of selecting internal standards to quantify target analytes should also include consideration of retention times as they should be similar.

10.6.1.5 If this criterion is not met and unless there are no other indicators of a component's identification such as a very unique but a high probability mass spectral match then that component may not be considered as identified by relative retention time.

10.6.1.6 The RRT evaluation allows the analyst to compensate for modest shifts in the chromatographic conditions that can occur due to interferences and simple day-to-day instrument variability. Many methods that employ internal standard calibration use more than one internal standard, and the target compounds are related to the internal standards on the basis of the similarity of their respective chromatographic retention times.

10.6.2 Retention Time Windows

10.6.2.1 The maximum retention time window is ± 0.45 minutes from the established retention time of the target analyte in the initial calibration.

10.6.2.1.1. Establishing this maximum retention time window, ensures that the RRT criteria of RRT ± 0.06 is achieved.

10.6.3 Internal standard retention time

10.6.3.1 The retention times of the internal standards in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

10.6.4 Retention Time Criteria

10.6.4.1 The retention times of all compounds in each continuing calibration must be within the retention time windows established.

10.7 Method Detection Limit Studies

10.7.1 Where required by regulatory agencies, full MDL studies are performed for the relevant analyses on an annual basis. South Carolina requires an annual MDL study. The study must encompass both columns. See SOP ST-QA-0016 for the requirements and procedures to determine and evaluate MDLs

11.0 PROCEDURE

11.1 Screening

11.1.1 Screening samples is a semi-quantitative determination and is not intended to be use as a reportable analytical result.

11.1.2 Screening may be performed on either a GC-FID or GC/MS instrument. The instrument should be capable of detecting the compounds of concern but does not adhere to any method calibration criteria or analysis tune clock times, nor are there any batch QC (eg method blanks, LCS) requirements for screening samples.

11.1.3 Water samples are screened using a minimum 0.1 mL of samples and diluting with target analyte free water to a final volume of 5 mL. Greater dilutions may be taken if the sample is suspected to have significantly high concentration of target analytes or interferents.

11.1.4 For soil samples, 1 g of sample is place in a 40 mL VOA vial with 5 mL of target analyte free water. Greater dilutions may be taken if the sample is suspected to have significantly high concentration of target analytes or interferents.

11.1.5 Sample screening may be performed utilizing a heated or non-heated purging vessel.

11.2 Allow standards, samples and sample extracts to reach ambient temperature before analysis.

11.3 All analysis conditions and injection volumes for samples must be the same for the calibration standards (including purge time and flow, desorb time and temperature, column temperatures, multiplier setting etc.).

11.3.1 Water, soil and medium level extract analyses are routinely performed by heated purge.

11.3.1.1 If desired, water, TCLP and methanol extracts may be performed using a non-heated purge.

11.3.1.2 If non-heated purge is desired, the calibration and all QC samples must also be performed utilizing a non-heated purge.

11.4 <u>Water Sample Preparation (5030B/C method)</u>

11.4.1 Transfer 5 mL or 25 mL sample to a VOA vial.

11.4.2 Transfer the 5 mL or 25 mL sample into an empty labeled 40 mL VOA vial.

11.4.3 Add 250 ng of each internal and surrogate standard (10 µL of a 25 µg/mL solution)

11.4.3.1 For routine TCLP samples use 0.5 mL of TCLP sample leachate with 4.5 mL reagent water and spike with surrogate and internal standards.

11.4.3.1.1.1 Note that TCLP reporting limits will be 10 times higher than the corresponding aqueous limits)

11.4.3.2 For low level TCLP samples, use 5 mL of TCLP sample leachate and spike with surrogate and internal standard.

11.4.4 Prepare a method blank with 5 mL or 25 mL of HPLC water. Add 250 ng of each internal and surrogate standard (10 µL of a 25 µg/mL solution)

11.4.5 Prepare a LCS with 5 mL or 25 mL of HPLC water. Add 250 ng of each internal and surrogate standard (10 µL of a 25 µg/mL solution). Add 10 µL of 25 µg/mL spiking solution

11.4.5.1 For samples designated for MS/MSD analysis, add 10 µL of 25 µg/mL of spiking solution.

11.4.6 Check and document the pH the remaining sample.

11.4.6.1 Do not check pH prior to taking aliquot for analysis.

11.5 <u>Low-Level Soil Preparation (5035A method)</u>

11.5.1 If samples arrive unpreserved, the laboratory must, within 48 hours of collection, preserve samples with sodium bisulfate or extrude sample into a clean, empty, sealed VOA vial and freeze.

11.5.1.1 Check the preparation method code to determine preservation.

11.5.2 <u>If samples arrive in the Encore (or equivalent) sampler and require Sodium bisulfate preservation</u>:

11.5.2.1 Pre-weigh a labeled 40 mL VOA vial.

11.5.2.1.1 Label with an indelible marker rather than a paper label, since paper labels may cause the autosampler to bind and malfunction.

11.5.2.2 Extrude the soil sample from the Encore (or equivalent) sampler into the VOA vial.

11.5.2.3 Weigh the vial to the nearest 0.01 g.

11.5.2.4 Record weight in appropriate TALS prep-batch.

11.5.2.5 Add a magnetic stir bar, approximately 1 g of sodium bisulfate and 5 mL of HPLC water.

11.5.2.5.1 Soils containing carbonates may effervesce when adding the sodium bisulfate solution. If this is the case, retrieve a second Encore sample plug, add 5 mL of water instead, and freeze at < 10 °C until analysis.

11.5.2.6 Seal the vial.

11.5.2.7 Add 10 µL each of surrogate and internal standard through the septum to each sample and QC.

    - 11.5.2.7.1 For samples designated for MS/MSD analysis, add 10 µL of spiking solution to the vials.
    - 11.5.2.7.2 Prepare a Method Blank using 5.0 g of glass beads and 5 mL of HPLC grade water. Add 10µL of surrogate to the vial.
    - 11.5.2.7.3 Prepare a LCS using 5.0 g glass beads, and 5 mL HPLC water. Add 10 µL of surrogate and 10 µL of spiking solution.

- 11.5.3 <u>If samples arrive 40 mL VOA vial already preserved with Sodium bisulfate</u>:
  - 11.5.3.1 Add 10 ul each of surrogate and internal standard through the septum to each sample and QC.
    - 11.5.3.1.1 For samples designated for MS/MSD analysis, add 10 µL of spiking solution to the vials.
    - 11.5.3.1.2 Prepare a Method Blank using 5.0 g of glass beads and 5 mL of HPLC grade water. Add 10 µL each of surrogate and internal standard to the vial.
    - 11.5.3.1.3 Prepare a LCS using 5.0 g glass beads, and 5 mL HPLC water. Add 10 µL each of surrogate and internal standard and 10 µL of spiking solution.
- 11.5.4 <u>If samples arrive in the Encore (or equivalent) sampler and require freezing as preservation:</u>
  - 11.5.4.1 Pre-weigh a labeled 40 mL VOA vial.
    - 11.5.4.1.1 Label with an indelible marker rather than a paper label, since paper labels may cause the autosampler to bind and malfunction.
  - 11.5.4.2 Extrude the soil sample from the Encore (or equivalent) sampler into the VOA vial.
  - 11.5.4.3 Weigh the vial to the nearest 0.01 g
  - 11.5.4.4 Record weight in appropriate TALS prep-batch.
  - 11.5.4.5 Seal the vial.
  - 11.5.4.6 Freeze sample until time of analysis.
  - 11.5.4.7 Add 5 mL of HPLC water.
  - 11.5.4.8 Seal the vial.
  - 11.5.4.9 Add 10 µL each of surrogate and internal standard through the septum to each sample and QC.
    - 11.5.4.9.1 For samples designated for MS/MSD analysis, add 10 µL of spiking solution to the vials.
    - 11.5.4.9.2 Prepare a Method Blank using 5.0 g of glass beads and 5mL of HPLC grade water. Add 10 µL each of surrogate and internal standard to the vial.
    - 11.5.4.9.3 Prepare a LCS using 5.0 g glass beads, and 5 mL HPLC water. Add 10 µL each of surrogate and internal standard and 10 µL of spiking solution.
- 11.5.5 <u>If samples arrive in 40 mL VOA vial and require freezing as preservation</u>:
  - 11.5.5.1 Freeze sample until time of analysis.
  - 11.5.5.2 Add 5 mL of HPLC water
  - 11.5.5.3 Seal the vial.
  - 11.5.5.4 Add 10 µL each of surrogate and internal standard through the septum to each sample and QC.
    - 11.5.5.4.1 For samples designated for MS/MSD analysis, add 10 µL of spiking solution to the vials.
    - 11.5.5.4.2 Prepare a Method Blank using 5.0g of glass beads and 5mL of HPLC grade water. Add 10 µL each of surrogate and internal standard to the vial.
    - 11.5.5.4.3 Prepare a LCS using 5.0 g glass beads, and 5 mL HPLC water. Add 10 µL each of surrogate and internal standard and 10 µL of spiking solution.

11.6 **Low-Level Soil Preparation (superceded 5030 method)**

- 11.6.1 See SOP ST-QA-0038 for the procedure for sub sampling.
- 11.6.2 Weigh 5 ± 0.05 g of the sample into a pre-weighed 40 mL glass labeled vial.
  - 11.6.2.1 If the sample is suspected or known to have high concentrations of analytes, reduce the sample aliquot to 1.0 g
- 11.6.3 Record the weight.
- 11.6.4 Add 5 mL HPLC water
- 11.6.5 Seal the vial.
- 11.6.6 The above steps should be performed rapidly and without interruption to avoid loss of volatile organics.
- 11.6.7 Add 10 µL of surrogate standard through the septum.
  - 11.6.7.1 Prepare a Method Blank using 5.0 g of glass beads and 5 mL of HPLC grade water. Add 10 µL of surrogate to the vial.
  - 11.6.7.2 Prepare a LCS using 5.0g glass beads, 10 µL of surrogate and 10 µL of spiking solution.
  - 11.6.7.3 For samples designated as for MS/MSD, add 10 µL of spiking solution.

11.7 **Methanol Extraction of Soils (5035A method)**

- 11.7.1 Extrude the (nominal) 5 g sample into a pre-weighed VOA vial containing 5mL methanol (25mL methanol for the 25 g sampler).
- 11.7.2 Obtain the weight of the soil added to the vial and note in preplog (Attachment 1).
- 11.7.3 Add 5 µL medium level surrogate to each sample and QC samples.
  - 11.7.3.1 Prepare a Method Blank using 5.0 g of glass beads and 5 mL methanol. Add 5 µL of parent surrogate to the vial.
  - 11.7.3.2 Prepare a LCS using 5.0 g glass beads, 5 mL of methanol , 5 µL of parent surrogate and 10 µL of spiking solution.
  - 11.7.3.3 For the LCS and MS/MSD, add 100 µL medium level spike mix.
- 11.7.4 Using a vortex mixer, agitate sample for at least half a minute.

11.8 **Methanol Extraction of Soils (superceded 5030 method)**

- 11.8.1 See SOP ST-QA-0038 for the procedure for sub sampling.
- 11.8.2 Weigh 5 ± 0.05 g of the sample into a pre-weighed 40 mL glass labeled vial.
  - 11.8.2.1 If the sample is suspected or known to have high concentrations of analytes, reduce the sample aliquot to 1.0 g
- 11.8.3 Record the weight in prep log (Attachment 1).
- 11.8.4 Seal the vial.
- 11.8.5 Add 5 mL of purge and trap methanol.
- 11.8.6 Add 5 µL medium level surrogate to each sample and QC samples.
  - 11.8.6.1 Prepare a Method Blank using 5.0 g of glass beads and 5 mL methanol. Add 5µL of surrogate to the vial.
  - 11.8.6.2 Prepare a LCS using 5.0 g glass beads, 5 mL methanol, 5 µL of surrogate and 20 µL of spiking solution.
  - 11.8.6.3 For the MS/MSD, add 100 µL medium level spike mix.
- 11.8.7 Using a vortex mixer, agitate sample for at least half a minute.

11.9 **Volatile Analysis**:

- 11.9.1 Load each 40 mL VOA sample vial (and QC) in the purge and trap autosampler.
  - 11.9.1.1 Medium Level Analysis
    - 11.9.1.1.1 Rinse a glass-tight syringe with organic free water and fill the syringe with water. Bring volume to 5 mL add 5 µL of internal standards.
    - 11.9.1.1.2 Add sample methanol extract to the syringe (no more than 100 µL for a 5 mL purge).

11.9.1.1.3 If less than 1 µL of methanol extract is to be added to the water, dilute the methanol extract using a serial dilution.

11.9.1.1.4 Transfer methanol extract/HPLC water in syringe to a labeled 40 mL VOA vial.

11.9.2 Record autosampler sample analysis sequence in logbook.

11.9.3 Start analysis.

11.9.4 After purging is complete, desorb the sample, start the GC temperature program, and begin data acquisition.

11.9.4.1 For method 524.2 the desorb time should be a minimum of 2 minutes.

11.9.5 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.

11.9.6 When the standards and extracts are not being used, refrigerate them at 4 ± 2 °C, protected from light in screw cap vials equipped with unpierced Teflon lined septa.

12.0 DATA ANALYSIS AND CALCULATIONS

12.1 Commonly used calculations (e.g. % recovery and RPD) and standard instrument software calculations are given in the TestAmerica ST-QAM.

12.2 Internal Standards

12.2.1 Samples that exhibit low IS recoveries < 50% or high IS recoveries > 100% are reanalyzed once to confirm matrix effect.

12.3 Manual Integrations

12.3.1 Identified compounds are reviewed for proper integration. Integrations are performed automatically by the data system. If necessary, manual integrations are performed and are documented by the analyst. Manual integrations are denoted with an “M” flag on the Target quantitation report. See TestAmerica Policy CA-Q-S-002, Acceptable Manual Integration Practices

12.4 Qualitative identification

12.4.1 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. Two criteria must be satisfied to verify identification:

12.4.1.1 Elution of sample component at the same GC retention time as the standard component; and

12.4.1.2 Correspondence of the sample component and the standard component characteristic ions.

12.4.1.2.1Note: Care must be taken to ensure that spectral distortion due to co-elution is evaluated.

12.4.2 The sample component retention time must compare to within ± 0.2 minutes. of the retention time of the standard component. For reference, the standard must be run within the same twelve hours as the sample.

12.4.3 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.

12.4.4 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 should be between 20 and 80%.)

12.4.5 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.

12.5 Retention time criteria for samples

12.5.1 If the retention time for any internal standard changes by more than 0.5 minutes from the last continuing calibration standard, the chromatographic system must be inspected for malfunctions and corrected. Reanalysis of samples analyzed while the system was malfunctioning is required.

12.5.2 If the retention time of any internal standard in any sample varies by more than 0.1 minute from the preceding continuing calibration standard, the data must be carefully evaluated to ensure that no analytes have shifted outside their retention time windows.

12.6 Tentatively Identified Compounds (TICs)

12.6.1 If the client requests components not associated with the calibration standards, a search of the NIST library may be made for the purpose of tentative identification. Guidelines are:

12.6.1.1 Relative intensities of major ions in the reference spectrum (ions > 10% of the most abundant ion) should be present in the sample spectrum.

12.6.1.2 The relative intensities of the major ions should agree to within 20%. (Example: If an ion shows an abundance of 50% in the standard spectrum, the corresponding sample ion abundance should be between 30% and 70%).

12.6.1.3 Molecular ions present in the reference spectrum should be present in the sample spectrum.

12.6.1.4 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.

12.6.1.5 Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the spectrum because of background contamination or co-eluting peaks. (Data system reduction programs can sometimes create these discrepancies.)

12.6.1.6 Computer-generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Only after visual inspection of the sample with the nearest library searches should the analyst assign a tentative identification. Library searches of peaks present in the chromatogram that are not target compounds (Tentatively Identified Compounds, TIC) may be performed if required by the client.

12.6.1.7 The first 20 TICs will be identified in a sample, unless a different number is specified by the client. See client requirement sheet.

12.7 Dilutions

12.7.1 If the concentrations of any analytes exceed the working range as defined by the calibration standards, then the sample must be diluted and reanalyzed.

12.7.2 A dilution should target the most concentrated analyte in the upper half (over 50% of the high level standard) of the client specific project requirements.

12.7.2.1 Aqueous samples requiring less than a 1:1000 dilution can be diluted directly using a 5 mL syringe

12.7.2.2 Aqueous samples requiring less than a 1:5000 dilution can be diluted directly using a 25 mL syringe

12.7.2.3 Low level soil samples may re-analyzed using a 1 g sample aliquot or utilizing the methanol extraction technique.

12.8 Carryover

12.8.1 When a sample has a high response for a compound, there is a real possibility that some of the sample may carry over into the sample analyzed immediately afterward.

12.8.1.1 If a sample analyzed after a sample with high concentrations has negative results, carryover did not occur.

12.8.1.2 If a sample analyzed after a sample with high concentrations has positive results for the same analyses, carryover may have occurred.

12.8.1.2.1 This sample must be reanalyzed under conditions in which carryover can be confirmed to not have occurred

12.8.1.3 If the chromatographic profile resembles the previous sample, the results are questionable.

12.8.1.3.1 This sample must be reanalyzed under conditions in which carryover can be confirmed to not have occurred.

13.0 DATA ASSESSMENT AND ACCEPTANCE CRITERIA; CORRECTIVE ACTIONS FOR OUT OF CONTROL DATA

13.1 The data assessment and corrective action process is detailed through the LIMS Nonconformance Memorandum (NCM) process. The NCM process is described in SOP: ST-QA-0036. Steps taken when an out of control situation occurs include demonstrating that all issues creating the out-of-control situation have been addressed, document the problem and the action taken to correct it, document that an in-control situation has been achieved.

13.2 Method Blank

13.2.1 Acceptance Criteria:

13.2.1.1 No target analytes may be present in the method blank above the reporting limit.

13.2.1.2 The method blank must have acceptable surrogate recoveries.

13.2.1.3 Corrective Action for Method Blanks not meeting acceptance criteria:

13.2.1.3.1 <u>Method Blank Contamination</u> – Blank contamination above the RL (>1/2 RL for some programs – see specific Client Requirement Memos for details) requires re-prep of batch unless all associated samples are < RL or greater than 10 times the amount detected in the method blank.

13.2.1.3.2 <u>Method Blank Surrogate excursion</u> – If excursion is limited to the blank, data may be reported with an NCM. If surrogates are also outside criteria in samples, re-prep and re-anlaysis is required. In cases where the surrogate recovery is high and the samples are non-detect, the data may be reported with an NCM.

13.2.1.3.3 <u>For South Carolina compliance workthe Method Blank concentration must be below the RL</u>.

13.3 Laboratory Control Sample (LCS)

13.3.1 Acceptance Criteria: All control analytes must be within established control limits for accuracy (%Recovery) and precision (RPD).

13.3.1.1 For long analyte spike list, marginal exceedances (ME) are allowed as follows:

13.3.1.2 less than 11 analytes in LCS, no analytes allowed in ME of the LCS control limit.

13.3.1.3 11-30 analytes in LCS, 1 analytes allowed in ME of the LCS control limit.

13.3.1.4 31-50 analytes in LCS, 2 analytes allowed in ME of the LCS control limit.

13.3.1.5 51-70 analytes in LCS, 3 analytes allowed in ME of the LCS control limit.

13.3.1.6 71-90 analytes in LCS, 4 analytes allowed in ME of the LCS control limit.

13.3.1.7 More than 90 analytes in LCS, 5 analytes allowed in ME of the LCS control limit.

13.3.1.8 No LCS recoveries may be outside the Marginal Exceedance limit.

13.3.1.9 Marginal exceedances must be random. If the same LCS analyte exceeds the control limit repeatedly, it is an indication of a systemic problem. The source of the error must be located and corrective action taken.

13.3.1.10 Marginal exceedance is not allowed by all programs. See specific Project/Client CRM for details. The use of marginal exceedances is not allowed for South Carolina compliance samples. LCS recoveries must be within 70 -130% for South Carolina compliance work.

13.3.2 The LCS should have acceptable surrogate recoveries.

13.3.3 Corrective Action for LCS not meeting acceptance criteria:

13.3.3.1 LCS Spike Recovery excursion (high) – Samples that are non-detect may be reported with an NCM (unless prohibited by client requirements). Samples with detects for the analyte recovered high in the LCS are re-prepped and re-analyzed. . In cases where the surrogate recovery is high and the samples are non-detect, the data may be reported with an NCM

13.3.3.2 LCS Spike Recovery excursion (low) – batch is re-prepped and re-analyzed.

13.3.3.3 LCS Surrogate Recovery excursion – If excursion is limited to the LCS, data may be reported with an NCM. If target analytes are in control in the LCS, data may be reported with an NCM. If surrogates are also outside criteria in samples, re-prep and re-analysis is required.

13.3.3.4 RPD excursion for LCS/LCSD – If target analytes recoveries are in control, data may be reported with an NCM

13.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

13.4.1 All analytes should be within established control limits for accuracy (%Recovery) and precision (RPD).

13.4.2 Corrective Action for MS/MSD not meeting acceptance criteria:

13.4.2.1 MS/MSD Spike Rec. excursion may not necessarily warrant corrective action other than narration. If affected analyte concentration in the original sample is greater than four times the amount spiked, percent recovery information is ineffective. Data is reported with an NCM. If the excursion is due to a physically evident matrix interference, the data is reported with an NCM (the physical interference must be described in the NCM). If there is no evidence of interference and the RPD as well as spike recoveries out outside limits out, sample re-prep and re-analysis are required.

13.5 Sample result evaluation

13.5.1 Dilutions

13.5.1.1 If the response for any compound exceeds the working range of the analytical system, a dilution of the extract is prepared and analyzed. An appropriate dilution should be in the upper half of the calibration range.

13.5.1.2 Dilution: Sample– An NCM is created when dilutions are required.

13.5.1.3 Dilution: Surrogate(s)/spikes diluted out– An NCM is generated to document the surrogates/spikes being diluted out.

13.5.2 Carryover

13.5.2.1 When a sample has a high response for a compound, there is a real possibility that some of the sample may carry over into the sample analyzed immediately afterward.

13.5.2.2 If a sample analyzed after a sample with high concentrations is non-detect for the high concentration analyted, carryover did not occur.

13.5.2.3 If a sample analyzed after a sample with high concentrations has positive results for the same analytes, or if the chromatographic profile resembles the previous sample, the results are questionable. This sample must be reanalyzed under conditions in which carryover can be confirmed to not have occurred.

13.5.3 Internal Standards

13.5.3.1 Acceptance Criteria:

13.5.3.1.1 If the EICP area for any of the internal standards in the calibration verification standard changes by a factor of two (-50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence.

13.5.3.1.2 If the EICP area for any of the internal standards in samples, spikes and blanks changes by a factor of two (-50% to +100%) from the areas determined in the continuing calibration analyzed that day, corrective action must be taken. The samples, spikes or blanks should be reanalyzed or the data should be qualified. (Some programs may require that the midpoint of the initial calibration be used for ISTD monitoring. See the project CRM for specifics.)

13.5.3.2 Corrective Action for Internal Standards not meeting acceptance criteria:

13.5.3.2.1 Internal Standard excursion – high – High ISTD recovery indicates a potential low bias to analytical results. Instrument maintenance, if required, is done and affected samples are reanalyzed. If ISTDs are outside criteria on the re-analysis, a matrix interference is suspected and data reported with an NCM.

13.5.3.3 Internal Standard excursion – low – Low ISTD recovery indicates the potential for a high bias to analytical results. Samples that are non-detect for affected analytes may be reported with an NCM. Samples with positive hits above the RL for analytes associated with the poor ISTD recovery require re-analysis. Instrument maintenance, if required, is done. If ISTDs are outside criteria on the re-analysis, a matrix interference is suspected and data reported with an NCM.

13.6 Surrogate

13.6.1 All Surrogates should be within established control limits for accuracy (%Recovery).

13.6.2 Corrective Action for Surrogate not meeting acceptance criteria:

13.6.2.1 Surrogate Spike Rec. excursion may not necessarily warrant corrective action other than narration.

13.7 Insufficient Sample

13.7.1 For each prescribed re-preparation corrective action, if there is insufficient sample to repeat the analysis, an NCM is created and a narrative comment stating such is included in the report's Case Narrative.

14.0 METHOD PERFORMANCE AND DEMONSTRATION OF CAPABILITY

14.1 Method performance data, Reporting Limits, and QC acceptance limits, are maintained in the LIMS.

14.2 Demonstration of Capability

14.2.1 Initial and continuing demonstrations of capability requirements are established in the ST-QAM.

14.3 Training Qualification

14.3.1 The manager/supervisor has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience.

14.3.2 The analyst must have successfully completed the initial demonstration capability requirements prior to working independently. See requirements in the ST-QAM.

14.4 Annually, the analyst must successfully demonstrate proficiency to continue to perform this analysis. See requirements in the ST-QAM.

15.0 VALIDATION

15.1 Laboratory SOPs are based on published methods (EPA, DOE, ASTM, Eichrom, Standard Methods) and do not require validation by the laboratory. The requirements for laboratory demonstration of capability are included in the ST-ST-QAM. Laboratory validation data would be appropriate for performance based measurement systems, non-standard methods and significant modifications to published methods. Data from said validations is held in the QA department.

16.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1 All waste will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

16.2 Waste Streams Produced by the Method

16.2.1 The following waste streams are produced when this method is carried out.

16.2.1.1 Acidic sample waste generated. All acidic waste will be accumulated in the appropriate waste accumulation container, labeled as Drum Type "A" or "B".

16.2.1.2 Solvent waste generated. Solvent waste must be accumulated in the appropriate waste accumulation container, labeled as Drum Type "D".

16.2.1.3 Contaminated disposable glass or plastic materials utilized in the analysis are disposed of in the sanitary trash. If the labware was used for the analysis of radioactive samples and contains radioactivity at a level of 100 cpm over background as determined by a GM meter, the labware will be collected in waste barrels designated for solid rad waste for disposal by the EH&S Coordinator.

17.0 REFERENCES

17.1 SW846, Test Methods for Evaluating Solid Waste, Third Edition, Gas Chromatography/Mass Spectrometry for Volatile Organics, Method 8000B, 8000C, 8260B and 8260C

17.2 40CFR Part 136: "Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix A, "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", Code of Federal Regulations, Revised July1, 1995, Method 624

17.3 USEPA Drinking Water method 524.2

17.4 TestAmerica St. Louis Quality Assurance Manual (ST-QAM), current revision.

17.5 TestAmerica Corporate Environmental Health and Safety Manual (CW-E-M-001) and St. Louis Facility Addendum (ST-HS-0002), current revisions

17.6 TestAmerica Policy CA-Q-S-002, Acceptable Manual Integration Practices

13.8 TestAmerica Policy CA-T-P-002, Selection of Calibration Points

17.7 Associated SOPs

17.7.1 ST-OP-0001, Organic Labware Cleaning Procedure
17.7.2 ST-PM-0002, Sample Receipt and Chain of Custody
17.7.3 ST-QA-0002, Standard and Reagent Preparation
17.7.4 ST-QA-0005, Calibration and Verification Procedure for Thermometers, Balances, Weights and Pipettes.
17.7.5 ST-QA-0014, Evaluation of Analytical Accuracy and Precision Through the Use of Control Charts
17.7.6 ST-QA-0016, IDL/MDL Determination
17.7.7 ST-QA-0031, VOA Holding Blank Analysis
17.7.8 ST-QA-0036, Non-conformance Memorandum (NCM) Process

18.0 CLARIFICATIONS, MODIFICATIONS OF PREVIOUS REFERENCE METHOD

18.1 Modification to Reference Method 624

18.1.1 Ion 119 is used as the quantitation ion for chlorobenzene-d5 for 25 mL purge tests.

18.1.2 A retention time window of 0.2 minutes is used for all components, since some data systems do not have the capability of using the relative retention time units specified in the reference method.

18.1.3 The quantitation and qualifier ions for some compounds have been changed from those recommended in SW-846 in order to improve the reliability of qualitative identification.

18.1.4 Method 624 Section 5.2.2 of the source method describes the trap packing materials as Tenax GC, Methyl silicone, silica gel and coconut charcoal. TestAmerica routinely employs the Supelco K trap.

18.2 Modifications required for drinking water analysis by method 524.2

18.2.1 The lab analyzes groundwater by method 524.2 for specific client(s); a narrative is to be included in the applicable data packages that details deviations from the method.

18.2.2 Only one internal standard — Fluorobenzene — is required for this method. The lab uses 3 ISTDs.

18.2.3 The same analysis run may be used to satisfy the requirements for an LCS (also known as a laboratory fortified blank, LFB) and a continuing calibration verification sample. The LCS/CCV does not need to be a second source standard.

18.2.4 524.2 Section 7.1 of the source method requires that the trap packing materials be Tenax GC, Methyl silicone, silica gel and coconut charcoal. TestAmerica routinely uses Supleco K trap

18.2.5 524.2 Section 7.8.2 of the source method requires that each calibration standard be prepared by diluting the appropriate volume of the working standard with organic-free water adjusted to pH < 2 in a volumetric flask. TestAmerica prepares calibration standards by diluting the appropriate volume of the working standard with organic-free water at neutral pH.

19.0 CHANGES FROM PREVIOUS REVISION

19.1 Section 9.1.5: Blank, LCS & MS/MSD must be run in same clock for non-medium level samples

19.2 Section 10.3.2: The number of calibration points required for curves is clarified

19.3 Section 10.3.6.6: notes added to address client requirements and y-intercept

19.4 Section 10.3.7.9.1: added six point requirement for all quadratic curves

19.5 Section 10.4.4.2: Added corrective action for ICV failure (use of third standard)

19.6 Section 10.3.7.9.3: added note addressing client specific requirements

19.7 Section 12.7.1.1: added CLP allowance for reporting data within 10% of upper standard without dilution

19.8 Table 2: added allowance of other published BFB Tune criteria (i.e. EPA CLP)

19.9 Added Attachment 1 – example page from VOA Medium Level Extraction log.

19.10 Revision 17:

19.10.1 Fixed grammatical errors throughout SOP

19.10.2 Updated section 9.1 regarding MS/MSD duplicates being performed for separate QC codes.

19.10.3 Updated section 10.5.7 regarding CCV criteria testing.

19.10.4 Removed section 10.5.8.3 regarding passing CCV percentage calibration points in the initial calibration curve.

19.10.5 Updated section 11.7 and 11.8 regarding volumes of medium level surrogate and medium level spike mix used.

19.11 Rev 18:

19.11.1 Added information for Select Ion Monitoring Procedure to Sections 2, 3 and Appendix 1

19.12 Rev 19:

19.12.1 Section 3, updated SIM definition

19.12.2 Clarified Section 9.3 stating that the LCS and CCV can be from the same source

19.12.3 References to QuantIMS and Clouseau were removed and replaced with “LIMS”

19.12.4 Section 12, updated Corp. SOP reference

19.12.5 Section 12.7.1.1: removed the CLP allowance for reporting data within 10% of upper standard without dilution

19.12.6 Section 13 was re-written to include specific corrective action scenarios.

19.12.7 Section 17, updated Corp. SOP reference

- 19.12.8 Formatting and grammatical corrections

19.13 Rev 20:

- 19.13.1 Section 6.10.5: indicated where instrument run conditions can be found
- 19.13.2 Section 7.4: Updated Standards Log to Reagents in TALS nomenclature
- 19.13.3 Section 10.3: updated analysis volumes used
- 19.13.4 Section 10.3: Added that non-linear regressions can be forced through origin
- 19.13.5 Section 10.3.8: Corrected RSD criteria for EPA 624 method
- 19.13.6 Section 11.1: Updated screening procedures.
- 19.13.7 Section 11.4: Added 25mL method
- 19.13.8 Section 11.5: Corrected various omissions from prep instructions
- 19.13.9 Section 18.2: referenced procedure for notification of client of deviation from EPA method.

19.14 Revsion 21 (9/18/14):

- 19.14.1 Section 10.3.7 updated to note that quadratic regression curves are not allowed for South Carolina compliance samples
- 19.14.2 Section 13.3 updated to note that marginal exceedances are not allowed for South Carolina compliance work

19.15 Revsion 22 (11/3/14)

- 19.15.1 SOP combined with ST-MS-0002SC to document all requirements for South Carolina DHEC work.
- 19.15.2 Added Appendix 2 to contain standard and reagent information.

19.16 Revision 23 (12/1/14)

- 19.16.1 re-worded Section 2.4 to include Scan mode for 1,4-dioxane
- 19.16.2 added column specifics to Section 6
- 19.16.3 added Ottawa sand to Sections 7 and 9
- 19.16.4 Update Section 10 to disallow the use of “Grand Mean” for South Carolina Compliance work
- 19.16.5 Update %D info in Section 10.5
- 19.16.6 Updated Section 13 to include the 70 – 130% LCS recovery required for South Carolina compliance work.
- 19.16.7 Added Appendices with standard prep and concentration information

Table 1
Internal Standards

	Standard Concentration µg/mL	Quantitation ion (5 mL purge)	Quantitation ion (25 mL purge)
Fluorobenzene	25	96	96
Chlorobenzene-d5	25	117	117
1,4-Dichlorobenzene-d4	25	152	152

Notes:

1) 10 µL of the internal standard is added to the sample. This results in a concentration of each internal in the sample of 50µg/L for a 5 mL purge or 10 µg/L for a 25 mL purge.
2) Surrogate and internal standards may be combined in one solution.

Surrogate and Spike concentrations are listed on the Structure and Analysis Codes, which are in the attachment to this SOP.

Table 2
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

- BFB tuning criteria for mass 75 are 30 – 80% of mass 95 for method 524.2
- Alternatively, other documented tuning criteria (e.g. EPA CLP) may be used provided method performance is not aversely affected

Table 3
Characteristic ions

Compound	Primary*	Secondary	Tertiary
1,2-Dichloroethane-d_4 (Surrogate)	67*	102*	65
Dichlorodifluoromethane	85	87	50, 101,103
Chloromethane	50	52	49
Vinyl chloride	62	64	61
Bromomethane	94	96	79
Chloroethane	64	66	49
Trichlorofluoromethane	101*	103*	66
1,1-Dichloroethene	96	61	63, 98
Acrolein	56	55	58

Characteristic ions

Compound	Primary*	Secondary	Tertiary
Iodomethane	142	127	141
Carbon disulfide	76	78	—
Trichlorotrifluoroethane	151	101	153
Acetone	58	43	—
Methylene chloride	84	86	49
tert-Butyl alcohol	59	74	—
trans-1,2-Dichloroethene	96	61	98
Acrylonitrile	53	52	51
Methyl *tert* butyl ether	73	57	—
Hexane	57	43	—
1,1-Dichloroethane	63	65	83
cis-1,2-Dichloroethene	96	61	98
2-Butanone	43*	72*	—
Tetrahydrofuran	71	42	72
Chloroform	83	85	47
1,2-Dichloroethane	62	98	64
Dibromomethane	93	95	172, 174, 176
1,4-Dioxane	88	58	43, 57
Vinyl acetate	43	86	—
1,1,1-Trichloroethane	97	99	117*
Carbon tetrachloride	117	119	121
Benzene	78	52	77
Trichloroethene	130*	95*	132
Methylcyclohexane	55	83	98
1,2-Dichloropropane	63	41*	—
Bromodichloromethane	83	85	129*
2-Chloroethyl vinyl ether	63	65	106
cis-1,3-Dichloropropene	75	77	39
trans-1,3-Dichloropropene	75	77	39
1,1,2-Trichloroethane	97*	83*	85
Chlorodibromomethane	129	127*	131*
Bromoform	173	171*	175*, 254
1,2,3-Trichloropropane	110*	77	75
Toluene-d_8 (Surrogate)	98	100	—
4-Bromofluorobenzene (Surrogate)	95	174	176
Toluene	91*	92*	65
4-Methyl-2-pentanone	43*	58*	85, 100
Tetrachloroethene	164	129	131, 166
Ethyl methacrylate	69	41	99, 86, 114
2-Hexanone	43	58	57, 100
Chlorobenzene	112	114	77

Characteristic ions

Compound	Primary*	Secondary	Tertiary
Ethylbenzene	91	106	—
Xylenes	106	91	—
Styrene	104	78	103
Dibromofluoromethane	113	111	192
Dichlorobenzene (all isomers)	146	111	148
trans 1,4-Dichloro-2-butene	53	88	75
1,1,2,2-Tetrachloroethane	83	85	131,133
Allyl Chloride	76	41	39, 78
Acetonitrile	41	40	39
Dichlorofluoromethane	67	69	—
Isopropyl ether	87	59	45
Chloroprene	53	88	90
n-Butanol	56	41	42, 43
Propionitrile	54	52	55
Methacrylonitrile	41	52	39
Isobutanol	43	42	74
Methyl methacrylate	41	69	39
1,1,1,2-Tetrachloroethane	131	133	119
1,2-Dibromo-3-chloropropane	157	155	75
Ethyl ether	59	74	—
Ethyl Acetate	43*	61*	88*
2-Nitropropane	46	43	—
Cyclohexanone	55	42	98
Isopropylbenzene	105	120	77
1,2-Dichlorobenzene	111	146	148
1,3-Dichlorobenzene	111	146	148
1,4-Dichlorobenzene	111	146	148
Nonanol	57	98	41
t-Butyl alcohol	59	41	—
1-Chlorohexane	91	55	43
Ethanol	45	46	—
TAME	73	87	43
ETBE	59	87	41
DIPE (Diisopropyl ether)	45	87	59
2,2-Dimethylpentane	45	46	—
2,4-Dimethylpentane	57	85	43
2,2,3-Trimethylbutane	57	43	85
3,3-Dimethylpentane	43	71	85
2-Methylhexane	43	57	85
2,3-Dimethylpentane	56	71	43
3-Methylhexane	43	57	71

Characteristic ions

Compound	Primary*	Secondary	Tertiary
3-Ethylpentane	43	71	55
Heptane	43	57	71
Dimethylsulfide	94	79	45
1,3,5-Trichlorbenzene	180	182	145

The primary ion should be used for quantitation unless interferences are present, in which case a secondary ion may be used.
*Primary/secondary and/or tertiary ions are switched from order in Method based on signal intensity and co-elutions.

TABLE 4

RECOMMENDED MINIMUM RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION VERIFICATION

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
meta-/para-Xylene	0.100
ortho-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

TestAmerica St. Louis has established a default minimum response factor of 0.01 for compounds not identified in this table, except for Acrolein, Acetonitrile, Isobutanol, Tetrahydrofuran, Propionitrile, n-butanol, 1,4-Dioxane, 2-chloroethyl vinyl ether, Cyclohexanone, nonanol (25 mL purge) and Acrolein, Acetonitrile, Tetrahydrofuran, Propionitrile, Isobutanoln-butanol, 1,4-Dioxane, Cyclohexanone (5 mL purge), which have a minimum response factor of 0.001.

Table 5
Assigned Surrogates/Internal Standards for Instruments using Instrument MSX

Compound	Assigned Surrogate	Assigned Internal Standard
Dichlorodifluoromethane	Dibromofluoromethane	Fluorobenzene
Freon-114	Dibromofluoromethane	Fluorobenzene
Chloromethane	Dibromofluoromethane	Fluorobenzene
Vinyl Chloride	Dibromofluoromethane	Fluorobenzene
Bromomethane	Dibromofluoromethane	Fluorobenzene
Chloroethane	Dibromofluoromethane	Fluorobenzene
Trichlorofluoromethane	Dibromofluoromethane	Fluorobenzene
Diethyl Ether	Dibromofluoromethane	Fluorobenzene
1,1,2-Trichlorofluoroethane	Dibromofluoromethane	Fluorobenzene
Acrolein	Dibromofluoromethane	Fluorobenzene
Acetone	Dibromofluoromethane	Fluorobenzene
1,1-Dichloroethene	Dibromofluoromethane	Fluorobenzene
Acetonitrile	Dibromofluoromethane	Fluorobenzene
Iodomethane	Dibromofluoromethane	Fluorobenzene
Methyl Acetate	Dibromofluoromethane	Fluorobenzene
Allyl chloride	Dibromofluoromethane	Fluorobenzene
Carbon Disulfide	Dibromofluoromethane	Fluorobenzene
Methylene Chloride	Dibromofluoromethane	Fluorobenzene
Acrylonitrile	Dibromofluoromethane	Fluorobenzene
MTBE	Dibromofluoromethane	Fluorobenzene
trans-1,2-Dichloroethene	Dibromofluoromethane	Fluorobenzene
n-Hexane	Dibromofluoromethane	Fluorobenzene
1,1-Dichloroethane	Dibromofluoromethane	Fluorobenzene
1,2-Dichloroethene (total)	Dibromofluoromethane	Fluorobenzene
Vinyl acetate	Dibromofluoromethane	Fluorobenzene
2-Chloro-1,3-butadiene	Dibromofluoromethane	Fluorobenzene
2-Butoxyethanol	Dibromofluoromethane	Fluorobenzene
2-Butanone	Dibromofluoromethane	Fluorobenzene
Propionitrile	Dibromofluoromethane	Fluorobenzene
2,2-Dichloropropane	Dibromofluoromethane	Fluorobenzene
cis-1,2-Dichloroethene	Dibromofluoromethane	Fluorobenzene
Isobutanol	Dibromofluoromethane	Fluorobenzene
Ethyl Acetate	Dibromofluoromethane	Fluorobenzene
Methacrylonitrile	Dibromofluoromethane	Fluorobenzene

Compound	Assigned Surrogate	Assigned Internal Standard
Chloroform	Dibromofluoromethane	Fluorobenzene
Bromochloromethane	Dibromofluoromethane	Fluorobenzene
Tetrahydrofuran	Dibromofluoromethane	Fluorobenzene
n-butanol	1,2-Dichloroethane-d4	Fluorobenzene
1,1,1-Trichloroethane	1,2-Dichloroethane-d4	Fluorobenzene
Cyclohexane	1,2-Dichloroethane-d4	Fluorobenzene
1,1-Dichloropropene	1,2-Dichloroethane-d4	Fluorobenzene
Carbon Tetrachloride	1,2-Dichloroethane-d4	Fluorobenzene
Heptane	1,2-Dichloroethane-d4	Fluorobenzene
Benzene	1,2-Dichloroethane-d4	Fluorobenzene
1,2-Dichloroethane	1,2-Dichloroethane-d4	Fluorobenzene
Trichloroethene	1,2-Dichloroethane-d4	Fluorobenzene
Methyl cyclohexane	1,2-Dichloroethane-d4	Fluorobenzene
1,2-Dichloropropane	1,2-Dichloroethane-d4	Fluorobenzene
Methyl methacrylate	1,2-Dichloroethane-d4	Fluorobenzene
Bromodichloromethane	1,2-Dichloroethane-d4	Fluorobenzene
Dibromomethane	1,2-Dichloroethane-d4	Fluorobenzene
1,4-Dioxane	1,2-Dichloroethane-d4	Fluorobenzene
4-Methyl-2-pentanone (MIBK)	1,2-Dichloroethane-d4	Fluorobenzene
2-Chloroethyl vinyl ether	1,2-Dichloroethane-d4	Fluorobenzene
Cis-1,3-Dichloropropene	1,2-Dichloroethane-d4	Fluorobenzene
Dimethyl disulfide	1,2-Dichloroethane-d4	Fluorobenzene
2-Nitropropane	1,2-Dichloroethane-d4	Fluorobenzene
Toluene	Toluene-d8	Chlorobenzene-d5
trans-1,3-Dichloropropene	Toluene-d8	Chlorobenzene-d5
Ethyl methacrylate	Toluene-d8	Chlorobenzene-d5
1,1,2-Trichloroethane	Toluene-d8	Chlorobenzene-d5
2-Hexanone	Toluene-d8	Chlorobenzene-d5
1,3-Dichloropropane	Toluene-d8	Chlorobenzene-d5
Tetrachloroethene	Toluene-d8	Chlorobenzene-d5
Chlorodibromomethane	Toluene-d8	Chlorobenzene-d5
1,2-Dibromoethane	Toluene-d8	Chlorobenzene-d5
Chlorobenzene	Toluene-d8	Chlorobenzene-d5
1,1,1,2-Tetrachloroethane	Toluene-d8	Chlorobenzene-d5
Ethylbenzene	Toluene-d8	Chlorobenzene-d5
m,p-Xylenes	Toluene-d8	Chlorobenzene-d5
o-Xylenes	Toluene-d8	Chlorobenzene-d5
Styrene	Toluene-d8	Chlorobenzene-d5
Bromoform	Toluene-d8	Chlorobenzene-d5
Isopropylbenzene	Toluene-d8	Chlorobenzene-d5

Compound	Assigned Surrogate	Assigned Internal Standard
Cyclohexanone	Toluene-d8	Chlorobenzene-d5
1,1,2,2-Tetrachloroethane	Toluene-d8	Chlorobenzene-d5
1,2,3-Trichloropropane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Bromobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
n-Propylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
trans-1,4-dichlorobenzene-2-butene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
2-Chlorotoluene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,3,5-Trimethylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
4-Chlorotoluene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
t-Butylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Pentachloroethane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,4-Trimethylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
sec-Butylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
4-Isopropyltoluene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,3-Dichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,4-Dichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
n-Butylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2-Dichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Nonanal	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2-Dibromo-3-chloropropane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,3,5-trichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,4-Trichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Hexachlorobutadiene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Naphthalene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,3-Trichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
4-Chlorophenyl methyl sulfide	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4

Assigned Surrogates/Internal Standards for Instruments using Instruments MSF, MSL, MSM, MSN, MSZ

Compound	Assigned Surrogate	Assigned Internal Standard
Dichlorodifluoromethane	Dibromofluoromethane	Fluorobenzene
Freon-114	Dibromofluoromethane	Fluorobenzene
Chloromethane	Dibromofluoromethane	Fluorobenzene
Vinyl Chloride	Dibromofluoromethane	Fluorobenzene
Bromomethane	Dibromofluoromethane	Fluorobenzene

Compound	Assigned Surrogate	Assigned Internal Standard
Chloroethane	Dibromofluoromethane	Fluorobenzene
Trichlorofluoromethane	Dibromofluoromethane	Fluorobenzene
Diethyl Ether	Dibromofluoromethane	Fluorobenzene
1,1-Dichloroethene	Dibromofluoromethane	Fluorobenzene
1,1,2-Trichlorofluoroethane	Dibromofluoromethane	Fluorobenzene
Carbon Disulfide	Dibromofluoromethane	Fluorobenzene
Iodomethane	Dibromofluoromethane	Fluorobenzene
Acrolein	Dibromofluoromethane	Fluorobenzene
Allyl chloride	Dibromofluoromethane	Fluorobenzene
Methylene Chloride	Dibromofluoromethane	Fluorobenzene
Acetone	Dibromofluoromethane	Fluorobenzene
Methyl Acetate	Dibromofluoromethane	Fluorobenzene
trans-1,2-Dichloroethene	Dibromofluoromethane	Fluorobenzene
n-Hexane	Dibromofluoromethane	Fluorobenzene
Acetonitrile	Dibromofluoromethane	Fluorobenzene
MTBE	Dibromofluoromethane	Fluorobenzene
2-Chloro-1,3-butadiene	Dibromofluoromethane	Fluorobenzene
1,1-Dichloroethane	Dibromofluoromethane	Fluorobenzene
1,2-Dichloroethene (total)	Dibromofluoromethane	Fluorobenzene
Acrylonitrile	Dibromofluoromethane	Fluorobenzene
Vinyl acetate	Dibromofluoromethane	Fluorobenzene
cis-1,2-Dichloroethene	Dibromofluoromethane	Fluorobenzene
2,2-Dichloropropane	Dibromofluoromethane	Fluorobenzene
Bromochloromethane	Dibromofluoromethane	Fluorobenzene
2-Butoxyethanol	Dibromofluoromethane	Fluorobenzene
Cyclohexane	Dibromofluoromethane	Fluorobenzene
Chloroform	Dibromofluoromethane	Fluorobenzene
t-Butyl Alcohol	Dibromofluoromethane	Fluorobenzene
Diisopropyl Ether	Dibromofluoromethane	Fluorobenzene
ETBE	Dibromofluoromethane	Fluorobenzene
Ethanol	Dibromofluoromethane	Fluorobenzene
2,2-Dimethylpentane	Dibromofluoromethane	Fluorobenzene
2,4-Dimethylpentane	Dibromofluoromethane	Fluorobenzene
2,2,3-Trimethylbutane	Dibromofluoromethane	Fluorobenzene
3,3-Dimethylpentane	Dibromofluoromethane	Fluorobenzene
Ethyl Acetate	Dibromofluoromethane	Fluorobenzene
Carbon Tetrachloride	Dibromofluoromethane	Fluorobenzene
Tetrahydrofuran	Dibromofluoromethane	Fluorobenzene
1,1,1-Trichloroethane	1,2-Dichloroethane-d4	Fluorobenzene

Compound	Assigned Surrogate	Assigned Internal Standard
2-Butanone	1,2-Dichloroethane-d4	Fluorobenzene
1,1-Dichloropropene	1,2-Dichloroethane-d4	Fluorobenzene
Heptane	1,2-Dichloroethane-d4	Fluorobenzene
Benzene	1,2-Dichloroethane-d4	Fluorobenzene
Propionitrile	1,2-Dichloroethane-d4	Fluorobenzene
Methacrylonitrile	1,2-Dichloroethane-d4	Fluorobenzene
Isobutanol	1,2-Dichloroethane-d4	Fluorobenzene
1,2-Dichloroethane	1,2-Dichloroethane-d4	Fluorobenzene
Trichloroethene	1,2-Dichloroethane-d4	Fluorobenzene
Methyl cyclohexane	1,2-Dichloroethane-d4	Fluorobenzene
n-butanol	1,2-Dichloroethane-d4	Fluorobenzene
Dibromomethane	1,2-Dichloroethane-d4	Fluorobenzene
1,2-Dichloropropane	1,2-Dichloroethane-d4	Fluorobenzene
Bromodichloromethane	1,2-Dichloroethane-d4	Fluorobenzene
Methyl methacrylate	1,2-Dichloroethane-d4	Fluorobenzene
1,4-Dioxane	1,2-Dichloroethane-d4	Fluorobenzene
Cis-1,3-Dichloropropene	1,2-Dichloroethane-d4	Fluorobenzene
2-Chloroethylvinyl ether	1,2-Dichloroethane-d4	Fluorobenzene
TAME	1,2-Dichloroethane-d4	Fluorobenzene
2-Methylhexane	1,2-Dichloroethane-d4	Fluorobenzene
2,3-Dimethylpentane	1,2-Dichloroethane-d4	Fluorobenzene
3-Methylhexane	1,2-Dichloroethane-d4	Fluorobenzene
3-Ethypentane	1,2-Dichloroethane-d4	Fluorobenzene
Heptane	1,2-Dichloroethane-d4	Fluorobenzene
Toluene	Toluene-d8	Chlorobenzene-d5
Dimethyl Disulfide	Toluene-d8	Chlorobenzene-d5
2-Nitropropane	Toluene-d8	Chlorobenzene-d5
4-Methyl-2-pentanone (MEK)	Toluene-d8	Chlorobenzene-d5
trans-1,3-Dichloropropene	Toluene-d8	Chlorobenzene-d5
Tetrachloroethene	Toluene-d8	Chlorobenzene-d5
Ethyl methacrylate	Toluene-d8	Chlorobenzene-d5
1,1,2-Trichloroethane	Toluene-d8	Chlorobenzene-d5
Chlorodibromomethane	Toluene-d8	Chlorobenzene-d5
1,3-Dichloropropane	Toluene-d8	Chlorobenzene-d5
1,2-Dibromoethane	Toluene-d8	Chlorobenzene-d5
2-Hexanone	Toluene-d8	Chlorobenzene-d5
Ethylbenzene	Toluene-d8	Chlorobenzene-d5
Chlorobenzene	Toluene-d8	Chlorobenzene-d5
1,1,1,2-Tetrachloroethane	Toluene-d8	Chlorobenzene-d5

Compound	Assigned Surrogate	Assigned Internal Standard
m,p-Xylenes	Toluene-d8	Chlorobenzene-d5
o-Xylenes	Toluene-d8	Chlorobenzene-d5
Styrene	Toluene-d8	Chlorobenzene-d5
1-Chlorohexane	Toluene-d8	Chlorobenzene-d5
Bromoform	Toluene-d8	1,4-Dichlorobenzene-d4
Isopropylbenzene	Toluene-d8	1,4-Dichlorobenzene-d4
n-Propylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,1,2,2-Tetrachloroethane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Bromobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,3,5-Trimethylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
2-Chlorotoluene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
trans-1,4-dichlorobenzene-2-butene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,3-Trichloropropane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
4-Chlorotoluene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Cyclohexanone	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
t-Butylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,4-Trimethylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Pentachloroethane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
sec-Butylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
4-Isopropyltoluene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,3-Dichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,4-Dichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
n-Butylbenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2-Dichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,3,5-trichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2-Dibromo-3-chloropropane	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Hexachlorobutadiene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,4-Trichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
Naphthalene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
1,2,3-Trichlorobenzene	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4
4-Chlorophenyl methyl sulfide	4-Bromofluorobenzene	1,4-Dichlorobenzene-d4

Attachment 1
Medium Level Soil Extraction Log

Analyst: ______________________ Extraction Date: ____________________

Methanol Lot ID: __________________ Batch # _________________________

Balance ID: ___________________________

The final volume of all extracts is 5 mL of methanol.
All weights are expressed in grams.

Sample ID	Sample Weight	Methanol volume	Sample spiked	Spike verification

QC Standards: LCS/MS/MSD________________________

Surrogate___________________________

Appendix 1

1,4-Dioxane 8260B and 8260C SIM Method

Standards

Internal Standard Working Mix	1,4-Dioxane-d8	50 ppm
Calibration Standard Working Mix	1,4-Dioxane	50 ppm
8260 IS Working Mix	8260 IS	1 ppm

Calibration Table

Level	1,4-Diox. Mix in 5ml	1,4-Diox. Mix in 20ml	d8-1,4-Diox in 20ml	8260 IS Mix in 20ml
5 ppb	0.5 µL	2µL	40 µL	10 µL
10 ppb	1.0 µL	4µL	40 µL	10 µL
20 ppb	2.0 µL	8µL	40 µL	10 µL
50 ppb	5.0 µL	20µL	40 µL	10 µL
100 ppb	10 µL	40 µL	40 µL	10 µL
200 ppb	20 µL	80 µL	40 µL	10 µL

d8-1,4-Dioxane IS concentration in sample	100 ppb
1,4-Dioxane ICV/LCS/MS/MSD concentration	20 ppb
8260 IS concentration in samples	0.5 ppb

Need MDL verification after BFB of each clock 2 ppb (based on current MDL 0.74 ppb)

Spike d8-1,4-Dioxane **and** 8260 IS in all analyses

GC/MS Method – 8260SIM Concentrator Method – 8260SIM

APPENDIX 2

Standards Prep information:

WM=Working Mix (single mix of all calibrated analytes at concentration levels as indicated in Appendix 3

Surr=Surrogate mix (single mix of all applicable surrogates at concentration levels as indicated in Appendix 3

8260 (B & C) - all matrices)

All calibration levels are calculated from 5mL of the appropriate matrix. All calibration levels are spiked with 50ug/L Internal Standard mix.

Level 1: 0.2uL WM and 0.2uL Surr

Level 2: 0.5uL WM and 0.5uL Surr

Level 3: 1uL WM and 1uL Surr

Level 4: 2uL WM and 2uL Surr

Level 5: 4uL WM and 4uL Surr

Level 6: 10uL WM and 10uL Surr

Level 7: 20uL WM and 20uL Surr

Level 8: 40uL WM and 40uL Surr

8260 (B & C) Low Level

All calibration levels are calculated from 25mL of water. All calibration levels are spiked with 10ug/L Internal Standard mix.

Level 1: 0.5uL WM and 0.5uL Surr

Level 2: 1uL WM and 1uL Surr

Level 3: 2uL WM and 2uL Surr

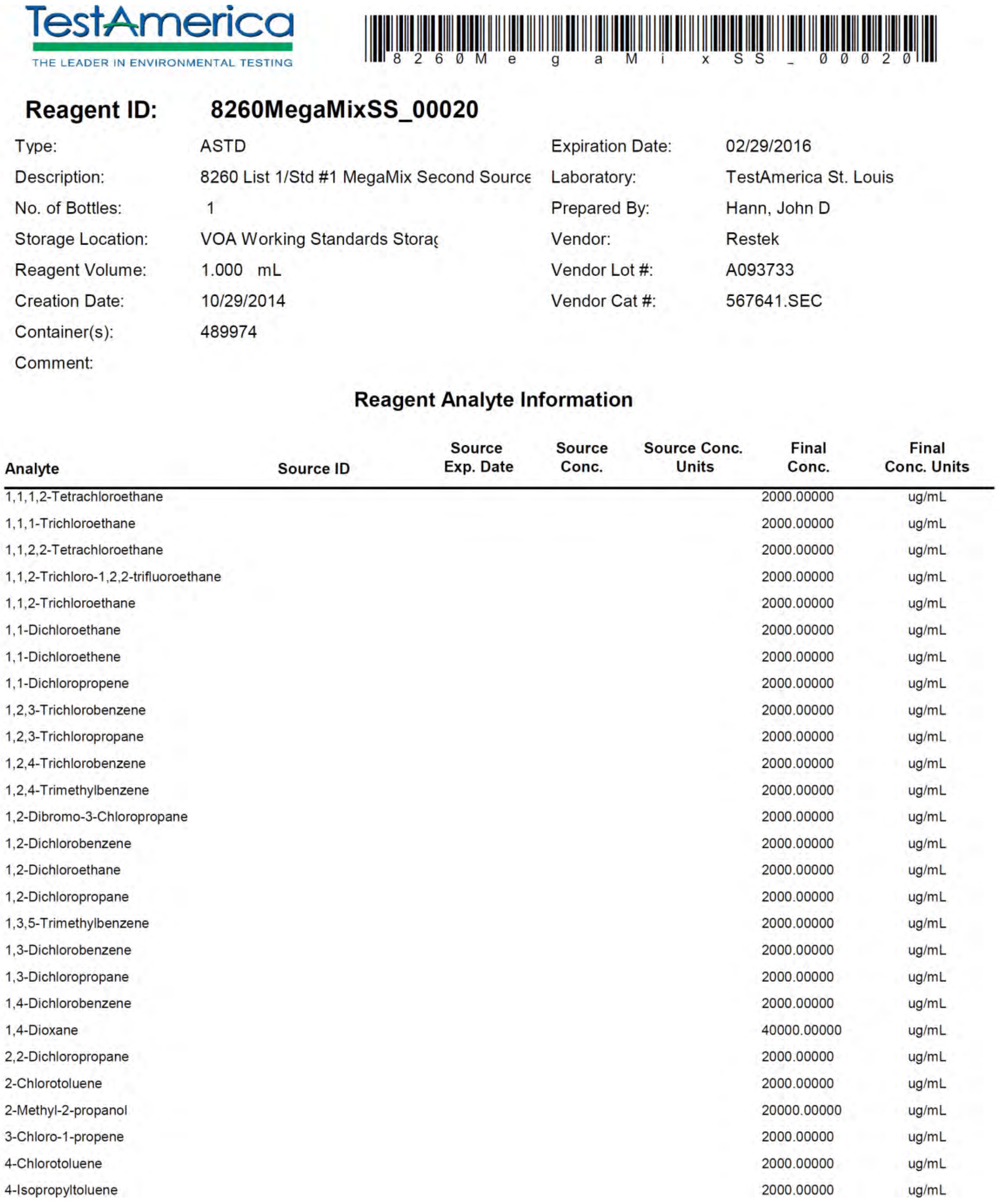
Level 4: 4uL WM and 4uL Surr

Level 5: 10uL WM and 10uL Surr

Level 6: 20uL WM and 20uL Surr

Level 7: 40uL WM and 40uL Surr

APPENDIX 3



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Reagent ID: **8260MegaMixSS_00020**

Type:	ASTD	Expiration Date:	02/29/2016
Description:	8260 List 1/Std #1 MegaMix Second Sourc	Laboratory:	TestAmerica St. Louis
No. of Bottles:	1	Prepared By:	Hann, John D
Storage Location:	VOA Working Standards Stora	Vendor:	Restek
Reagent Volume:	1.000 mL	Vendor Lot #:	A093733
Creation Date:	10/29/2014	Vendor Cat #:	567641.SEC
Container(s):	489974		
Comment:			

Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
1,1,1,2-Tetrachloroethane					2000.00000	ug/mL
1,1,1-Trichloroethane					2000.00000	ug/mL
1,1,2,2-Tetrachloroethane					2000.00000	ug/mL
1,1,2-Trichloro-1,2,2-trifluoroethane					2000.00000	ug/mL
1,1,2-Trichloroethane					2000.00000	ug/mL
1,1-Dichloroethane					2000.00000	ug/mL
1,1-Dichloroethene					2000.00000	ug/mL
1,1-Dichloropropene					2000.00000	ug/mL
1,2,3-Trichlorobenzene					2000.00000	ug/mL
1,2,3-Trichloropropane					2000.00000	ug/mL
1,2,4-Trichlorobenzene					2000.00000	ug/mL
1,2,4-Trimethylbenzene					2000.00000	ug/mL
1,2-Dibromo-3-Chloropropane					2000.00000	ug/mL
1,2-Dichlorobenzene					2000.00000	ug/mL
1,2-Dichloroethane					2000.00000	ug/mL
1,2-Dichloropropane					2000.00000	ug/mL
1,3,5-Trimethylbenzene					2000.00000	ug/mL
1,3-Dichlorobenzene					2000.00000	ug/mL
1,3-Dichloropropane					2000.00000	ug/mL
1,4-Dichlorobenzene					2000.00000	ug/mL
1,4-Dioxane					40000.00000	ug/mL
2,2-Dichloropropane					2000.00000	ug/mL
2-Chlorotoluene					2000.00000	ug/mL
2-Methyl-2-propanol					20000.00000	ug/mL
3-Chloro-1-propene					2000.00000	ug/mL
4-Chlorotoluene					2000.00000	ug/mL
4-Isopropyltoluene					2000.00000	ug/mL

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

8260MegaMixSS_00020

Reagent ID: 8260MegaMixSS_00020

Type:	ASTD	Expiration Date:	02/29/2016
Description:	8260 List 1/Std #1 MegaMix Second Source	Laboratory:	TestAmerica St. Louis
No. of Bottles:	1	Prepared By:	Hann, John D
Storage Location:	VOA Working Standards Storag	Vendor:	Restek
Reagent Volume:	1.000 mL	Vendor Lot #:	A093733
Creation Date:	10/29/2014	Vendor Cat #:	567641.SEC
Container(s):	489974		
Comment:			

Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
Acrylonitrile					20000.00000	ug/mL
Benzene					2000.00000	ug/mL
Bromobenzene					2000.00000	ug/mL
Bromoform					2000.00000	ug/mL
Carbon disulfide					2000.00000	ug/mL
Carbon tetrachloride					2000.00000	ug/mL
Chlorobenzene					2000.00000	ug/mL
Chlorobromomethane					2000.00000	ug/mL
Chlorodibromomethane					2000.00000	ug/mL
Chloroform					2000.00000	ug/mL
cis-1,2-Dichloroethene					2000.00000	ug/mL
cis-1,3-Dichloropropene					2000.00000	ug/mL
Cyclohexane					2000.00000	ug/mL
Dibromomethane					2000.00000	ug/mL
Dichlorobromomethane					2000.00000	ug/mL
Ethyl ether					2000.00000	ug/mL
Ethyl methacrylate					2000.00000	ug/mL
Ethylbenzene					2000.00000	ug/mL
Ethylene Dibromide					2000.00000	ug/mL
Hexachlorobutadiene					2000.00000	ug/mL
Hexane					2000.00000	ug/mL
Iodomethane					2000.00000	ug/mL
Isobutyl alcohol					50000.00000	ug/mL
Isopropylbenzene					2000.00000	ug/mL
Methyl acetate					10000.00000	ug/mL
Methyl tert-butyl ether					2000.00000	ug/mL
Methylcyclohexane					2000.00000	ug/mL

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

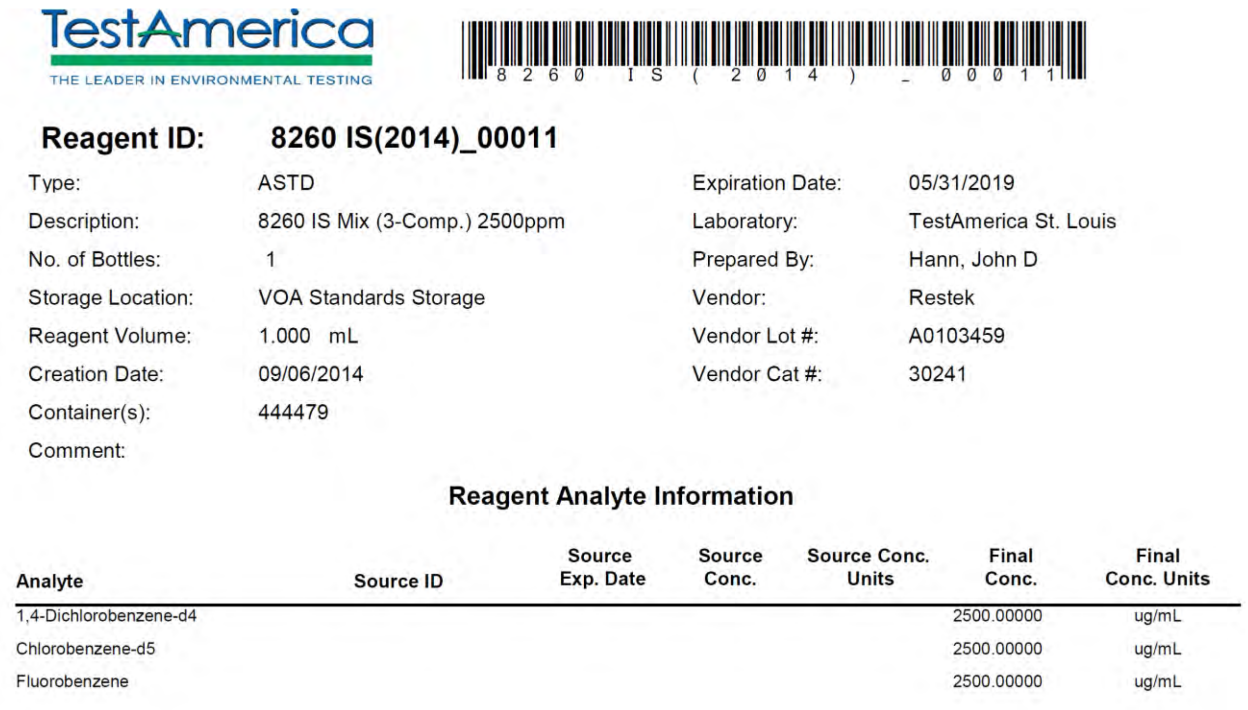
8260MegaMixSS_00020

Reagent ID: **8260MegaMixSS_00020**

Type:	ASTD	Expiration Date:	02/29/2016
Description:	8260 List 1/Std #1 MegaMix Second Source	Laboratory:	TestAmerica St. Louis
No. of Bottles:	1	Prepared By:	Hann, John D
Storage Location:	VOA Working Standards Storag	Vendor:	Restek
Reagent Volume:	1.000 mL	Vendor Lot #:	A093733
Creation Date:	10/29/2014	Vendor Cat #:	567641.SEC
Container(s):	489974		
Comment:			

Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
Methylene Chloride					2000.00000	ug/mL
m-Xylene & p-Xylene					2000.00000	ug/mL
Naphthalene					2000.00000	ug/mL
n-Butylbenzene					2000.00000	ug/mL
n-Heptane					2000.00000	ug/mL
N-Propylbenzene					2000.00000	ug/mL
o-Xylene					2000.00000	ug/mL
sec-Butylbenzene					2000.00000	ug/mL
Styrene					2000.00000	ug/mL
tert-Butylbenzene					2000.00000	ug/mL
Tetrachloroethene					2000.00000	ug/mL
Tetrahydrofuran					4000.00000	ug/mL
Toluene					2000.00000	ug/mL
trans-1,2-Dichloroethene					2000.00000	ug/mL
trans-1,3-Dichloropropene					2000.00000	ug/mL
trans-1,4-Dichloro-2-butene					2000.00000	ug/mL
Trichloroethene					2000.00000	ug/mL



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

8260 IS(2014)_00011

Reagent ID: 8260 IS(2014)_00011

Type:	ASTD	Expiration Date:	05/31/2019
Description:	8260 IS Mix (3-Comp.) 2500ppm	Laboratory:	TestAmerica St. Louis
No. of Bottles:	1	Prepared By:	Hann, John D
Storage Location:	VOA Standards Storage	Vendor:	Restek
Reagent Volume:	1.000 mL	Vendor Lot #:	A0103459
Creation Date:	09/06/2014	Vendor Cat #:	30241
Container(s):	444479		
Comment:			

Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
1,4-Dichlorobenzene-d4					2500.00000	ug/mL
Chlorobenzene-d5					2500.00000	ug/mL
Fluorobenzene					2500.00000	ug/mL

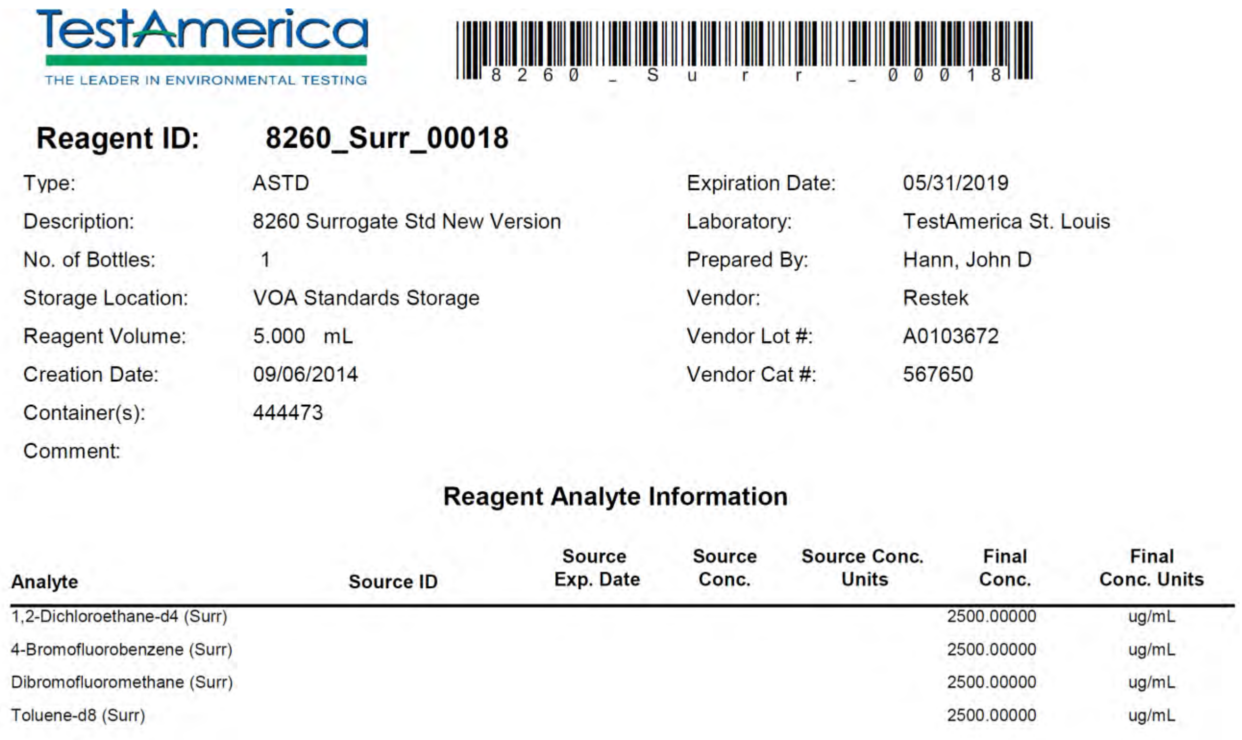
TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Reagent ID: **8260Gases_00078**

Type:	ASTD	Expiration Date:	09/30/2016
Description:	8260 List 1/Std #3 Gases	Laboratory:	TestAmerica St. Louis
No. of Bottles:	1	Prepared By:	Hann, John D
Storage Location:	VOA Working Standards Storag	Vendor:	Restek
Reagent Volume:	1.000 mL	Vendor Lot #:	A0105755
Creation Date:	10/30/2014	Vendor Cat #:	567645
Container(s):	489981		
Comment:			

Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
Bromomethane					2000.00000	ug/mL
Butadiene					2000.00000	ug/mL
Chloroethane					2000.00000	ug/mL
Chloromethane					2000.00000	ug/mL
Dichlorodifluoromethane					2000.00000	ug/mL
Dichlorofluoromethane					2000.00000	ug/mL
Trichlorofluoromethane					2000.00000	ug/mL
Vinyl chloride					2000.00000	ug/mL



TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

8260_Surr_00018

Reagent ID: 8260_Surr_00018

Type:	ASTD	Expiration Date:	05/31/2019
Description:	8260 Surrogate Std New Version	Laboratory:	TestAmerica St. Louis
No. of Bottles:	1	Prepared By:	Hann, John D
Storage Location:	VOA Standards Storage	Vendor:	Restek
Reagent Volume:	5.000 mL	Vendor Lot #:	A0103672
Creation Date:	09/06/2014	Vendor Cat #:	567650
Container(s):	444473		
Comment:			

Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
1,2-Dichloroethane-d4 (Surr)					2500.00000	ug/mL
4-Bromofluorobenzene (Surr)					2500.00000	ug/mL
Dibromofluoromethane (Surr)					2500.00000	ug/mL
Toluene-d8 (Surr)					2500.00000	ug/mL

Title: TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) SYNTHETIC PRECIPITATION LEACHING PROCEDURE (SPLP) AND THE CALIFORNIA WET LEACH PROCEDURE (CWET)

Approvals (Signature/Date):

6/4/15
Mark Minier — Date
Pre-prep Lead

6/4/15
Michael Ridenhower — Date
Health & Safety Manager / Coordinator

Marti Ward 6 4.15
Marti Ward — Date
Quality Assurance Manager

Elaine Wild 6/4/15
Elaine Wild — Date
Laboratory Director

This SOP was previously identified as SOP No. ST-OP-0009 Rev. 4

Facility Distribution No.: 0 **Distributed To:** See Electronic Distribution Sheet

1.0 SCOPE AND APPLICATION

1.1 This SOP describes the application of the Toxicity Characteristic Leaching Procedure (TCLP), SW-846 Method 1311.

1.1.1 The Toxicity Characteristic (TC) of a waste material is established by determining the levels of 8 metals and 31 organic chemicals in the aqueous leachate of a waste. The TC is one of four criteria in 40 CFR Part 261 to determine whether a solid waste is classified as a hazardous waste. The other three are corrosivity, reactivity and ignitability. The TC Rule utilizes the TCLP method to generate the leachate under controlled conditions which were designed to simulate leaching through a landfill. EPA's "worst case" waste disposal model assumes mismanaged wastes will be exposed to leaching by the acidic fluids generated in municipal landfills. The EPA's model also assumes the acid/base characteristics of the waste will be dominated by the landfill fluids. The TCLP procedure directs the testing laboratory to use a more acidic leaching fluid if the sample is an alkaline waste, again in keeping with the model's assumption that the acid fluids will dominate leaching chemistry over time.

1.2 This SOP also describes the application of the Synthetic Precipitation Leaching Procedure (SPLP) which was designed to simulate the leaching that would occur if a waste was disposed in a landfill and exposed only to percolating rain water. The procedure is based on SW846 Method 1312.

1.2.1 The list of analytes for SPLP may extend beyond the toxicity characteristic compounds shown in Appendix A. With the exception of the use of a modified extraction fluid, the SPLP and TCLP protocols are essentially equivalent. Where slight differences may exist between the SPLP and TCLP they are distinguished within this SOP.

1.3 This SOP describes the procedure for obtaining a leachate of solid, liquid, or multiphasic samples, as provided by the California Title 22, Waste Extraction Test (WET).

1.3.1 The leachate procedure is intended to determine the mobility of both organic and inorganic analytes. However, this SOP covers only the application of this procedure for inorganic analytes.

1.4 Results obtained are highly dependent on the pH of the extracting solution, the length of time that the sample is exposed to the extracting solution, the temperature during extraction, and the particle size/surface area of the sample. These parameters must be carefully controlled.

1.5 The laboratory target analytes supported by this method, the reporting limits, method detection limits and QC limits are maintained in the Laboratory Information Management System (LIMS).

2.0 SUMMARY OF METHOD

2.1 For liquid wastes that contain less than 0.5% dry solid material, the waste, after filtration through 0.6 to 0.8 µm glass fiber filter, is defined as the TCLP leachate.

2.2 For wastes containing greater than or equal to 0.5% solids, the liquid, if any, is separated from the solids and stored for later analysis. The particle size of the remaining solid phase is reduced, if necessary. The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. For TCLP, the extraction fluid employed for extraction of non-volatile analytes is a function of the alkalinity of the solid phase of the waste. For SPLP, the extraction fluid employed is a function of the region of the country where the sample site is located if the sample is a soil. If the sample is a waste or wastewater the extraction fluid employed is a pH 4.2 solution. Two leachates may be generated: a) one for analysis of non-volatile constituents (semi-volatile organics, pesticides, herbicides and metals and/or b) one from a Zero Headspace Extractor (ZHE) for analysis of volatile organic constituents. Following extraction, the liquid leachate is separated from the solid phase by filtration through a 0.6 to 0.8 µm fiber filter.

2.3 If compatible (i.e., multiple phases will not form on combination), the initial liquid phase of the waste is added to the liquid leachate and these are prepared and analyzed together. If incompatible, the liquids are analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration.

3.0 DEFINITIONS

3.1 See the TestAmerica St. Louis Quality Assurance Manual (QAM) a glossary of common laboratory terms and data reporting qualifiers.

3.2 "Leachate" is used to refer to the TCLP solution generated from this procedure.

3.3 "Percent Wet Solids" is that fraction of a waste sample (as a percentage of the total sample) from which no liquid may be forced out by an applied pressure.

4.0 INTERFERENCES

4.1 Oily wastes may present unusual filtration and drying problems. As recommended by EPA (see Figure 3), oily wastes that are unfilterable will be assumed to be 100% liquid and *with client approval* the laboratory will perform a total constituent analysis in lieu of the TCLP extraction. Note that per Section 1.2 of method 1311 the results of the total analysis may be divided by 20 to convert the total results into the "maximum leachable concentration." This applies specifically to samples containing viscous non-aqueous liquids that would be difficult to filter.

NOTE: Discussion with client regarding the substitution of total analysis for TCLP and the conversion factor of 20 to determine "maximum leachable concentration" must be documented and included in the job's Case Narrative.

If total analysis is performed, a density measurement is needed in order to convert results from a weight basis (mg/Kg) to a volume basis (mg/L) in order to compare results to the limits that are expressed in mg/L. The laboratory should explain to the client that the total results divided by 20 represent the "maximum leachable concentration," and those are the values that should be compared to the Toxicity Characteristic Limits.

4.2 Wastes containing free organic liquids (i.e., those with separable non-aqueous liquid phases) will be assumed to be 100% liquid and totals analysis will be performed to determine if the oil exceeds TCLP limits.

4.3 Solvents, reagents, glassware and other sample processing hardware may yield artifacts and/or interferences to sample analysis. All these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing method blanks.

4.4 Glassware and equipment contamination may result in analyte degradation. Soap residue on glassware and equipment may contribute to this. All glassware and equipment should be rinsed very carefully to avoid this problem.

4.5 Phthalates may be eliminated by proper glassware cleanup and by avoiding plastics. Only glass, Teflon or Type 316 stainless steel tumblers may be used for leachates to be analyzed for organics. Plastic tumblers may be used for leachates to be analyzed for the metals.

4.6 Overexposure of the sample to the environment will result in the loss of volatile components.

4.7 Glass fiber filters must be pre-cleaned with 1:1 nitric acid before use with leachates to be analyzed for the metals.

5.0 SAFETY

5.1 Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001), Radiation Safety Manual 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.

5.1 SPECIFIC SAFETY CONCERNS OR REQUIREMENTS

5.1.1 None.

5.2 PRIMARY MATERIALS USED

5.2.1 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 MSDS 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 MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	**Hazards**	**Exposure Limit (2)**	**Signs and symptoms of exposure**
Acetic Acid	Corrosive Poison Flammable	10 ppm (TWA)	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
Hydrochloric Acid	Corrosive Poison	5 ppm (Ceiling)	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Nitric Acid	Corrosive Oxidizer Poison	2 ppm (TWA) 4 ppm (STEL)	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.

Sodium Hydroxide	Corrosive	2 Mg/M3 (Ceiling)	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			
STEL – Short Term Exposure Limit			
TWA – Time Weighted Average			
Ceiling – At no time should this limit be exceeded.			

6.0 EQUIPMENT AND SUPPLIES

6.1 Extraction vessels

6.1.1 For volatile analytes - zero-headspace extraction (ZHE) vessel, gas-pressure actuated, Millipore YT3009OHW or equivalent (see Figure 2).

6.1.1.1 ZHE Cleaning Procedure

6.1.1.1.1 Clean all parts, thoroughly, in warm, soap water using a brush and/or steel wool. Rinse completely with tap water followed by DI water. Set aside any plastic parts.

6.1.1.1.2 If the ZHE is suspected to be highly contaminated based on visual examination, screening information and/or technical judgment, proceed with these additional steps.

6.1.1.1.2.1 Completely disassemble the ZHE including all valves, pressure gauge and Teflon tape.

6.1.1.1.2.2 Place all stainless steel parts in a 200°C oven for 3 hours, minimum.

6.1.1.1.2.3 Remove parts from oven and allow to air cool for 1 hour, minimum, and rinse with DI water.

6.1.1.1.2.4 Reassemble using new O-rings and Teflon tape.

6.1.1.2 ZHE Leak Testing

6.1.1.2.1 The ZHE should be checked for leaks after every extraction.

6.1.1.2.1.1 If device has a built in pressure gauge, pressurize the device to 50 psi and allow to stand for one hour. Recheck the pressure.

6.1.1.2.1.2 If the device does not have a built in guage, pressurize to 50 psi and submerge in water. Check for the presence of escaping air bubbles.

6.1.1.2.1.3 If pressure is lost, check all fittings and inspect or replace O-rings as needed.

6.1.1.2.1.4 Re-test the device.

6.1.2 For metals - 2 L HDPE (Nalgene or equivalent) bottles may be used.

6.2 Vacuum filtration apparatus

6.2.1 Cleaning procedure

6.2.1.1 Clean all parts, thoroughly, in warm, soap water using a brush. Rinse completely with tap water followed by DI water.

6.3 Borosilicate glass fiber filters, 0.6 - 0.8 µm (Whatman GF/F 14.2 cm, 0.7 µm or equivalent). When analyzing for metals, wash the filters with 1 N nitric acid and de-ionized water prior to use, or purchase filters that are pre-washed with acid. Glass fiber filters are fragile and should be handled with care.

6.4 Rotary agitation apparatus, multiple-vessel, Associated Design and Manufacturing Company 3740-6 or equivalent (see Figure 1). The apparatus must be capable of rotating the extraction vessel in an end-over-end fashion at 30 ± 2 rpm.

6.5 ZHE Extract Collection Devices are used to collect the initial liquid phase and the final extract of the waste from the ZHE device, either of the following may be used:
6.5.1 Gas-tight syringes, 25 mL, Hamilton 0158330 or equivalent, or Tedlar bags

6.6 Top loading balance (all measurements are to be within ± 0.1 grams).

6.7 pH meter and probe capable of reading to the nearest 0.01 unit, and with automatic temperature compensation; pH strips

6.8 Magnetic stirrer/hotplate and 1.5 inch magnetic stirring bars.

6.9 VOA vials, 20 mL, with caps and septa, prepreserved with 0.5ml HCl

6.10 HDPE plastic bottles, 2 liter.

6.11 Glass fiber filters (pre-filters), acid washed with 1:1 nitric, then rinsed with copious amounts of deionized water.

6.12 Sieve, No. 10

6.13 Aluminum Weigh Dishes (200g)

7.0 REAGENTS AND STANDARDS

7.1 All standards and reagent preparation, documentation and labeling must follow the requirements of SOP ST-QA-0002, current revision.

7.2 Reagent water for non-volatile constituents must be produced by a Millipore DI system or equivalent. For volatile constituents, water must be passed through an activated carbon filter bed (Milli-Q or tap water passed through activated carbon). Reagent water must be free of the analytes of interest as demonstrated through the analysis of method blanks.

7.3 Hydrochloric acid, 1 N: Carefully add 83 mL concentrated reagent grade HCl to 800 mL reagent water, cool and dilute to 1 liter with reagent water. Cap and shake to mix well.

7.4 Nitric acid, 1 N: Carefully add 64 mL concentrated reagent grade HNO_3 to 800 mL of reagent water, cool and dilute to 1 liter with reagent water. Cap and shake to mix well.

7.5 Sodium hydroxide, 5N and 10 N

7.6 Acetic acid, glacial: concentrated, reagent grade liquid (HOAc).

7.7 pH calibration solutions: buffered to a pH of 2, 4, 7, and 10. Commercially available.

7.8 Citric acid, anhydrous, ACS reagent grade

7.9 TCLP Leaching Fluids

7.9.1 The pH of both solutions listed below shall be monitored daily and the pH probes are to be calibrated on a daily basis.

7.9.1.1 The leaching fluids MUST be prepared carefully. If the desired pH range is not achieved and maintained, the TCLP may yield erroneous results due to improper leaching. If the pH is not within the specifications, the fluid must be discarded and fresh extraction fluid prepared.

7.9.1.2 Additional volumes of extraction fluids listed above may be prepared by multiplying the amounts of acetic acid and NaOH by the number of liters of extraction fluid required.

7.9.2 TCLP Fluid #1: Carefully add 250 mL glacial acetic acid and 290 mL of 10 N NaOH to 45 L reagent water in a 45 liter carboy. Cap and shake to mix well. The pH of this solution is 4.93 ± 0.05.

7.9.2.1 Alternatively, add 11 mL of acetic acid and 26.8 mL of 5N NaOH to 2000 g of reagent water.

7.9.2.1.1 Fill the extraction vessel to approximately 1900 g of reagent water, add 26.8 mL 5N NaOH and 11 mL of acetic acid then bring to a 2000 g final weight with reagent water.

7.9.3 TCLP Fluid #2: Carefully add 250 mL glacial acetic acid to 45 L reagent water in a 45 liter carboy. Cap and shake to mix well. The pH of this solution is 2.88 ± 0.05.

7.9.3.1 Alternatively, add 11 mL acetic acid to 2 L reagent water.

7.9.3.1.1 Fill the extraction vessel to approximately 1900 g of reagent water, add 11 mL of acetic acid then bring to a 2000 g final weight with reagent water.

7.10 Nitric acid, 50% solution: Slowly and carefully add 500 mL concentrated HNO_3 to 500 mL reagent water. Cap and shake to mix well.

7.11 Sulfuric acid / nitric acid (60/40 weight percent mixture) H_2SO_4/HNO_3. Cautiously mix 60 g of concentrated sulfuric acid with 40 g of concentrated nitric acid. A more dilute acid mixture may be prepared, if desired. (1000X dilution is recommended)

7.12 SPLP Leaching fluids

7.12.1 SPLP solutions are unbuffered and exact pH may not be attained. The pH of TCLP and SPLP fluids should be checked prior to use. If not within specifications, the fluid should be discarded and fresh fluid prepared.

7.12.2 SPLP fluid #1: Add 60/40 weight percent mixture of sulfuric and nitric acids to reagent water until the pH is 4.20 ± 0.05 This fluid is used for soils from a site that is east of the Mississippi River and for wastes and wastewaters.

7.12.3 SPLP fluid #2: Add 60/40 weight percent mixture of sulfuric and nitric acids to reagent water until the pH is 5.00 ± 0.05. This fluid is used for soils from a site that is west of the Mississippi River.

7.12.4 SPLP fluid #3: This fluid is reagent water and is used for leaching of volatiles. Additionally, any cyanide-containing waste or soil is leached with fluid #3 because leaching of cyanide containing samples under acidic conditions may result in the formation of hydrogen cyanide gas.

7.13 CWET Leaching fluid

7.13.1 0.2 M Sodium Citrate Extraction Fluid. Add 18L of DI water to a 20 liter carboy. Carefully add 924 g of anhydrous citric acid and 1950 ml of 5N NaOH. Place on a magnetic stirrer and stir until all the solids dissolve. Measure the pH and adjust until the pH is 5.0 +/- 0.1. Alternatively, the fluid may be purchased. The pH of the fluid must be checked and recorded daily prior to use.

8.0 SAMPLE COLLECTION, PRESERVATION, STORAGE AND SHIPMENT

8.1 TestAmerica St. Louis supplies sample containers and chemical preservatives in accordance with the method. TestAmerica St. Louis does not perform sample collection. Samplers should reference the methods referenced and other applicable sample collection documents for detailed collection procedures. Sample volumes and preservative information is given in ST-PM-0002.

8.2 Samples being analyzed for non-volatile organic compounds should be collected and stored in glass containers with Teflon lid liners. Chemical preservatives shall NOT be added UNTIL AFTER leachate generation.

8.3 Samples being analyzed for metals only can be collected in either glass or polyethylene containers.

8.4 When the waste is to be evaluated for volatile analytes, care should be taken to minimize the loss of volatiles. Samples shall be collected and stored in a manner intended to prevent the loss of volatile analytes (e.g., samples should be collected in Teflon lined septum capped vials with minimal headspace and stored at 4 ± 2 ^{o}C). Samples should be opened only immediately prior to extraction. Samples being analyzed for volatile organics do not require preservation.

8.5 Samples should be refrigerated to 4 ± 2 ^{o}C unless refrigeration results in irreversible physical changes to the waste. If precipitation occurs, the entire sample (including precipitate) should be extracted.

8.6 The minimum TCLP sample collection size is determined by the physical state or states of the waste and the analytes of concern. The amount of waste required varies with the percent solids. The lower the percent solids, the more waste will be required for preliminary and final testing. For aqueous samples containing between 0.5 and 10% solids, several kilograms of sample are required to complete the analyses. The general minimal requirements when the samples are 100% solids include: 1 - 32 oz jar for semi-volatile organic analysis and metals, and 1 - 4 oz jar for volatile organic analysis. Low density sample materials, such as rags or vegetation, will require larger volumes of sample. For liquid samples (less than 50% solids) the minimum requirements are 2 - 32 oz jars for semi-volatile organic analysis and metals, and 2 - 8 oz jars for volatile organic analysis. If volatile organic analysis is the only requested parameter, 2 separate jars are required. If matrix spike or duplicate control samples are requested, additional sample volume is required. If sufficient sample volumes were not received, analyses cannot be started and the client should be notified as soon as possible.

8.7 TCLP leachates should be prepared for analysis and analyzed as soon as possible following extraction. Leachates or portions of leachates for metallic analyte determinations must be acidified with nitric acid to a pH less than 2, unless precipitation occurs. **If precipitation occurs upon addition of nitric acid to a small aliquot of the leachate, then the remaining portion of the leachate shall not be acidified** and the leachate shall be analyzed as soon as possible. All other leachates should be stored under refrigeration (4 ± 2 °C) until analyzed.

8.8 Samples are subject to appropriate treatment within the following time periods:

Table 1 – Holding Times (days)

Parameter	Collection to Leach	Leach to Preparation	Preparation to Analysis	Total Elapsed Time
Volatiles:	14	N/A	14	28
Extractable Organics:	14	7	40	61
Mercury:	28	N/A	28	56
Other Metals:	180	N/A	180	360

NOTE: The initial holding time is measured from date of collection to date extraction started, and subsequent holding times are measured from the date extraction starts**.** If sample holding times are exceeded, the values obtained will be considered minimal concentrations. Exceeding holding times is not acceptable in establishing that a waste does not exceed the regulatory level. Exceeding the holding time will not invalidate characterization if the waste exceeds the regulatory limit.

9.0 QUALITY CONTROL

9.1 Batch

9.1.1 A batch consists of environmental samples, which are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of a similar matrix, meeting the above mentioned criteria. Where no preparation method exists (example, volatile organics, water) the batch is defined as environmental samples that are analyzed together with the same process and personnel, using the same lots of reagents, not to exceed 20 environmental samples. An analytical batch is composed of prepared environmental samples, extracts, digestates or concentrates that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

9.1.2 Each LEACHATE batch may contain up to 20 environmental samples, a method blank for each fluid.

9.2 Method Blank

9.2.1 A Method Blank is a blank matrix processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

9.2.2 One leachate (method) blank must be prepared and leached for each leachate batch.

9.2.3 One leachate blank is prepared for each leachate fluid used. The leachate blank must consist of the same extraction fluid as used for the samples or reagent water if only filtration of the sample(s) was required.

9.3 LCS and MS/MSD

9.3.1 For metals analysis, a MS/MSD is spiked after leaching but prior to preservation and submittal for metals sample preparation. All Laboratory Control Samples (LCS) and Organic MS/MSD samples are initiated in inorganic and organic sample preparation procedures and not included in this SOP. See SOPs: ST-IP-0013 (ICP metals digestion), ST-MT-0005 (mercury), ST-OP-0002 (pesticides and semivolatile extraction), and ST-OP-0007 (herbicide extraction)

9.3.2 See appendix table for metals MS/MSD spiking concentrations.

9.4 Procedural Variations

9.4.1 Any variation shall be completely documented using a Nonconformance Memo and approved by the Supervisor and QA Manager. The Nonconformance Memo shall be filed in the project file and incorporated into the report narrative.

9.5 Nonconformance and Corrective Action

9.5.1 Any deviations from QC procedures must be documented as a nonconformance, with applicable cause and corrective action approved by the facility QA Manager. See SOP ST-QA-0036 for details regarding the NCM process.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Sample analysis instrumentation calibration requirements are found in the respective analytical SOPs: ST-MT-0003 (metals by ICP), ST-MT-0005 (mercury), STL-GC-0016 (pesticides), ST-GC-0017 (herbicides), ST-MS-0001 (Semivolatiles) and ST-MS-0002 (Volatiles).

10.2 The rotation devices must be checked once a month for proper rotation speed. Count the number of rotations in exactly 60-seconds. The number of rotations must be between 28 and 32, or corrective action is required. Record the result in a logbook.

10.3 Calibrate the pH meter daily when used to bracket the pH being measured. The pH meter is calibrated in accordance with SOP: ST-WC-0011.

10.4 Calibrate the top loading balance with weights bracketing the targeted weights. See SOP, ST-QA-0005, for details regarding balance calibration and documentation.

11.0 PROCEDURE

11.1 Preliminary evaluations (percent solids, particle size, selection of extraction fluid, and fluid/leachate compatibility)

11.1.1 Preliminary evaluations are required to be done using a minimum of a 100 gram aliquot of waste. This aliquot may also undergo the actual leachate extraction for Non-volatiles ONLY IF it has NOT been oven dried. If the solid portion is oven dried, a separate aliquot must be used for the actual leaching procedure.

11.1.2 Determine the total volume of leachate (solid phase leachate + liquid filtrate) that needs to be generated for analysis according to the following:

Minimum Required Leachate Volume

Analysis	Required Volume (mL)
Volatiles	2 x 20
Semi-volatiles	200
Pesticides/ PCBs/Herbicides	100 each
Metals	100

11.1.2.1 If extractable organics are required on the same sample, a full 1 L volume must be prepared for each test requested.

11.1.2.2 For samples used for matrix spike and matrix spike duplicate analysis, three times the listed volumes are required.

11.1.3 Check the number of phases observed in the sample. It is common that when more than one container of multi-phasic materials is received from the field, each container will show different amounts of each phase.

11.1.3.1 If the sample has multiple phases and is received in more than 1 bottle then the contents of each bottle should be combined in a single larger container prior to processing the sample further. If this is not possible, then the alternate procedure described in the following section should be used.

11.1.4 Properly record the relative amounts of each phase by measuring the depth of the layers in each container after the contents have been allowed to settle. Determine the combined volume of each phase for all containers. Then mark the phase composition on a single container, mix thoroughly to obtain a representative subsample, and accurately measure the phase composition according to the following procedure. The two sets of values (combined volumes per phase and phase composition for one container) are used to determine the correct volume/mass adjustments on the final result. This procedure is not appropriate if testing will be done for volatile organic compounds.

11.2 Percent Solid Phase

11.2.1 If the waste will obviously yield no free liquid when subjected to pressure filtration (i.e., it is 100% solid), then proceed to Section 11.4 (Particle-size Reduction).

11.2.2 If the waste will obviously yield no solid when subjected to pressure filtration (i.e. it is 100% liquid), then proceed to Section 11.3.7.

11.2.3 For TCLP and SPLP determinations:

11.2.3.1 Percent Solids and ZHE Extractions - The ZHE filtration apparatus cannot accurately determine percent **solids less than 5%**. If an extraction is to be performed solely for volatile organic compounds and the percent solids concentration is apparently greater than 5%, proceed to Section 11.7. (Procedure: ZHE Extraction Procedure, Volatile Constituents). Otherwise, continue with the steps in this section. The aliquot of sample used here cannot be used again for the ZHE extraction.

11.2.3.2 Weight of filter - Measure and record this value on the extraction record before loading the filter into the filter holder.

11.2.3.3 Assemble the filtration apparatus.

11.2.3.3.1 Homogenize the waste, transfer a minimum of a 100 g subsample to the weighing vessel. Measure and record the gross weight.

11.2.3.3.2 Determine the exact amount of sample transferred by weighing a beaker containing the sample before and after transfer of the sample.

11.2.3.4 Transfer the sample to the filtration device attempting to spread the waste sample evenly over the surface of the filter. Measure and record the tare weight of the empty weighing vessel and any residual sample.

11.2.3.5 Calculate and record the net weight of sample used for testing.

11.2.4 For CWET determinations

NOTE: Percent solids for WET is not the same as the percent solids normally referred to in other extractions and is not at all related to the percent moisture. Here, the percent solids is the dried fraction of the sample from which no liquid may be forced by applied pressure.

11.2.4.1 If visual inspection indicated that the sample will yield no liquid upon filtration, the sample is declared to be 100% solids.

11.2.4.2 If the sample is liquid or multiphasic, filtration must be used to determine the percent solids.

11.2.4.3 Record the weight of the filter and pre-filter in the laboratory notebook. Securely assemble the filter holder, screen, pre-filter, filter, and head onto the filtration unit. Leave off the screw-on cap on the filtration head.

11.2.4.4 Weigh a minimum 50-gram aliquot of the sample into a 250-ml beaker, after homogenizing the sample. If the percent solids are expected to be low, it may be advantageous to use a larger amount of the sample in order to obtain enough filtrate for subsequent metals analysis. Record the weight to the nearest 0.1 gram. Quantitatively transfer (>99%), the aliquot into the filter unit through the opening at the top of the filtration head using physical means only. Do not rinse with water. Tightly screw the cap onto the opening.

11.2.4.5 Collect the filtrate into a clean collection flask. Filtration stops when no additional filtrate in two-minute interval, is collected.

11.2.4.6 After filtration is complete, if liquid remains, it is considered part of the solids content since it would not filter.

11.2.4.7 Remove the screen with the pre-filter, filter and solids on it. If the solids are obviously greater than 0.5% by weight, it is not necessary to dry the filter and the weight of the pre-filter, filter and solids can be immediately determined. If it is not obvious transfer the screen, pre-filter, filter, and solids to the oven. Dry in the oven at 100 +/- 20 degrees C for approximately 1-hour. Remove from the oven and allow too cool. Using forceps transfer the pre-filter and filter onto the balance. Record the weight in the logbook. **Note:** if no liquid was obtained from the filtration, the sample is considered 100% solids, and it is not necessary to continue with drying the filter, etc.

11.2.4.8 Calculate and record the percent solids in the logbook. If the percent solid is < 0.5%, the sample is considered 100% liquid, otherwise, the sample is multiphasic. If the solids were not dried, they may be used to obtain the leachate, which must be combined with the original filtrate (if the liquids are compatible). If the solids were dried, and the percent solids is less than or equal to 0.5%, then a fresh aliquot of waste must be filtered to obtain solids to be leached.

11.3 Filtration for percent solids

11.3.1 Slowly apply gentle pressure of 10 psi to the filtration apparatus. Allow the sample to filter until no SIGNIFICANT additional liquid has passed through the filter during a 2 minute period.

11.3.2 Repeat previous step by increasing the pressure in 10 psi increments until a maximum of 50 psi is reached. Stop the filtration when no additional filtrate is generated within a 2 minute period.

NOTE: Some samples will contain liquid material that does not filter (e.g., oil). Do not attempt to filter the sample again by exchanging filters. Viscous oils or any wastes which does not pass through the filter is classified as a solid.

11.3.3 Weight percent of dry solids (skip this step for oily samples).

NOTE: These steps are required only if it is noticed that a small amount of the filtrate is entrained in wetting of the filter and the percent wet solids (if measured) is ≥ 0.5%.

11.3.3.1 Remove the filter with the wet solids from the filtration apparatus.

11.3.3.2 Dry the filter and solid phase at 100 ± 20 ° C.

11.3.3.3 Remove the filter from the oven and allow to cool in a desiccator.

11.3.3.4 Weigh and record the gross dry weight.

11.3.4 If not dried > 18 hours, repeat the drying step. Weigh and record the second gross dry weight. If the two weightings do not agree within 1%, perform additional drying and weighing until successive weighings agree within 1%.

11.3.5 Calculate and record the weight percent of dry solids.

11.3.6 If the dry solids result is ≥ 0.5% and the sample will be extracted for non-volatile constituents, proceed to Section 11.4 (Particle Size Reduction) using a fresh wet portion of waste.

11.3.7 If the percent solids result is less than 0.5%, discard the solid phase. No leaching will be necessary; the filtrate is the TCLP leachate. Proceed to Section 11.6.11 for non-volatile constituents and Section 11.7.9.2 for volatile constituents.

11.4 Particle-size Reduction for Fluid Selection

11.4.1 For TCLP and SPLP determinations:

11.4.1.1 The subsample used for fluid selection must consist of particles less than 1 mm in diameter (versus the less than 1 cm requirement for the material used for the actual extraction). The method requires a smaller particle size to partially compensate for the shorter duration of contact time with the leachate solution as compared to the full extraction. Inappropriate use of coarser materials could result in the selection of the wrong fluid type.

11.4.1.2 Surface area exclusion - size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram., such as might be the case with pieces of paper, cloth, etc.

11.4.1.3 If the sample contains particles greater than 1 mm in diameter, crush, cut, or grind the solids to the required size. Note the type of particle size reduction performed on the extraction record.

11.4.2 For CWET determinations:

11.4.2.1 Determine if particle-size reduction is required by sieving the solids through a No. 10 sieve (unless it is obvious that all material will pass through the sieve). Material that does not pass through the sieve must be crushed, ground, etc. in order to pass through the sieve.

11.4.2.2 Perform any particle size reduction on the solid portion of the sample as necessary, for sample to pass through a no. 10 sieve.

11.4.2.2.1 For a multiphasic sample, quantitatively transfer the entire solids portion obtained, including filter, into an extraction bottle.

11.5 Determination of Appropriate Extraction Fluid

11.5.1 If the solid content is greater than or equal to 0.5%, and if the sample is being analyzed for metals or nonvolatile organic compounds, the type of leaching solution must be determined.

11.5.2 For SPLP, refer to Section 7.12 for fluid selection. Matrix type must be specified by the client. Check special instructions or see the project manager, then put a check mark by the fluid type selected.

11.5.3 For CWET use the equation in section 12.1.5, to determine the appropriate volume of 0.2-M sodium citrate solution to add to the extraction bottle. Add this volume to the extraction bottle.

11.5.4 The TCLP leaching fluid for all volatiles is Fluid #1.

11.5.5 For TCLP leach fluid determination for non-volatile analytes, continue with the following steps.

11.5.5.1 Weigh out a 5.0 ± 0.1 g subsample (less than 1 mm particle size) of the solid phase into a 150-mL disposable plastic bottles.

11.5.5.2 Add 96.5 ± 1.0 mL of reagent water, cover with a disposable watchglass, and stir with a 1.5 inch stirring bar for 5 minutes.

11.5.5.3 Measure and record the pH

11.5.5.4 If the pH is less than or equal to 5.0, use Fluid #1 and proceed to Section 11.5.6.

11.5.5.5 If the fluid pH is greater than 5.0, add 3.5 mL 1 N HCl, cover with a disposable watchglass. Slurry the sample briefly then transfer to a hotplate. Place a thermometer in sample, heat at 50 ^{o} C - 55 ^{o}C for 10 minutes.

NOTE: The heating cycle is a critical step. If the solid waste does not remain in contact with the acidic solution under specified time and temperature conditions, an erroneous pH may be measured.

11.5.5.6 Allow sample to cool until to reaches between 25 ^{o}C (room temperature) and 30 ^{o}C.

11.5.5.7 Slurry the sample briefly and let the solids settle.

11.5.5.8 Measure and record the pH using a pH meter.

11.5.5.9 If the pH is less than or equal to 5.0, use Fluid #1.

11.5.5.10 If the pH is greater than 5.0, use Fluid #2.

11.5.6 For samples requiring analysis for semi-volatile organics, pesticides, herbicides or metals proceed to Section 11.6.

11.5.7 For samples requiring analysis for volatile organics (ZHE), proceed to Section 11.7.

11.6 TCLP/SPLP Bottle Extraction Procedure: Non-Volatile Constituents

11.6.1 All masses should be recorded to the nearest 0.1 g.

11.6.2 The aliquot used in the Preliminary Evaluation MAY be used for this procedure ONLY if it was not oven dried. If the sample is 100% solid or if the preliminary aliquot was not oven dried proceed directly to Section 11.6.8 (Particle Size Reduction). If the Preliminary Evaluation aliquot was oven dried then, using a fresh aliquot of sample, continue as described in Sections 11.6.3 through 11.6.5.

11.6.3 Determine the minimum total volume of solid phase leachate that needs to be generated. Refer to Section 11.1.2.

11.6.4 Divide the total volume of solid phase leachate required by 20 to determine the mass of solid phase required for leaching. Round this mass UP to the nearest 5 g.

11.6.5 Repeat the steps outlined in Sections 11.2.3 through 11.3.2. (skipping CWET section inserts)

11.6.6 Determine and record the volume (mass) of the initial filtrate. Cover with aluminum foil or retain in a glass bottle for use.

11.6.7 Determine and record the “solid” phase mass by subtracting the mass of the liquid filtrate from the mass of the subsample.

11.6.8 Evaluate the solid portion of the waste for particle size. If it contains particles greater than 1 cm in size, prepare the solid portion of the waste for leaching by crushing, cutting, or grinding such that all particles are less than 1 cm in size (i.e., capable of passing through a 9.5 mm, 0.375 inch, standard sieve). Size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram. If particle size reduction was required, record the type of reduction used onto the extraction record.

11.6.8.1 Scissors or shears may be used to cut cloth, plastic or sheet metal. Saws may be used for wood or solid metal. Note that size reduction to fine powder is not appropriate, and could invalidate results. If necessary, consult client for guidance.

11.6.9 Weigh the required mass of solid phase into an appropriate plastic bottle and **slowly** add 20 times its mass of appropriate leaching fluid as determined under Section 11.5 (e.g., 20 g of sample would require 400 g of leaching fluid). Record the weight of the sample aliquoted for the extraction and the amount of extraction fluid added.

11.6.10 Ensure any effervescence has stopped before capping the bottle tightly. Secure in a rotary agitator and rotate end-over-end at 28-32 rpm for 16-20 hours. The temperature of the room should be 23 ± 2°C. The room temperature and time should be checked at both the start and end of the extraction and recorded on the extraction record.

NOTE: As agitation continues, pressure may build up within the bottle for some types of wastes. To relieve excessive pressure, the bottle may be removed and opened periodically in a properly vented hood to relieve any built-up pressure.

11.6.11 Remove the bottle and filter the sample using pressure filtration by filtering through a new glass fiber filter. For final filtration of the TCLP leachate, the glass fiber filter may be changed, if necessary, to facilitate filtration. Filters must be acid washed if metals are to be determined (see Section 6.3). The entire sample need not be filtered unless the sample yielded an initial liquid phase that needs to be combined with this filtrate; however, sufficient volume should be generated to support the required analyses.

11.6.12 If the waste contained no initial filtrate, this solution is defined as the leachate.

11.6.13 If the waste did yield an initial filtrate, and if this filtrate and the initial filtrate are compatible, they are to be combined in the correct proportions (see Section 12.1.4) and mixed well. This combined solution is defined as the TCLP leachate.

11.6.14 If the individual phases are NOT miscible, they are to be prepared and analyzed separately and the results combined mathematically. See Section 12.1.5.

11.6.15 Measure and record the pH of the TCLP leachate using a pH meter.

11.6.16 Prepare subsamples for metals for MS/MSD quality control testing using the appropriate TCLP spiking solution (do not spike for organics). Refer to the appropriate determinative SOPs for further guidance on the spike components, levels and action criteria.

11.6.17 Immediately preserve the leachate as follows:

11.6.17.1 Metals to pH < 2 w/concentrated HNO_3 for non-oils (do not acidify oils)

11.6.17.1.1 If precipitate is observed upon addition of nitric acid to a small aliquot of the extract, the remaining portion of the extract for metals shall not be acidified and the extract shall be analyzed as soon as possible.

11.6.17.2 All others: Refrigerate to 4 ± 2 ^{o}C.

NOTE: Refer to Section 8.6 if precipitation occurs upon preservation.

11.6.18. Label each sample with the appropriate information and submit to the appropriate analytical groups for prep and analysis with copies of the TCLP preparation worksheets.

11.7. TCLP/SPLP ZHE Extraction Procedure: Volatile Constituents

11.7.1 Use the ZHE device to obtain a TCLP leachate for analysis of volatile compounds only. Leachate resulting from the use of the ZHE shall NOT be used to evaluate the mobility of non-volatile analytes (e.g. metals, pesticides, etc.).

11.7.2 Due to some shortcomings of the method, losses of volatile compounds may occur. Extra care should be observed during the ZHE procedure to ensure that such losses are minimized. Charge the ZHE with sample only once and do not open the device until the final extract has been collected. Do not allow the waste, the initial liquid phase or the extract to be exposed to the atmosphere any longer than necessary.

11.7.3 If the TCLP extraction is for volatile components only, refer to Section 11.2.3.1 before proceeding.

11.7.4 All masses should be recorded to the nearest 0.01 g.

11.7.5 Partially assemble the ZHE apparatus.

11.7.6 Adjust the ZHE piston in the ZHE body to the appropriate height (slightly moisten the O-rings with leaching fluid or DI water if necessary).

11.7.7 If the preliminary evaluations indicated the need for particle size reduction, homogenize the waste, weigh out a sufficient size subsample and prepare for leaching by crushing, cutting, or grinding such that all particles are less than 1 cm in size as measured with a ruler (Do NOT sieve the sample). Size reduction is not required if the sample surface area is greater than or equal to 3.1 cm^2 per gram If particle size reduction was required record the type of reduction used on the extraction record.

NOTE: To minimize loss of volatiles, samples for volatiles that require particle size reduction should be kept in sample storage (at 4 ºC) until immediately before size reduction. Aggressive reduction which would generate heat should be avoided and exposure of the waste to the atmosphere should be avoided to the extent possible. Size reduction to a fine powder is not appropriate.

11.7.7.1 Scissors or shears may be used to cut cloth, plastic or sheet metal. Saws may be used for wood or solid metal.

11.7.8 Place a 200g Aluminum weigh dish on the balance and tare the balance.

11.7.9 Determine the appropriate size subsample to weigh using the percent solids information from Section 11.2

11.7.10 Homogenize and transfer an appropriate size sub-sample of the waste into the weigh dish and record the weigh in the extraction log.

11.7.11 If the waste is 100% solid, pour TCLP fluid number 1, in the amount of 20 times the aliquot's weights into the ZHE. **NOTE: Reserve approximately half the aliquot to wash off the weigh dish.**

11.7.12 Transfer the entire sample from the weigh dish into the ZHE.

11.7.13 Using the remainder of the ZHE fluid, rinse off the weigh dish into the ZHE.

11.7.14 Immediately place the glass fiber filter between the support screens, place the lid on the ZHE and to secure the ZHE tighten all the fittings.

11.7.14.1 For wastes that are 100% solids, a 25 g sample is used.

11.7.14.2 For wastes containing < 0.5% solids, the liquid portion of the waste, after filtration, is defined as the TCLP leachate. Filter enough of the sample to support all of the volatile analyses required.

11.7.14.3 For wastes containing ≥ 0.5% and < 5.0% solids, a 500 g subsample of waste is recommended.

11.7.14.4 If the sample has ≥ 5.0% solids, a smaller sample size can be determined using the equation in Section 12.1.2.

11.7.15 Homogenize and transfer an appropriate size subsample of the waste into the weigh dish and record the weight in the extraction log.

11.7.16 If the waste is 100% solid, pour TCLP fluid number 1, in the amount of 20 times the aliquot's weight, into the ZHE.

Note: Reserve approximately half the aliquot to wash off the weigh dish.

11.7.17 Transfer the entire sample from the weigh dish into the ZHE.

11.7.18 Using the remainder of the ZHE fluid, rinse off the weigh dish into the ZHE.

11.7.19 Immediately place the glass filter between the support screens, place the lid on the ZHE and to secure the ZHE tighten all the fittings.

11.7.20 Place the ZHE in an upright position; open both the gas AND liquid inlet/outlet valves. Attach a gas line to the gas inlet/outlet valve.

11.7.21 If the waste is 100% solid, carefully apply gentle pressure of 10 psi (or more, if necessary) to force all headspace slowly out of the ZHE. At the FIRST appearance of liquid from the liquid inlet/outlet valve, quickly close the valve and discontinue gas pressure. Proceed to Section 11.7.16.

11.7.22 If the waste is < 100% solids, proceed as follows:

- 11.7.22.1 Carefully apply gentle pressure of 10 psi (or more, if necessary) to force all headspace slowly out of the ZHE. At the FIRST appearance of liquid from the liquid inlet/outlet valve, quickly close the valve and discontinue gas pressure.
- 11.7.22.2 Attach a pre-weighed Tedlar bag to the liquid inlet/outlet valve and open the valve. Record the tare weight of the bag. A tared gas-tight syringe may also be used to collect the liquid phase.
- 11.7.22.3 Carefully apply gas pressure of no more than 10 psi to force out the liquid phase. Allow the sample to filter until no SIGNIFICANT additional filtrate has passed in a 2 minute period.
- 11.7.22.4 Repeat previous step increasing the pressure in 10 PSI increments until 50 psi is reached and no significant liquid has passed in a 2 minute period. Remove the Tedlar bag or syringe and record the total weight of the container with filtrate. Close the gas-inlet valve and discontinue gas pressure. Retain the Tedlar bag or syringe with filtrate at 4° C for recombination with the leachate.
- 11.7.22.5 If the original waste contained less than 0.5% solids (Section 11.2), this filtrate is defined as the TCLP leachate. Proceed to 11.7.23.
- 11.7.22.6 If the original waste contained greater than 0.5% solids (Section 11.2), the material remaining in the ZHE is defined to be the “solid” phase. Calculate the weight of the solid phase using Equation 4.
- 11.7.22.7 Based on the information from Sections 11.2, and using the formula in 12.1.3, determine the weight of fluid to load into the ZHE onto the “solid” phase.
  - 11.7.22.7.1 Load ZHE with 500 mL of Fluid #1

11.7.23 Check the ZHE to make sure all valves are closed and manually rotate the ZHE (end-over-end) 2 or 3 times. Reposition the ZHE in the vertical position.

11.7.24 Slowly open the liquid inlet/outlet valve to bleed out any headspace that may have been introduced during the introduction of the Fluid. Upon the first sign of liquid from the valve, close the valve.

11.7.25 Pressurize the ZHE to 30 psi. Allow to stand for 10 minutes, and then recheck the pressure. If the ZHE appears to be leaking, follow the corrective action protocols recommended by the manufacturer and repeat the analysis.

11.7.26 Place the ZHE in the rotary agitator. Record the initial ZHE pressure on the extraction record. Rotate at 28-32 rpm for 16-20 hours. Room temperature should be 23 ± 2 °C. The room temperature and time should be checked at both the start and end of the extraction and recorded on the extraction record.

11.7.27 Confirm that the pressure of 30 psi was maintained throughout the leaching. Record the final ZHE pressure on the extraction record. If it was NOT maintained, return to Section 11.7.1 and repeat the leachate with a new aliquot of sample.

11.7.28 Attach a syringe or Tedlar bag and open the liquid inlet/outlet valve to collect the aqueous leachate. If the filtrate is to be combined with an initial filtrate, record the volume/mass of the leachate and any oil phase.

NOTE: If the waste contained an initial liquid phase, and the leachate is miscible with the initial liquid, the liquid may be filtered directly into the same collection device holding the initial liquid phase of the waste.

- 11.7.28.1 A separate filtrate collection container must be used if combination would create multiple phases or there is not enough volume left within the filtrate collection container.

11.7.29 If the waste contained an initial filtrate (Section 11.7.15) that is miscible with the leachate, the leachate and the initial filtrate are directly recombined in the correct proportions. If the individual phases are NOT compatible, they are to be collected and analyzed separately.

11.7.30 Following collection, store the TCLP leachate in 2 20-mL unpreserved VOA vials with minimal headspace at 4 ± 2 ^{o}C and prepare for analysis as soon as possible using the appropriate organic extraction procedure.

11.7.31 If the individual phases are analyzed separately, combine the results mathematically by using the recombination calculation in Section 12.1.4.

11.8 CWET Leaching Procedure for the Solid Fraction

11.8.1 For a 100% solids sample, weigh out and quantitatively transfer a minimum of 50-grams of the sample into an extraction bottle. The extraction bottles shall be fitted with covered air scrubbers extended well into the extraction solution and flushed vigorously with nitrogen gas for 15 minutes so as to remove and exclude atmospheric oxygen from the extraction medium.

11.8.2 Secure the lid on the bottle and place the bottle in the rotator. Rotate the sample for a minimum of 48 hours (and a maximum of 50 hours) at 20-40 degrees C at 30 +/- 2 rpm. Record the initial room temperature in the logbook.

NOTE: It may be necessary to vent the extraction bottle periodically throughout the extraction (samples that contain carbonates may react with the acid to yield carbon dioxide gas). It is recommended to check the bottles for built-up gas after 15-30 minutes. If a build-up was observed, the bottle should be vented occasionally. If no build-up is observed, it is safe to let it rotate without further venting. Failure to vent the bottles may result in breakage of the bottle, with subsequent loss of the sample, and possible widespread radioactivity contamination.

11.8.3 Following the rotation period, record the room temperature, then stop the rotator and remove the bottle. If using a 1-liter plastic bottle, the bottle can be centrifuged at 2300 rpm for about 10-minutes, otherwise it is recommended to stand to allow the solids to settle in order to facilitate the filtering process. The method makes no specification on the maximum amount of time the bottle can stand before beginning the filtration process.

11.8.4 Filter the leachate using disposable 0.45 um filter or vacuum filtration apparatus. Record the lot number of the filter used on the TCLP prep-sheet.

11.8.5 If the leachate is from a 100% solids, the leachate is ready for preservation. If the leachate is from a multiphasic sample, the leachate should be physically recombined with the filtrate obtained from the pre-rotation filtration if the two are miscible. If the two are not miscible, record the volumes of each liquid, and report to the analytical labs that both must be analyzed separately. The results from the analyses must then be mathematically combined. Proceed with preservation.

11.8.6 CWET Preservation

11.8.6.1 Leachates to be analyzed for the metals must be preserved with nitric acid, so as to add an equivalence of 5% by volume concentrated nitric acid (*e.g.* for 100-mls of leachate, add 5-mls of concentrated nitric acid). Matrix spiking is performed prior to acidification. Measure out the appropriate volumes of leachate. Record the standard number, volume added and standard expiration date on the extraction record.

11.8.7 Analysis of the leachate proceeds according to the standard analytical procedures.

NOTE: Non-aqueous samples would normally be reported on a weight by weight basis; however, the WET regulatory limits are stated on a weight by volume basis. Therefore, aliquots on non-aqueous liquids for WET analysis should be measures by volume instead weight. For example, if the procedure calls for 1-gram of sample, measure 1-ml of sample instead.

11.9 TCLP Procedure for Determination of Major Cations

11.9.1 Record physical description of sample.
11.9.2 Mix sample thoroughly prior to taking aliquot.
11.9.3 Weigh 100g +/- 0.5g.
11.9.4 Add volume of DI water in mL to 20x weight in grams (100g - 2000mL).
11.9.5 Process a blank comprised of DI water only.
11.9.6 Agitate continuously for 18 hours (+/- 0.25hrs), tumbler must rotate at a rate of 29 r/mins.
11.9.7 Maintain room temperature at 18-27c°.
11.9.8 Record any physical changes in the sample and or leaching solution.
11.9.9 Allow sample to settle.

11.9.10 Filter through TCLP filter (7µm)
11.9.11 Filter again through 0.45µm filter.
11.9.12 Record pH
11.9.13 Preserve with HNO3.
11.9.14 Sample is ready to be analyzed by ICP or ICPMS.

12.0 DATA ANALYSIS AND CALCULATIONS

12.1. Commonly used calculations (e.g. % recovery and RPD) and standard instrument software calculations are given in the TestAmerica St. Louis QAM**.**

12.1.1 Calculation of Percent Wet Solids:

$$Percent\ \ Wet\ Solids = 100\left(\frac{Mass,"solid"\ phase}{Mass, initial\ subsample}\right)$$

12.1.2 Calculation of weight of waste to charge to ZHE:

$$Weight\ of\ \ waste\ to\ add\ to\ ZHE\ = 100\left(\frac{25}{\%wet\ solids}\right)$$

12.1.3 Calculation of weight of extraction fluid to use:

$$Weight\ of\ \ Extraction\ \ fluid = \frac{20\,x\,\%\ wet\ solids\ x\ weight\ of\ \ waste\ to\ be\ extracted}{100}$$

TCLP/SPLP Calculation of volume of initial filtrate phase to recombine with solid phase leachate:

$$\text{Vol. filtrate for recombination} \ = \left(\frac{Wt\ \ solids\ \ leached}{Total\ \ Wt\ \ solids}\right)\left(\frac{Leachate\ \ reovered}{Fluid\ \ added}\right)\left(Vol.\,of\ \ initial\ \ aq.\ \ filtrate\right)$$

$$\text{Vol. filtrate for recombination} \ = \left(\frac{Wt\ \ solids\ \ leached}{Total\ \ Wt\ \ solids}\right)\left(\frac{Leachate\ \ reovered}{Fluid\ \ added}\right)\left(Vol.\,of\ \ initial\ \ aq.\ \ filtrate\right)$$

12.1.4 Mathematical recombination of analytical results:

$$Final\ Analyte\ Concentration = \frac{(V_1 \times C_1) + (V_2 \times C_2)}{V_1 + V_2}$$

V_1 = total volume of the initial filtrate phase (L).
C_1 = analyte concentration in initial filtrate phase (mg/L).
V_2 = volume of the theoretical solid phase leachate (L).
C_2 = analyte concentration in solid phase leachate (mg/L).,

12.1 For CWETs Extraction Fluid Volume Requirement:
Volume = 0.10 x *%solids* x *Wtw*
Where:

Volume = volume of the extraction fluid to be added to the extraction vessel (mls)
%solids = Percent Solids (%)
Wtw = weight the waste filtered (grams)

12.2 REPORTING REQUIREMENTS

12.2.1 Follow these reporting conventions for multi-phase samples:

12.2.2 If both phases have positive results, use the values from each phase to calculate the recombined result. Use the reporting limit for each phase to calculate the recombined reporting limit.

12.2.2.1 If both phases are "ND," not detected, the recombined result is "ND," and the reporting limit is calculated from the reporting limit for each phase.

12.2.2.2 If one phase is "ND" and the other phase has a positive result, use the reporting limit for the "ND" phase and the positive value for the other phase to calculate the combined result. The combined reporting limit is based on the reporting limit for both phases. If the combined result is less than the combined reporting limit, then supply a footnote to indicate that "a positive result was detected below the calculated detection limit."

12.2.3 Units - regardless of the nature of the sample, all results are reported in units of mg/L.

13.0 DATA ASSESSMENT AND ACCEPTANCE CRITERIA; CORRECTIVE ACTIONS FOR OUT OF CONTROL DATA

13.1 The data assessment and corrective action process is detailed through the LIMs Nonconformance Memorandum (NCM) process. The NCM process is described in SOP ST-QA-0036.

13.2 Method Blanks: Leachate blanks which show contamination for the analytes of interest may require reextraction of the leachate batch (if positive detects were encountered), if the contamination cannot be traced to the analytical method's preparatory procedure.

13.3 A NCM shall be generated for the following anomalies:

13.3.1 Sample weights less than the method requirement

13.3.2 Temperature excursions outside 23°C ± 2°C.

13.3.3 Multiphasic samples, single phase oils, or samples that contain liquids that didn't filter under test conditions.

13.4 All quality control measures described in the appropriate analytical SOPs shall be followed. Sample QC requirements are found in the respective analytical SOPs: ST-MT-0003 (metals by ICP), ST-MT-0005 (mercury), ST-GC-0016 (pesticides), ST-GC-0017 (herbicides), ST-MS-0001 (Semivolatiles) and ST-MS-0002 (Volatiles).

14.0 METHOD PERFORMANCE

14.1 Method performance data, Reporting Limits, MDLs, and QC acceptance limits, are maintained in the LIMS.

14.2 Demonstration of Capability

14.2.1 Initial and continuing demonstrations of capability requirements are established in the QAM.

14.3 Training Qualification

14.3.1 The manager/supervisor has the responsibility to ensure that this procedure is performed by an analyst who has been properly trained in its use and has the required experience.

14.3.2 The analyst must have successfully completed the initial demonstration capability requirements prior to working independently. See requirements in the QAM.

14.4 Annually, the analyst must successfully demonstrate proficiency to continue to perform this analysis. See requirements in the QAM.

15.0 VALIDATON

15.1 Laboratory SOPs are based on standard reference EPA Methods that have been validated by the EPA and the lab is not required to perform validation for these methods. The requirements for lab demonstration of capability are included in LQM. Lab validation data would be appropriate for performance based measurement systems or non-standard methods. TestAmerica St. Louis will include this information in the SOP when accreditation is sought for a performance based measurement system or non-standard method.

16.0 WASTE MANAGEMENT AND POLLUTION PREVENTION

16.1 All waste will be disposed of in accordance with Federal, State and Local regulations. Where reasonably feasible technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in section 13 of the Corporate Environmental Health and Safety Manual for "Waste Management and Pollution Prevention."

16.2 WASTE STREAMS PRODUCED BY THE METHOD

16.2.1 The following waste streams are produced when this method is carried out.

16.2.1.1 Acidic sample waste generated. All acidic waste will be accumulated in the appropriate waste accumulation container, labeled as Drum Type "A" or "B".

16.2.1.2 Contaminated disposable glass or plastic materials utilized in the analysis are disposed of in the sanitary trash. If the lab ware was used for the analysis of radioactive samples and contains radioactivity at a level of 100 cpm over background as determined by a GM meter, the lab ware will be collected in waste barrels designated for solid rad waste for disposal by the EH&S Coordinator.

17.0 REFERENCES

17.1 Method 1311, Toxicity Characteristic Leaching Procedure, Revision 0, July 1992, SW-846 Final Update II. (Source method.)
17.2 Method 1312, Synthetic Precipitation Leaching Procedure, Revision 0, September 1994, SW-846 Final Update II. (Source method.)
17.3 Toxicity Characteristic: Corrections to Final Rule. Method 1311, Federal Register, Vol. 55, No. 126, Friday, June 29, 1990.
17.4 Toxicity Characteristic: Final Rule. Method 1311, Federal Register, Vol. 55, No. 61, Thursday, March 29, 1990.
17.5 Technical Background Document and Response To Comments, Method 1311, Toxicity Characteristic Leaching Procedure, USEPA/OSW, April, 1989.
17.6 TestAmerica Quality Assurance Manual (QAM), current revision
17.7 TestAmerica Corporate Environmental Health and Safety Manual (CW-E-M-001) and St. Louis Facility Addendum (SOP ST-HS-0002), current revisions.
17.8 ASTM D3987-06, Standard Test Method for Shake Extraction of Solid Waste with Water1.
17.9 Associated SOPs
  17.9.1 ST-PM-0002, Sample Receipt and Chain of Custody
  17.9.2 ST-QA-0002, Standard and Reagent Preparation
  17.9.3 ST-QA-0005, Calibration and Verification Procedure for Thermometers, Balances, Weights and Pipettes
  17.9.4 ST-QA-0036, Non-conformance Memorandum (NCM) Process
  17.9.5 ST-OP-0002, Extraction and Cleanup of Organic Compounds from Water and Soils, Based on SW-846 3500 Series, 3600 Series, and 600 Series
  17.9.6 ST-OP-0007, Extraction and Cleanup of Herbicides from Water and Soils, Based on SW-846 8151A
  17.9.7 ST-IP-0013, Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by ICP Spectroscopy, and ICP/MS (Method 3010A)

17.9.8 ST-MT-0003, Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analysis, SW-846 Method 6010B and EPA Method 200.7
17.9.9 ST-MT-0005, Preparation and Analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW846 7470A and MCAWW 245.1
17.9.10 ST-MS-0001, GC/MS Analysis Based on Methods 8270C and 625
17.9.11 ST-MS-0002, Determination of Volatile Organics by GC/MS Based on Method 8260B, 624, and 524.2
17.9.12 ST-GC-0016 , Pesticide Gas Chromatography Analysis Method SW-846 8000C/8081B and EPA 608
17.9.13 ST-GC-0017, Herbicide Gas Chromatography Analysis Method SW-846 8000C/8151A
17.9.14 ST-WC-0011, Analysis of pH in Water

18.0 CLARIFICATIONS, MODIFICATIONS TO THE REFERENCE METHOD

18.1 Preliminary Evaluations. Section 7.1 of the source method states that the sample aliquot used for the preliminary evaluation "...may not actually undergo TCLP extraction." Section 7.1.5 of the source method indicates that the portion used for the preliminary evaluation may be used for either the ZHE or non-volatile extraction if the sample was 100% solid. Section 7.1.5 further indicates that if the sample was subjected to filtration (i.e., < 100% solid) that this aliquot may be used for the non-volatile extraction procedure only as long as sufficient sample is available (minimum 100 g). Samples which have been subjected to the oven drying step may not be used for TCLP extraction because solid phase degradation may result upon heating.

18.2 Percent Solids Determination. Section 7.1.2 of the source method indicates that "if the percent wet solids is ≥ 0.5% and it is noticed that a small amount of the filtrate is entrained in wetting of the filter" that the filter should be oven dried to determine percent dry solids ". Drying of oil or organic matrices can both be hazardous and inappropriate. Additionally, it may be impossible to achieve a constant weight when performing this step. Due to safety concerns, if obviously oily or heavy organic matrices are entrained on the filter, the filter is not oven dried.

18.3 TCLP Extraction Blanks. Section 8.1 of the source method states that a minimum of one blank for every 20 extractions "...that have been conducted in an extraction vessel." TestAmerica has interpreted this to mean one blank per twenty samples leached per TYPE of leaching vessel (i.e., Bottle or ZHE) per leach fluid used.

18.4 Determination of Appropriate Extraction Fluid. Method 1311 does not address the appropriate approach to take if the pH equals 5.0. This SOP requires that Fluid #1 must be used if the pH is less than or equal to 5.0.

18.5 QA/QC - Matrix Spikes. Section 8.2 of the source method states, "A matrix spike shall be performed for each waste type..." and "A minimum of one matrix spike must be analyzed for each analytical batch." Further, Section 8.2.3 of the source method also states, "The purpose of the matrix spike is to monitor the performance of the analytical methods used, and to determine whether matrix interferences exist." A minimum of one MS will be prepared for each TCLP leachate batch. The MS results are used to determine the effect of a matrix on the accuracy of the analytical process. Due to the potential variability of the matrix of each sample, the MS results have immediate bearing only on the specific sample spiked and not all samples in the batch.

19.0 CHANGES FROM PREVIOUS REVISION

19.1 Adding section 11.9; TCLP Procedure for Determination of Major Cations.
19.2 01/07/2011, Rev 0, SOP name changed from ST-IP-0016 to ST-OP-0009.
19.3 Revision 1:

- 19.3.1 Updated section 11.6.15 by replacing the use of pH strips with a pH probe.
- 19.3.2 Updated section 11.7.22 by replacing preserved VOA vials with unpreserved ones to store TCLP leachate samples.

19.4 Revision 2;

- 19.4.1 Removed reference for storing ZHE leachates in HCL persevered VOA vials in section 8.7.

19.5 Rev 3:

- 19.5.1 Updated section equipment in Section 6 (added aluminum weigh pans).
- 19.5.2 Updated the ZHE weighing procedure throughout section 11.0.

19.6 Revision 4 (4/2/14):

- 19.6.1 Updated Section 4.1 to include requirement to discuss and get documented client approval before running a total analysis on an oily sample and to include information on converting the total analysis to a “maximum leachable concentration.”
- 19.6.2 Added example/reference to form ORG-0034 TCLP MSA spreadsheet.

19.7 Revision 5 (6/5/15)

- 19.7.1 Removed left over reference to Quantims (Section 9.1.3)
- 19.7.2 Added note to Section 10.3 that the pH meter needs to be calibrated to bracket the pH level being measured.
- 19.7.3 19.7.3 Updated Section 11.5.5.8 regarding measuring the final pH.

Metals Spiking for MS/MSD:

Spike Volume	Solution	Metals	Concentration
0.25 mL	ICP Spike #1	Ca, Mg, K, Na	5000 ug/mL
		Al, As, Ba, Se, Tl	200 ug/mL
		Fe, Sr	100 ug/mL
		Co, Pb, Mn, Ni, V, Zn	50 ug/mL
		Cu	25 ug/ml
		Cr (trivalent)	20 ug/mL
		Be, Cd, Ag	5 ug/mL
0.25 mL	ICP Spike #2	Mo	100 ug/mL
		Sb	50ug/mL
0.05 mL	Hg Spike	Hg	3 ug/L

Figure 1 & 2 - Rotary Agitation Apparatus and Zero Headspace Extraction Vessel (ZHE)

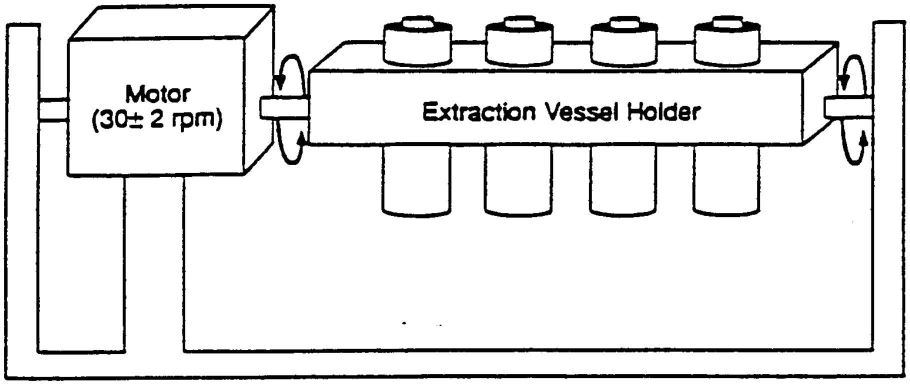


Figure 1. Rotary Agitation Apparatus

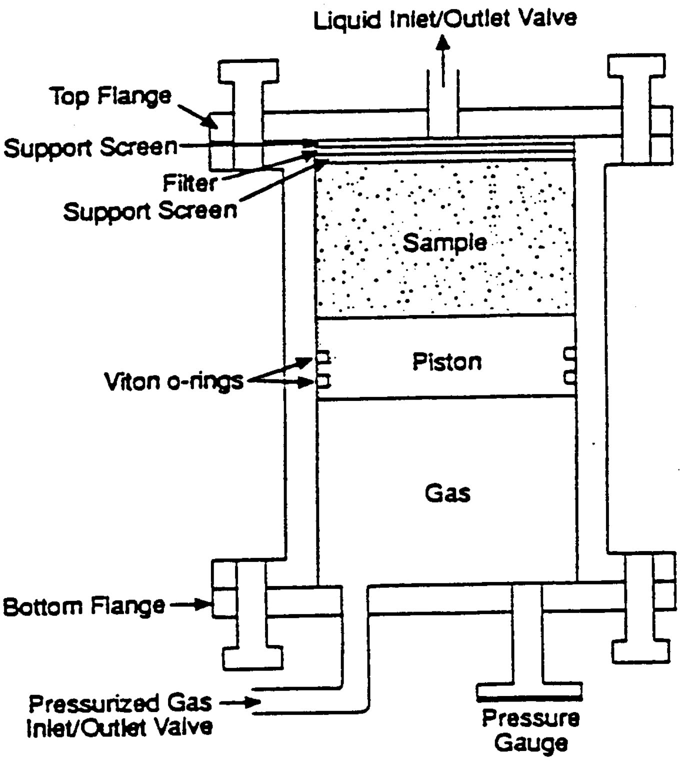
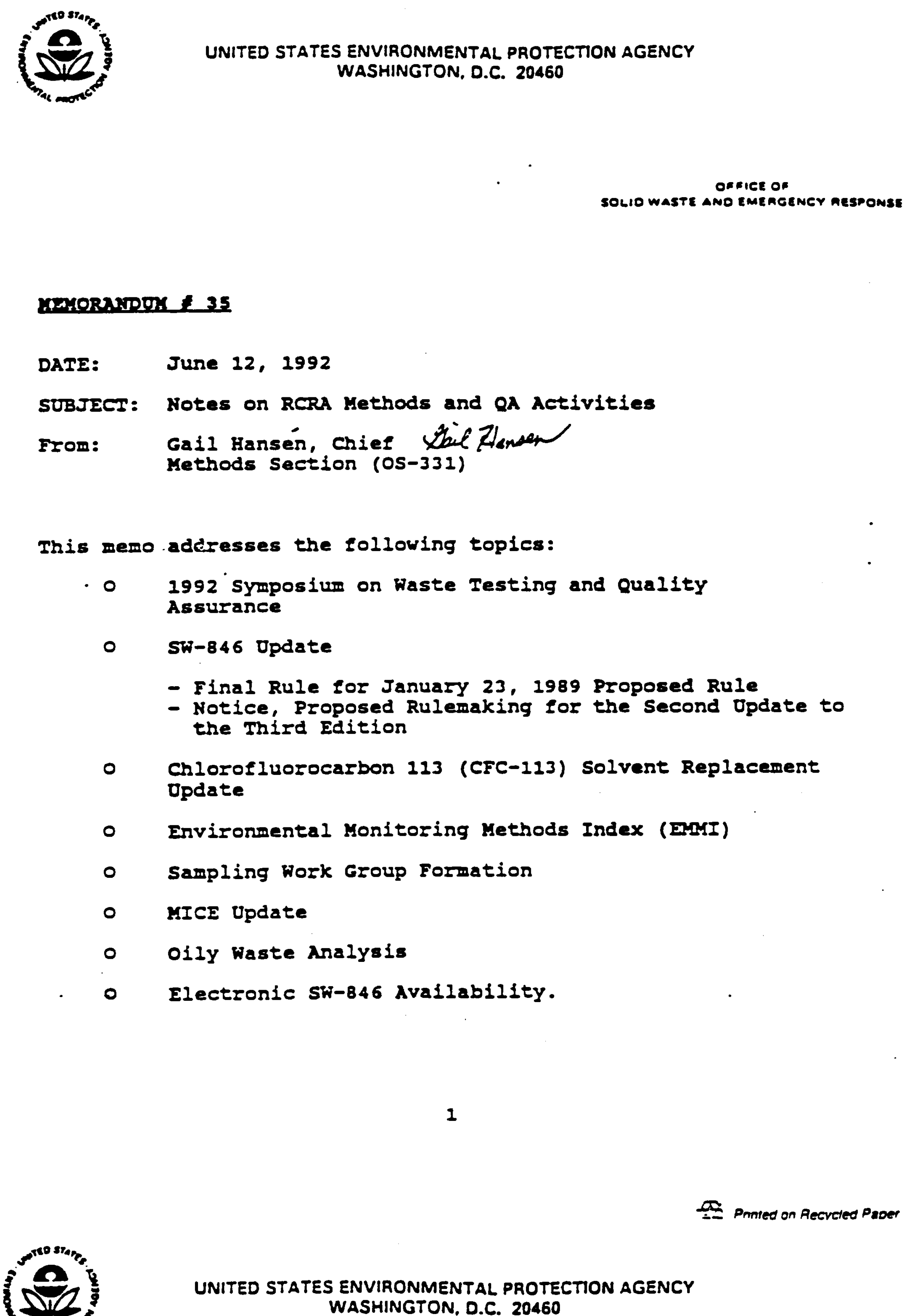


Figure 3 - US Environmental Protection Agency Memorandum #35, Page 1



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

MEMORANDUM # 35

DATE: June 12, 1992

SUBJECT: Notes on RCRA Methods and QA Activities

From: Gail Hansen, Chief Gail Hansen
Methods Section (OS-331)

This memo addresses the following topics:

- o 1992 Symposium on Waste Testing and Quality Assurance
- o SW-846 Update
  - Final Rule for January 23, 1989 Proposed Rule
  - Notice, Proposed Rulemaking for the Second Update to the Third Edition
- o Chlorofluorocarbon 113 (CFC-113) Solvent Replacement Update
- o Environmental Monitoring Methods Index (EMMI)
- o Sampling Work Group Formation
- o MICE Update
- o Oily Waste Analysis
- o Electronic SW-846 Availability.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Figure 3 - US Environmental Protection Agency Memorandum #35, Page 10

Oily Waste Analysis

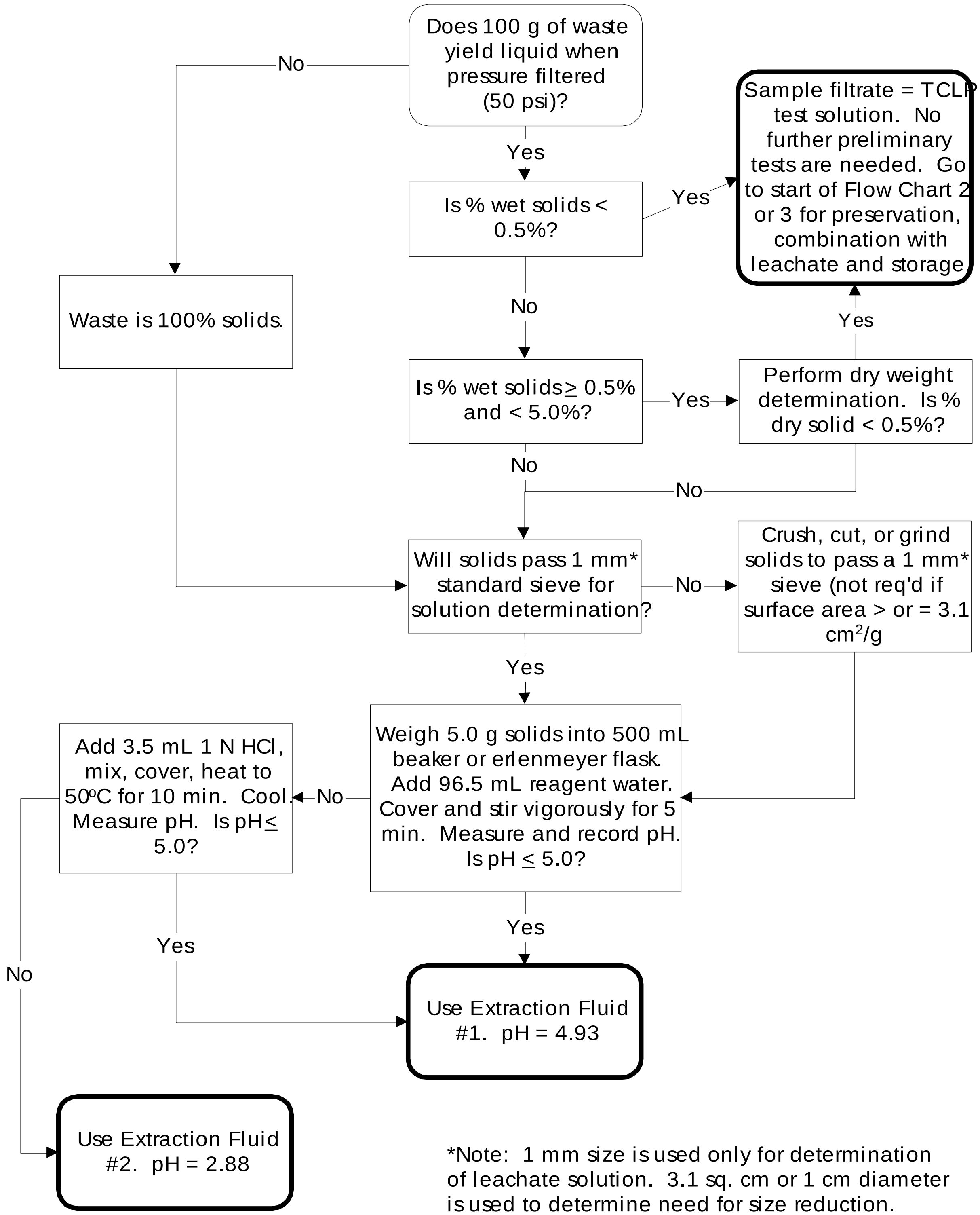
One of the most frequently asked questions on the MICE Service concerns the application of the TCLP, Method 1311, to oily wastes. Many callers request technical guidance on the extraction of oily wastes due to the difficulty in the filtration on these types of waste. In many cases, an oily waste does not filter completely due to premature clogging of the glass fiber filter. This can result in the retention of standing liquid on the glass fiber filter. Material that do not pass through the glass fiber filter at the conclusion of the filtration step is defined by the method as the solid phase of the waste. The solid phase is then subjected to the leaching procedure of the TCLP. For oily wastes, clogging of the glass fiber filter can result in an overestimation of the amount of solid material available for leaching.

To solve this problem, the Agency recommends a conservative approach, one that probably will overestimate the amount of leaching. Rather than performing the TCLP extraction on the unfiltered portion of the oily waste, assume the waste is 100% liquid (e.g., will pass through the glass fiber filter) and perform a totals analysis on the oily waste to determine if the oil exceeds the appropriate regulatory level.

Filterable waste oil generated during the TCLP must be analyzed for a variety of organic and inorganic analytes. The OSW recognizes the difficulty in achieving acceptable performance for the analysis of waste oil using methods currently provided in SW-846. As a result, the Agency will provide several new methods for the preparation and analysis of oil samples to the Organic Methods Workgroup in July. In addition, a microwave assisted digestion procedure should improve the analysis of metals and will be proposed as part of the Second Update of the Third Edition of SW-846. Brief descriptions of these techniques are provided below, for additional information on the organic procedures contact Barry Lesnik at (202) 260-7459. For additional information on microwave digestion contact Ollie Fordham (202) 260-4778.

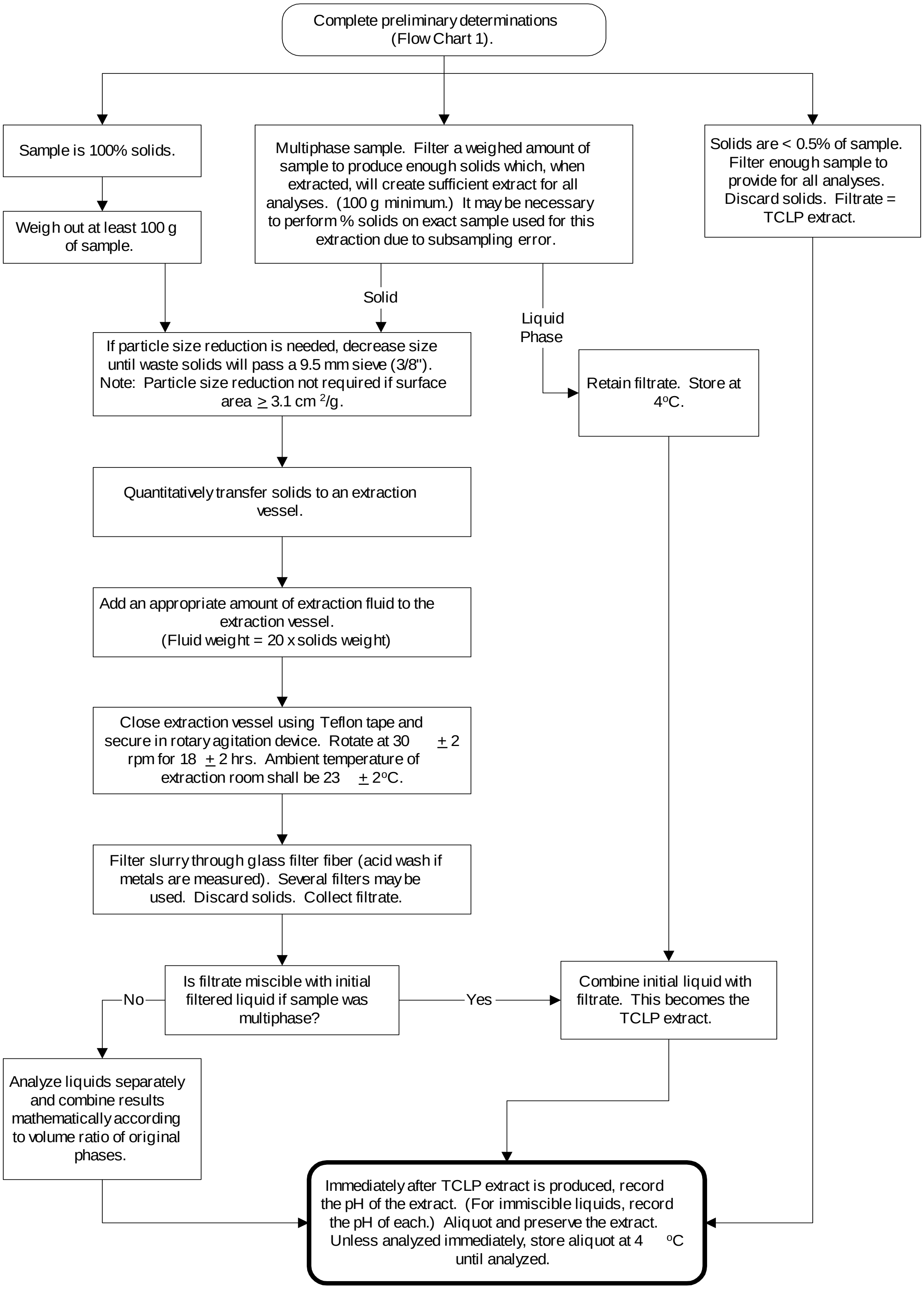
The use of purge-and-trap (Method 5030) for volatiles in oil generally results in severe contamination of analytical instrumentation. Traps, transfer lines and chromatography columns may become contaminated with oil. This leads to elevated baselines, hydrocarbon background in subsequent analyses, and cross-contamination. Headspace (Method 3810) is currently allowed only as a screening procedure in SW-846. The Agency is evaluating the use of headspace in conjunction with isotope dilution mass spectrometry for the quantitative analysis of volatiles in oil. Headspace reduces interference problems encountered with purge-and-trap. However, headspace quantitation can be questionable because the distribution of analytes is not

Flow Chart 1. Preliminary Sample Evaluation
(Section 11.2)



*Note: 1 mm size is used only for determination of leachate solution. 3.1 sq. cm or 1 cm diameter is used to determine need for size reduction.

Flow Chart 2. Bottle Extraction, Non-Volatile Constituents (Section 11.3)



Complete preliminary determinations (Flow Chart 1).

Sample is 100% solids.

Weigh out at least 100 g of sample.

Multiphase sample. Filter a weighed amount of sample to produce enough solids which, when extracted, will create sufficient extract for all analyses. (100 g minimum.) It may be necessary to perform % solids on exact sample used for this extraction due to subsampling error.

Solids are < 0.5% of sample. Filter enough sample to provide for all analyses. Discard solids. Filtrate = TCLP extract.

If particle size reduction is needed, decrease size until waste solids will pass a 9.5 mm sieve (3/8"). Note: Particle size reduction not required if surface area ≥ 3.1 cm ^{2}/g.

Retain filtrate. Store at 4°C.

Quantitatively transfer solids to an extraction vessel.

Add an appropriate amount of extraction fluid to the extraction vessel. (Fluid weight = 20 x solids weight)

Close extraction vessel using Teflon tape and secure in rotary agitation device. Rotate at 30 ± 2 rpm for 18 ± 2 hrs. Ambient temperature of extraction room shall be 23 ± 2°C.

Filter slurry through glass filter fiber (acid wash if metals are measured). Several filters may be used. Discard solids. Collect filtrate.

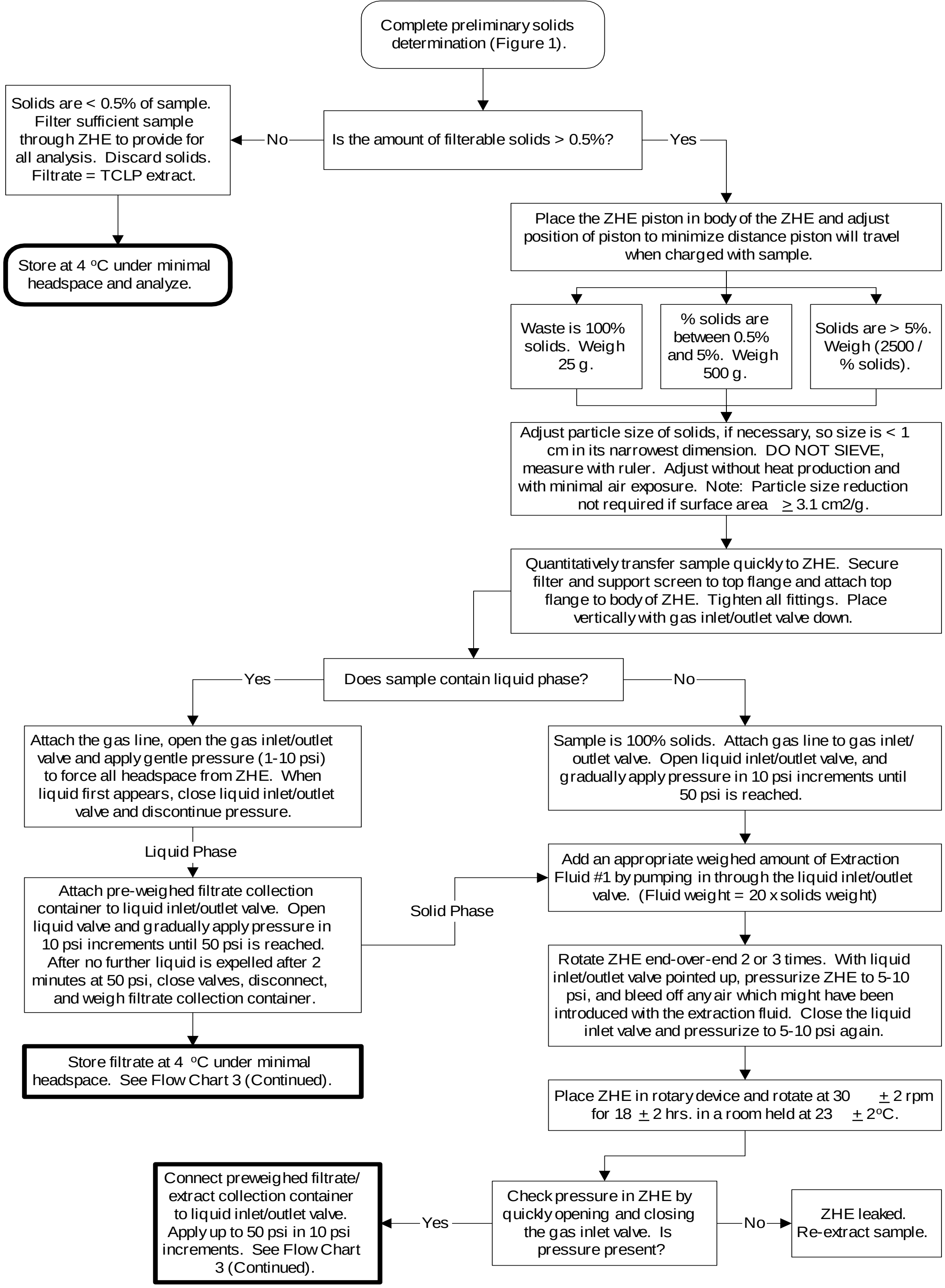
Is filtrate miscible with initial filtered liquid if sample was multiphase?

Combine initial liquid with filtrate. This becomes the TCLP extract.

Analyze liquids separately and combine results mathematically according to volume ratio of original phases.

Immediately after TCLP extract is produced, record the pH of the extract. (For immiscible liquids, record the pH of each.) Aliquot and preserve the extract. Unless analyzed immediately, store aliquot at 4 °C until analyzed.

Flow Chart 3. ZHE Extraction, Volatile Constituents (Section 11.4)



Complete preliminary solids determination (Figure 1).

Is the amount of filterable solids > 0.5%?

Solids are < 0.5% of sample. Filter sufficient sample through ZHE to provide for all analysis. Discard solids. Filtrate = TCLP extract.

Store at 4 °C under minimal headspace and analyze.

Place the ZHE piston in body of the ZHE and adjust position of piston to minimize distance piston will travel when charged with sample.

Waste is 100% solids. Weigh 25 g.

% solids are between 0.5% and 5%. Weigh 500 g.

Solids are > 5%. Weigh (2500 / % solids).

Adjust particle size of solids, if necessary, so size is < 1 cm in its narrowest dimension. DO NOT SIEVE, measure with ruler. Adjust without heat production and with minimal air exposure. Note: Particle size reduction not required if surface area ≥ 3.1 cm2/g.

Quantitatively transfer sample quickly to ZHE. Secure filter and support screen to top flange and attach top flange to body of ZHE. Tighten all fittings. Place vertically with gas inlet/outlet valve down.

Does sample contain liquid phase?

Attach the gas line, open the gas inlet/outlet valve and apply gentle pressure (1-10 psi) to force all headspace from ZHE. When liquid first appears, close liquid inlet/outlet valve and discontinue pressure.

Attach pre-weighed filtrate collection container to liquid inlet/outlet valve. Open liquid valve and gradually apply pressure in 10 psi increments until 50 psi is reached. After no further liquid is expelled after 2 minutes at 50 psi, close valves, disconnect, and weigh filtrate collection container.

Store filtrate at 4 °C under minimal headspace. See Flow Chart 3 (Continued).

Sample is 100% solids. Attach gas line to gas inlet/outlet valve. Open liquid inlet/outlet valve, and gradually apply pressure in 10 psi increments until 50 psi is reached.

Add an appropriate weighed amount of Extraction Fluid #1 by pumping in through the liquid inlet/outlet valve. (Fluid weight = 20 x solids weight)

Rotate ZHE end-over-end 2 or 3 times. With liquid inlet/outlet valve pointed up, pressurize ZHE to 5-10 psi, and bleed off any air which might have been introduced with the extraction fluid. Close the liquid inlet valve and pressurize to 5-10 psi again.

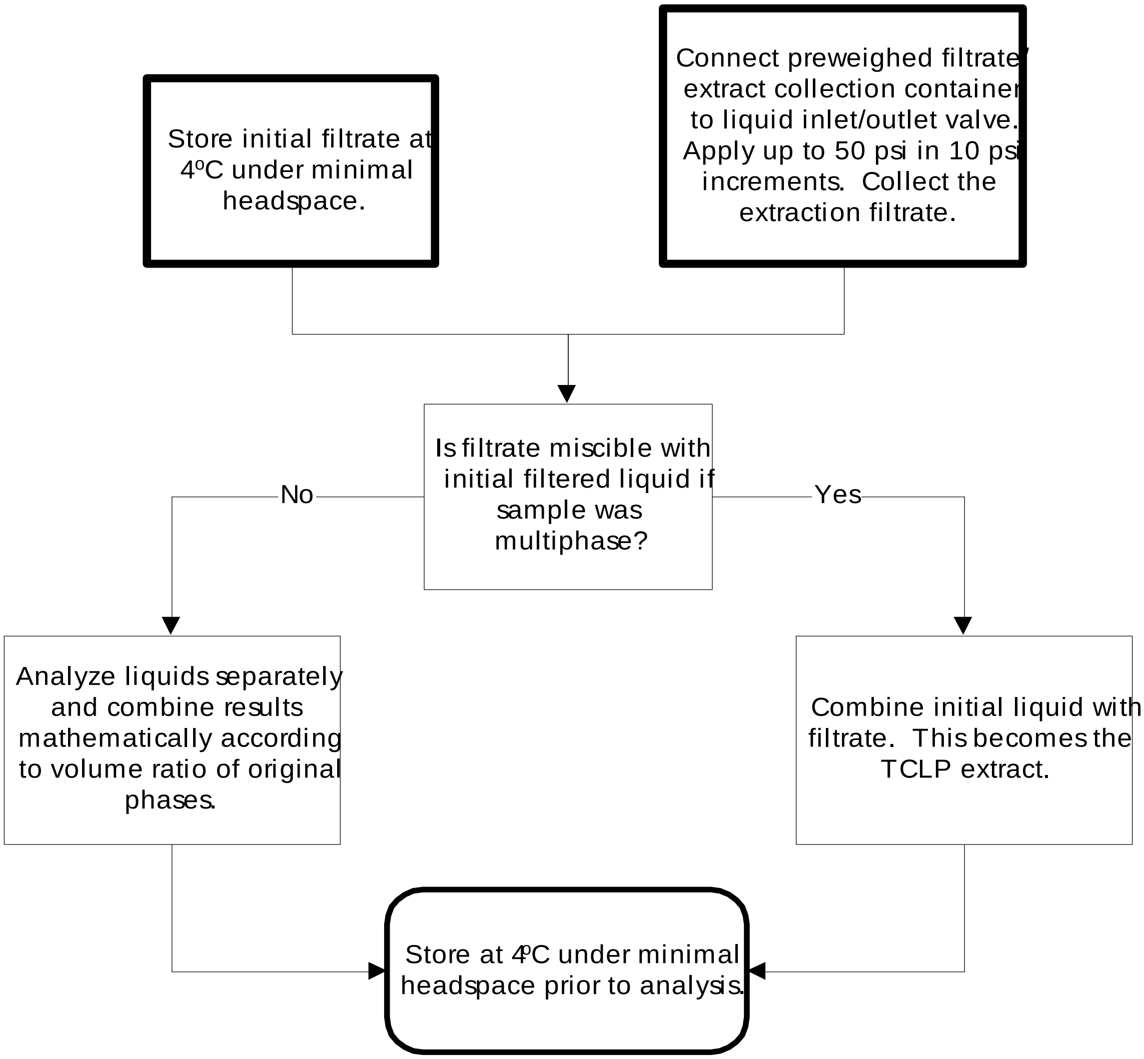
Place ZHE in rotary device and rotate at 30 ± 2 rpm for 18 ± 2 hrs. in a room held at 23 ± 2°C.

Check pressure in ZHE by quickly opening and closing the gas inlet valve. Is pressure present?

Connect preweighed filtrate/extract collection container to liquid inlet/outlet valve. Apply up to 50 psi in 10 psi increments. See Flow Chart 3 (Continued).

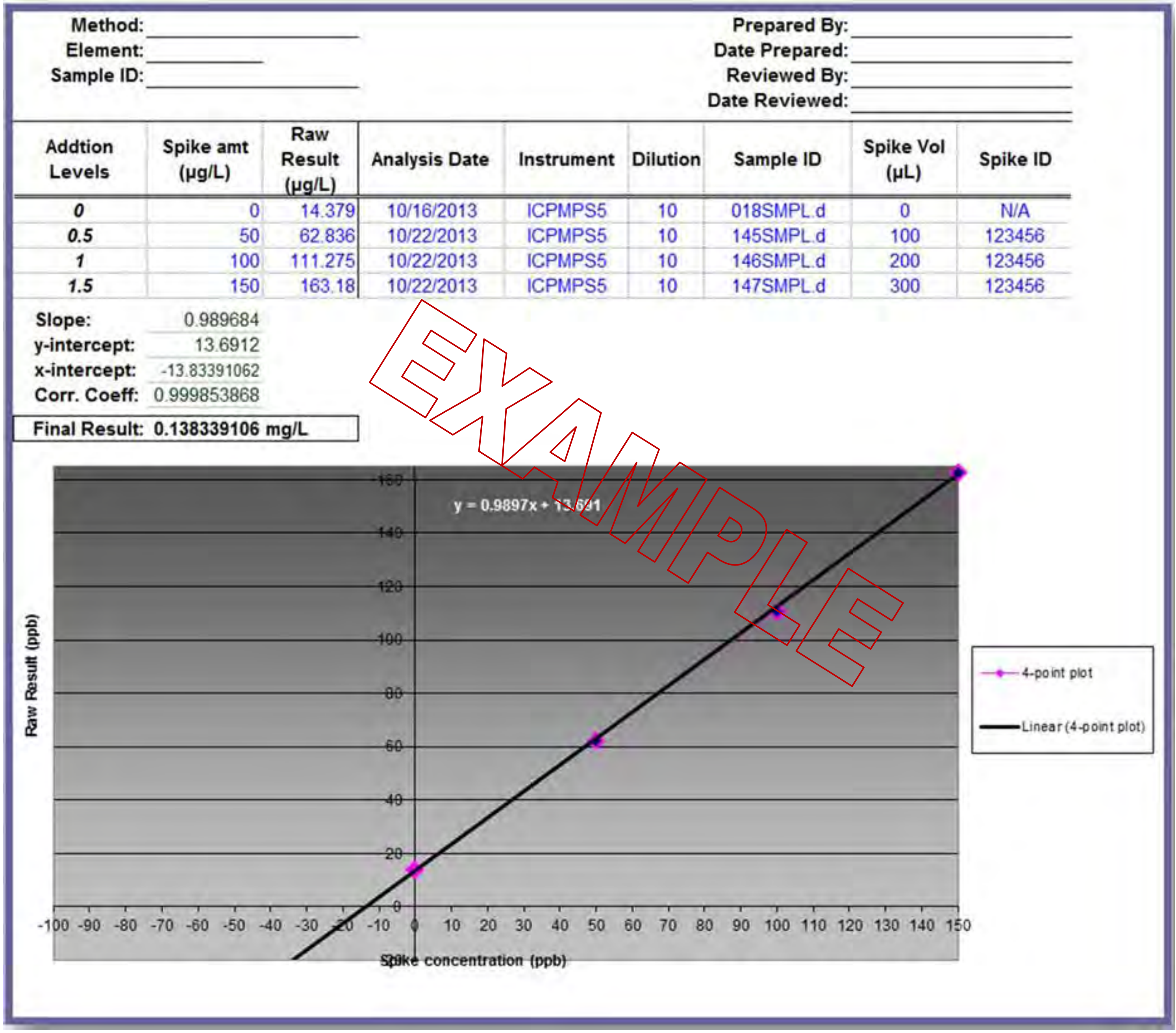
ZHE leaked. Re-extract sample.

Flow Chart 3. ZHE Extraction
(Continued)



ORG-0034 **TCLP MSA Spreadsheet Example**

TAFS\Lab\St Louis\Public\QA\FORMS\ORG



Method: ____________
Element: ____________
Sample ID: ____________

Prepared By: ____________
Date Prepared: ____________
Reviewed By: ____________
Date Reviewed: ____________

Addtion Levels	Spike amt (µg/L)	Raw Result (µg/L)	Analysis Date	Instrument	Dilution	Sample ID	Spike Vol (µL)	Spike ID
0	0	14.379	10/16/2013	ICPMPS5	10	018SMPL.d	0	N/A
0.5	50	62.836	10/22/2013	ICPMPS5	10	145SMPL.d	100	123456
1	100	111.275	10/22/2013	ICPMPS5	10	146SMPL.d	200	123456
1.5	150	163.18	10/22/2013	ICPMPS5	10	147SMPL.d	300	123456

Slope:	0.989684
y-intercept:	13.6912
x-intercept:	-13.83391062
Corr. Coeff:	0.999853868

Final Result: 0.138339106 mg/L

Title: Seta Flash Ignitability
[Method SW 1020A, *ASTM D3278-78*]

Approvals

Signatures on File

Stan Palmquist Date Inorganic Department Manager	Sandra Langway Date Health & Safety Manager / Coordinator
Terri Torres Date Quality Assurance Manager	Heather Prater Date Laboratory Director

Facility Distribution No. 001 **Distributed To:** Lab Intranet

1.0 Scope and Application

1.1 Analytes, Matrix(s), and Reporting Limits

1.1.1 This SOP is applicable to the operation of the Seta Flash Closed-Cup tester to determine the flash point of liquids or solids.

1.1.2 The practical working range of this method is <70℉ to <212℉.

1.1.3 On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 12.2.1 in the Quality Assurance Manual.

2.0 Summary of Method

2.1 By means of a syringe, 2.5 mL of sample is introduced through a leak-proof entry port into the tightly closed Setaflash Tester or into the cup which has been brought to within 5℉ (3℃) below the expected flash point.

2.2 As a flash/no-flash test, the expected flash-point temperature may be a specification (e.g., 212℉). For specification testing, the temperature of the apparatus is raised to the precise temperature of the specification flash point by adjustment of the temperature switch. After 1 minute, a test flame is applied inside the cup and note is taken as to whether the test sample flashes or not. If a repeat test is necessary, a fresh sample is used.

2.3 For a finite flash measurement, the temperature is sequentially increased through the anticipated range, the test flame being applied at 5℉ (3℃) intervals until the flame approximately doubles in size then applied at 1℉ (0.5°C) intervals until a flash is observed.

3.0 Definitions

3.1 Flash point - the lowest temperature at which a liquid or waste can form an ignitable mixture in air near the surface of the liquid or waste.

4.0 Interferences

~~4.1~~ Liquids that tend to form surface films under the test conditions or those that contain non-filterable suspended solids should be tested for ignitibility using Method 1010.

5.0 Safety

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.

5.1 Specific Safety Concerns or Requirements

5.1.1 In the event a sample ignites in the test apparatus, do not attempt to remove the sample. Turn off the apparatus and flame. The flame should go out when the cup is closed. If this does not happen the flame may be extinguished by covering the sample with a non-flammable material. After the apparatus has cooled the sample may be removed.

5.2 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 MSDS 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 MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material	Hazards	Exposure Limit (1)	Signs and symptoms of exposure
Toluene	Flammable Poison Irritant	200 ppm-TWA 300 ppm-Ceiling	Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Causes severe eye and skin irritation with redness and pain. May be absorbed through the skin.
p-xylene	Flammable Irritant	100 ppm-TWA	Inhalation of vapors may be irritating to the nose and throat. Inhalation of high concentrations may result in nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties, which may be delayed in onset. High vapor concentrations are anesthetic and central nervous system depressants. Skin contact results in loss of natural oils and often results in a characteristic dermatitis. May be absorbed through the skin. Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
1 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Instrumentation

- Seta Flash Closed-Cup Tester

7.0 Reagents and Standards

7.1 Document reagent/standards and reagent/standard preparation in TALS using the reagent module as described in SOP TA-QA-0619.

7.2 p-xylene

7.3 Managers/supervisors or a designee are expected to check their areas on a monthly basis for expired standards and dispose of them according to SOP TA-EHS-0036.

8.0 Sample Collection, Preservation, Shipment and Storage

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time	Reference
Waters	Glass	15 mLs	Minimum headspace; Cool 0-6°C	N/A	N/A

9.0 Quality Control

9.1 The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section.

9.2 The laboratory's standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in SOP TA-QA-0620, Quality Control Program.

9.4 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.

9.5 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 TA-QA-0610. This is in addition to the corrective actions described in the following sections.

9.6 Batch Definition

A group of up to 20 samples that are of the same matrix and are processed together using the same procedures and reagents. The preparation batch must contain a laboratory control sample (LCS), and duplicate (DUP). As discussed in the following sections, special program or project requirements can include additional requirements. Always refer to special project instructions for details before proceeding with the analysis.

9.7 Method Blank (MB)

Method blanks (MB) are not applicable to this technique.

9.8 Laboratory Control Sample (LCS)

A p-xylene standard is flashed in duplicate to ensure proper working of the system.

Acceptance Criteria: p-xylene mean should be at 81 ± 1.5°F (27.2 ± 1°C).

Corrective Action: If p-xylene does not flash within the specified temperature range, the analysis is stopped, the problem corrected by cleaning the cup and starting over. No samples are analyzed until an acceptable result is achieved with the p-xylene.

9.9 Duplicate Sample Analysis

A duplicate pair is required with each analytical batch and must be within 20% RPD. If there isn't sufficient sample for a duplicate sample analysis, then a LCSD (9.8) must also be processed and reported. The process of establishing control limits is described in more detail in the QC SOP TA-QA-0620.

Corrective Action: If the RPD is greater than 20 the sample should be reanalyzed.

9.10 Any extra QC that is analyzed in a batch or sequence must be evaluated using the same criteria as the corresponding QC above.

10.0 Procedure

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 in procedure shall be completely documented using an 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 department also receives NCMs by e-mail for tracking and trending purposes. The NCM process is described in more detail in SOP # TA-QA-0610. The NCM shall be filed in the project file and addressed in the case narrative.

10.1 Sample Preparation

None

10.2 Calibration

10.2.1 The thermometer is calibrated annually per SOP TA-QA-0024.

10.3 Sample Analysis

10.3.1 Record barometric pressure for the batch at the time the first sample is started.

10.3.2 Shake or stir the sample and note any odor (to determine the presence of gasoline or similarly combustible material).

10.3.3 Place 2.5 mL of a liquid sample through the sample tube into the flash chamber.

10.3.4 Push the time-start button and light the flame.

10.3.5 When the timer sounds, slowly lower the flame into the flash chamber.

10.3.6 If the sample flashes at room temperature or does not flash by 212°, report the sample as <70° or >212°. If the sample flashes bet ween 70° and 212°, repeat the analysis and report the average.

10.3.7 Clean the cup out with toluene if necessary. Check clean cup for flash to be sure all toluene is consumed.

10.3.8 Record the uncorrected temperature and then apply the thermometer's temperature correction factor to the temperature reading and record the corrected temperature.

10.4 Calculations / Data Reduction

*The results are reported in °F. If a °C thermometer is used, the following temperature conversion must be used. F=C*9/5+32*

For the barometric pressure correction calculations use the following formula:
Calculated Flash = F+0.06(760-P)*
Calculated Flash = C+0.03(760-P)*
Where F is Fahrenheit and C is Centigrade and P is the observed barometric pressure in mm Hg

Note: If the barometric pressure is between 760 ± 8 mm Hg no correction is needed.

11.0 Method Performance

11.1 Method Detection Limit Study (MDL)

A method detection limit (MDL) study is not performed for this analysis.

11.2 Demonstration of Capabilities

Analyst initial and continuing Demonstrations of Capability (DOC) are performed before any client samples are analyzed and are updated annually. See SOP TA-QA-0617 for details.

11.3 Training Requirements

See SOP TA-QA-0608 for detailed training requirements.

12.0 Pollution Control

It is TestAmerica's 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."

13.0 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 SOP TA-EHS-0036.

13.1 The following waste streams are produced when this method is carried out:

Excess flammable samples/solvents. Any waste samples or solvents from the procedure are collected in a flammable satellite container labeled "Hazardous Waste" located in the cabinet under the hood. When the satellite container is full it is emptied into the waste solvent barrel located next to the neutralization tank in lab hood #17. The funnel lid on the drum must be closed after each use. At or before the satellite waste reaches 55 gallons, the barrel is transferred to the waste disposal room from where it is sent out for recycling or fuel blending.

14.0 References / Cross-References

14.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Method 1020A.

15.0 Method Modifications:

None

16.0 Attachments

None

17.0 Revision History

- Revision 16, dated 20 November 2013
    - Added instructions to record barometric pressure, Section 10.3.1
    - Added Celsius to Fahrenheit conversion and calculation for barometric pressure correction, section 10.4

- Revision 15, dated 8 October 2012
    - Procedural and reporting instructions were added, Section 10.3.5
    - Updated waste streams, section 13.1

- Revision 14, dated 16 May 2011
    - Removed soil testing procedures (ROMD 00014)
    - Incorporated ROMD 00021 in section 10.3.6
    - Incorporated ROMD 00025 in section 9.9

- Revision 13, dated 16 April 2010
    - Added documentation of standards/reagents and standard/reagent preparation Section 7.1
    - Added removal of expired standards Section 7.4.
    - Added criteria for additional QC, Section 9.10.

- Revision 12, dated 2 December 2008
    - Integration for TestAmerica and STL operations.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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ENVIRONMENTAL

Valid To: November 30, 2015 Certificate Number: 2907.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories), 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, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon, Total Organic Halide

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Metals				
Aluminum	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Antimony	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Arsenic	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Barium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Beryllium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Boron	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Cadmium	EPA 6010C	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Calcium	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Chromium	EPA 6010C	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Cobalt	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Copper	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Iron	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Lead	EPA 6010C	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Lithium	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Magnesium	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Manganese	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Mercury	---------------------	---------------------	EPA 7470A	EPA 7471A / 7471B
Molybdenum	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Nickel	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Potassium	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Selenium	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Silica	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Silicon	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Silver	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Sodium	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Strontium	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Thallium	---------------------	---------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Tin	---------------------	---------------------	EPA 6010B / 6010C	EPA 6010B / 6010C

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Titanium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Vanadium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Zinc	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Nutrients				
Nitrate (as N)	----------------------	By calculation	By calculation / EPA 9056 / 9056A	By calculation / EPA 9056 / 9056A
Nitrate-nitrite (as N)	----------------------	EPA 353.2	EPA 353.2 / 9056 / 9056A	EPA 9056 / 9056A
Nitrite (as N)	----------------------	SM 4500-NO2 B	SM 4500-NO2 B; EPA 9056 / 9056A	EPA 9056 / 9056A
Orthophosphate (as P)	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Total phosphorus	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Demands				
Total Organic Carbon	----------------------	----------------------	EPA 9060 / 9060A	EPA 9060 / 9060A
Total Organic Halides	----------------------	----------------------	EPA 9020B	----------------------
Wet Chemistry				----------------------
Alkalinity (Total Bicarbonate, Carbonate, and Hydroxide Alkalinty)	----------------------	SM 2320 B_1997	SM 2320 B	SM 2320 B
Ammonia	----------------------	EPA 350.1	EPA 350.1	----------------------
Biological Oxygen Demand	----------------------	SM 5210B	SM 5210B	----------------------
Bromide	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Chloride	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Chemical Oxygen Demand	----------------------	EPA 410.4	EPA 410.4	----------------------
Conductivity	----------------------	----------------------	EPA 9050 / 9050A	EPA 9050 / 9050A
Cyanide	----------------------	----------------------	9012A / 9012B	9012A / 9012B
Ferrous Iron	----------------------	SM 3500 Fe B, D	SM 3500 Fe B, D	----------------------
Fluoride	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Hexavalent Chromium	EPA 7196A	----------------------	EPA 7196A	----------------------
pH	----------------------	----------------------	EPA 9040B / 9045C	EPA 9045C / 9045D
Oil and Grease (HEM and SGT-HEM)	----------------------	----------------------	EPA 1664A/ 1664B	9071B
Percent Moisture	----------------------	----------------------	----------------------	ASTM D2216
Perchlorate	----------------------	----------------------	EPA 6860	EPA 6860
Phenols	----------------------	----------------------	EPA 9066	EPA 9066
Solids, Total	----------------------	SM 2540 B	SM 2540 B	SM 2540 B
Solids, Total Suspended	----------------------	SM 2540 D	SM 2540 D	SM 2540 D
Solids, Total Dissolved	----------------------	SM 2540 C	SM 2540 C	SM 2540 C
Sulfate	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Sulfide, Total	----------------------	----------------------	EPA 9034	EPA 9034
Sulfide	----------------------	----------------------	EPA 9030B	EPA 9030B
Total Kjeldahl Nitrogen	----------------------	----------------------	EPA 351.2	----------------------

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Purgeable Organics (volatiles)				----------------------
Acetone	----------------------	----------------------	EPA 8260B	EPA 8260B
Acetonitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
Acrolein	----------------------	----------------------	EPA 8260B	EPA 8260B
Acrylonitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
Allyl Chloride	----------------------	----------------------	EPA 8260B	EPA 8260B
tert-Amyl Methyl Ether	EPA 8260B			
Benzene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101/ OK DEQ GRO/ 8260B SIM	EPA 8260B / 8021B / AK101/ OK DEQ GRO
Bromobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromochloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromodichloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromoform	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromomethane	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Butanone	----------------------	----------------------	EPA 8260B	EPA 8260B
n-Butyl alcohol	----------------------	----------------------	EPA 8260B / 8015B / 8015C	EPA 8260B / 8015B / 8015C
tert-Butyl alcohol (2-Methyl-2-Propanol)	EPA 8260B		EPA 8260B / 8260B SIM	EPA 8260B
n-Butylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
sec-Butylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
tert-Butylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Carbon disulfide	----------------------	----------------------	EPA 8260B	EPA 8260B
Carbon tetrachloride	----------------------	----------------------	EPA 8260B	EPA 8260B
Chlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B
2-Chloro-1,3-butadiene	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Chloroethyl vinyl ether	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloroform	----------------------	----------------------	EPA 8260B	EPA 8260B
1-Chlorohexane	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloroprene	----------------------	----------------------	EPA 8260B	EPA 8260B
4-Chlorotoluene	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Chlorotoluene	----------------------	----------------------	EPA 8260B	EPA 8260B
Cyclohexane	----------------------	----------------------	EPA 8260B	EPA 8260B
Cyclohexanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Dibromochloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	----------------------	EPA 504.1	EPA 504.1 / 8260B / 8011	EPA 8260B / 8011
Dibromochloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Dichlorodifluoromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Dibromomethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2 Dibromoethane (EDB)	EPA 8011	EPA 504.1	EPA 504.1 / 8260B / 8011	EPA 8260B / 8011
1,2-Dichlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
1,3-Dichlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B
1,4-Dichlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B
cis-1,4-Dichloro-2-butene	----------------------	----------------------	EPA 8260B	EPA 8260B
trans-1,4-Dichloro-2-butene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1-Dichloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dichloroethane	EPA 8260B	----------------------	EPA 8260B	EPA 8260B
1,1-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
cis-1,2-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
trans-1,2-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
Dichlorofluoromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dichloropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,3-Dichloropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
2,2-Dichloropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,3-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
cis-1,3-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
trans-1,3-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
Diethyl ether	----------------------	----------------------	EPA 8260B	EPA 8260B
Di-isopropylether	EPA 8260B	----------------------	EPA 8260B	EPA 8260B
1,4-Dioxane	----------------------	----------------------	EPA 8260B / 8260B SIM	EPA 8260B / 8260B SIM
Ethanol	----------------------	----------------------	EPA 8260B / 8015B / 8015C	EPA 8260B / 8015B / 8015C
Ethyl Acetate	----------------------	----------------------	EPA 8260B	EPA 8260B
Ethyl Benzene	EPA 8260B/8021B	----------------------	EPA 8260B / 8021B / AK101/ OK DEQ GRO	EPA 8260B / 8021B/ AK101/ OK DEQ GRO
Ethyl Methacrylate	----------------------	----------------------	EPA 8260B	EPA 8260B
Ethyl tert-Butyl Ether	EPA 8260B	----------------------	----------------------	----------------------
Ethylene Glycol	----------------------	----------------------	EPA 8015C	EPA 8015C
Gas Range Organics (GRO)	EPA 8015C	----------------------	EPA 8015B / 8015C / AK101 / 8015D/ OK DEQ GRO	EPA 8015B / 8015C / AK101 / 8015D/ OK DEQ GRO
Hexane	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Hexanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Hexachlorobutadiene	----------------------	----------------------	EPA 8260B	EPA 8260B
Isobutyl Alcohol (2-Methyl-1-propanol)	----------------------	----------------------	EPA 8260B / 8015B / 8015C	EPA 8260B / 8015B / 8015C
Isopropyl Alcohol	----------------------	----------------------	EPA 8260B	EPA 8260B
Isopropylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,4-Isopropyltoluene	----------------------	----------------------	EPA 8260B	EPA 8260B
Iodomethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Methacrylonitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
Methanol	----------------------	----------------------	EPA 8015B / 8015C	EPA 8015B / 8015C
Methyl Acetate	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl Cyclohexane	----------------------	----------------------	EPA 8260B	EPA 8260B
Methylene Chloride	----------------------	----------------------	EPA 8260B	EPA 8260B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Methyl Ethyl Ketone (MEK)	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl Isobutyl Ketone	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl Methacrylate	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl tert-Butyl Ether (MtBE)	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / OK DEQ GRO	EPA 8260B / 8021B/ OK DEQ GRO
4-Methyl-2-Pentanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Naphthalene	EPA 8260B / 8021B	----------------------	EPA 8260B/ OK DEQ GRO	EPA 8260B / OK DEQ GRO
2-Nitropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
2,2' Oxybisethanol	----------------------	----------------------	EPA 8015C	EPA 8015C
2-Pentanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Propionitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
n-Propylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Propylene Glycol	----------------------	----------------------	EPA 8015C	EPA 8015C
Styrene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,1,2-Tetrachloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,2,2-Tetrachloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Tetrachloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
Tetrahydrofuran	----------------------	----------------------	EPA 8260B	EPA 8260B
Toluene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO
Total Petroleum Hydrocarbons (TPH)	----------------------	EPA 1664A EPA 1664B	EPA 1664A EPA 1664B	----------------------
1,2,3-Trichlorobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,1-Trichloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,2-Trichloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Trichloroethene	----------------------	----------------------	EPA 8260B / 8260B SIM	EPA 8260B
Trichlorofluoromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,3-Trichlorobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,4-Trichlorobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,3-Trichloropropane	----------------------	EPA 504.1	EPA 504.1 / 8260B / 8011	EPA 8260B / 8011
1,1,2-Trichloro-1,2,2-trifluoroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Triethylene Glycol	----------------------	----------------------	EPA 8015C	EPA 8015C
1,2,3-Trimethylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,4-Trimethylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,3,5-Trimethylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Vinyl Acetate	----------------------	----------------------	EPA 8260B	EPA 8260B
Vinyl Chloride	----------------------	----------------------	EPA 8260B / 8260B SIM	EPA 8260B
Xylenes, total	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO
1,2-Xylene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
M+P-Xylene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO
Methane	----------------------	----------------------	RSK-175	----------------------
Ethane	----------------------	----------------------	RSK-175	----------------------
Ethylene (Ethene)	----------------------	----------------------	RSK-175	----------------------
Acetylene	----------------------	----------------------	RSK-175	----------------------
Acetylene Ethane	----------------------	----------------------	RSK-175	----------------------
Extractable Organics (semivolatiles)				
Acenaphthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Acenaphthylene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Acetophenone	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Acetylaminofluorene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Alachlor	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Aminobiphenyl	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Aniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Anthracene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Aramite	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Atrazine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Azobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzaldehyde	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzoic acid	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzo (a) Anthracene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (b) Fluoranthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (k) Fluoranthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (ghi) Perylene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (a) Pyrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzyl Alcohol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Bis (2-chloroethoxy) methane	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Bis (2-chloroethyl) Ether	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Bis (2-chloroisopropyl) Ether (2,2'Oxybis(1-chloropropane)	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Bis (2-ethylhexyl) Phthalate	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Bromophenyl Phenyl Ether	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Butyl Benzyl Phthalate	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-sec-Butyl-4,6-Dinitrophenol	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Carbazole	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Chloroanilene	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Chlorobenzilate	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Chloro-3-Methylphenol	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1-Chloronaphthalene	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Chloronaphthalene	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Chlorophenol	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Chlorophenyl Phenyl Ether	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Chrysene	---------------------	---------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Cresols	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diallate	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Dibenzo (a,h) Anthracene	---------------------	---------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Dibenzofuran	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2-Dichlorobenzene	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,3-Dichlorobenzene	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,4-Dichlorobenzene	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3,3'-Dichlorobenzidine	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dichlorophenol	---------------------	---------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
2,6-Dichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diethyl phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Dimethoate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3,3-Dimethylbenzidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
p-Dimethylaminoazobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
7,12-Dimethylbenz(a)anthracene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Alpha-,alpha-Dimethylphenethylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dimethylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Dimethyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Di-n-Butyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Di-n-Octyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,3-Dinitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,4-Dinitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dinitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dinitrotoluene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,6-Dinitrotoluene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,4-Dioxane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diphenylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2-Diphenylhydrazine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Disulfoton	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diesel Range Organics (DRO)	EPA 8015C	----------------------	EPA 8015B / 8015C, AK102/ 8015D / OK DEQ DRO	EPA 8015B / 8015C, AK102 / 8015D / OK DEQ DRO
Ethyl Methanesulfonate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Famphur	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Fluoroanthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Fluorene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM

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Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Hexachlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachlorobutadiene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachlorocyclopentadiene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachloroethane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachloropropene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Indeno (1,2,3-cd) Pyrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Isodrin	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Isophorone	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Isosafrole	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Methapyrilene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3-Methylcholanthrene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Methyl-4,6-Dinitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Methyl Methane Sulfonate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1-Methylnaphthalene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
2-Methylnaphthalene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
2-Methylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3+4-Methylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Naphthalene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
1,4-Naphthoquinone	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1-Naphthylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Naphthylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Nitroaniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3-Nitroaniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Nitroaniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Nitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Nitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
4-Nitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Nitroquinoline-1-Oxide	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodiethylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodimethylamine	----------------------	----------------------	EPA 8270C / 8270D/ 8270D SIM	EPA 8270C / 8270D/ 8270D SIM
N-Nitrosodi-n-Butylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodi-n-Propylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodiphenylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosomethylethylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosomorpholine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosopiperidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosopyrrolidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
5-Nitro-o-Toluidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,2-oxybis(1-chloropropane)	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Parathion, Methyl	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Parathion, Ethyl	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachloroethane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachloronitobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachlorophenol	----------------------	----------------------	EPA 8270C / 8270D / 8321A / 8321B	EPA 8270C / 8270D / 8321A / 8321B
Phenacetin	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Phenanthrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Phenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Phorate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Picoline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pronamide	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Pyrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Pyridine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Safrole	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Sulfotepp	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2,4,5-Tetrachlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,3,4,6-Tetrachlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Thionazin	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
o-Toluidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2,4-Trichlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4,5-Trichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4,6-Trichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
o,o,o-Triethyl Phosphorothioate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,3,5-Trinitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Motor Oil (Residual Range Organics)	----------------------	----------------------	EPA 8015B / 8015C, 8015D, AK103 / OK DEQ RRO	EPA 8015B / 8015C, 8015D, AK103 / OK DEQ RRO
Pesticides/Herbicides/PCBs				
Aldrin	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Atrazine	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Azinophos ethyl	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Azinophos methyl	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
alpha-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
beta-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
delta-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
gamma-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Bolstar	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
alpha-Chlordane	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
gamma-Chlordane	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Chlordane (technical)	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Chloropyrifos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Coumaphos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
2,4-D	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A /8321A
Dalapon	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
2,4-DB	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
4,4'-DDD	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
4,4'-DDE	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
4,4'-DDT	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Demeton-O	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Demeton-S	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Demeton, total	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Diazinon	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Dicamba	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Dichlorovos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Dichloroprop	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Dieldrin	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Dimethoate	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Dinoseb	----------------------	----------------------	EPA 8151A / 8321A	EPA 8321A
Disulfoton	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Endosulfan I	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endosulfan II	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endonsulfan sulfate	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endrin	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endrin aldehyde	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Endrin ketone	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
EPN	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Ethoprop	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Ethyl Parathion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Famphur	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Fensulfothion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Fenthion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Heptachlor	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Heptachlor Epoxide	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Hexachlorobenzene	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Malathion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
MCPA	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
MCPP	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Merphos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Methoxychlor	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Methyl parathion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Mevinphos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Naled	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
PCB-1016 (Arochlor)	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1221	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1232	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1242	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1248	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1254	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1260	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1262	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1268	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
Total PCBs	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
Phorate	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Phosmet	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Propazine	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Ronnel	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Simazine	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Stirophos	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Sulfotepp	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
2,4,5-T	---------------------	---------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Thionazin	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Tokuthion	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
2,4,5-TP	---------------------	---------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Toxaphene	---------------------	---------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Trichloronate	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
o,o,o-Triethylphos Phorothioate	---------------------	---------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Explosives				
1,3,5-Trinitrobenzene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
1,3-Dinitrobenzene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2,4,6-Trinitrotoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
3,5-Dinitroaniline	---------------------	---------------------	EPA 8330B	EPA 8330B
2,4-Dinitrotoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2,6-Dinitroltoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2-Amino-4,6-Dinitrotoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2-Nitrotoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
3-Nitrotoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
4-Amino-2,6-Dinitrotoluene	---------------------	---------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
4-Nitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Nitrobenzene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Nitroglycerin	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Octahydro-1,3,5,7-Tetrabitro-1,3,5,7-Tetrazocine (HMX)	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Pentaerythritoltetranitrate (PETN)	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Picric acid	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
RDX (Hexahydro-1,3,5-Trinitro-1,3,5-Triazine)	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Tetryl (Methyl 2,4,6-Trinitrophenylnitramine	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Perfluorinated Hydrocarbons (PFCs) and Perfluorinated Sulfonates (PFSs)				
Perfluorobutanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluoropentanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorohexanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluoroheptanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorooctanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorononanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorodecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluoroundecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorododecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorotridecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorotetradecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorobutane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorohexane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorooctane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorodecane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorooctane Sulfonamide	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Hazardous Waste Characteristics				
Conductivity	----------------------	----------------------	EPA 9050A	EPA 9050A
Corrosivity	----------------------	----------------------	EPA 9040B/ 9040C	EPA 9045C / 9045D
Ignitibility	----------------------	EPA 1010/EPA 1010A	EPA 1010 / 1010A	EPA 1010 / 1010A

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Paint Filter Liquids Test	----------------------	----------------------	EPA 9095A	EPA 9095A
Synthetic Precipitation Leaching Procedure (SPLP)	----------------------	----------------------	EPA 1312	EPA 1312
Toxicity Characteristic Leaching Procedure	----------------------	----------------------	EPA 1311	EPA 1311
Organic Prep Methods				
Separatory Funnel Liquid-Liquid Extraction	----------------------	----------------------	EPA 3510C	-----------------------
Continuous Liquid-Liquid Extraction	----------------------	----------------------	EPA 3520C	-----------------------
Soxhlet Extraction	----------------------	----------------------	-----------------------	EPA 3540C
Microwave Extraction	----------------------	----------------------	-----------------------	EPA 3546
Ultrasonic Extraction	----------------------	----------------------	-----------------------	EPA 3550B
Ultrasonic Extraction	----------------------	----------------------	-----------------------	EPA 3550C
Waste Dilution	----------------------	----------------------	EPA 3580A	EPA 3580A
Solid Phase Extraction Volatiles Purge and trap Volatiles Purge and Trap for Soils	----------------------	----------------------	EPA 3535A EPA 5030B	EPA 5030B EPA 5035
Organic Cleanup Procedures				
Florisil Cleanup	----------------------	----------------------	EPA 3620B	EPA 3620B
Florisil Cleanup	----------------------	----------------------	EPA 3620C	EPA 3620C
Sulfur Cleanup	----------------------	----------------------	EPA 3660B	EPA 3660B
Sulfuric Acid/Permanganate Cleanup	----------------------	----------------------	EPA 3665A	EPA 3665A
Metals Digestion				
Acid Digestion Total Recoverable or Dissolved Metals	----------------------	----------------------	EPA 3005A	----------------------
Acid Digestion for Total Metals	----------------------	----------------------	EPA 3010A	----------------------
Acid Digestion for Total Metals	----------------------	----------------------	EPA 3020A	----------------------
Acid Digestion of Sediments, Sludges and Soils	----------------------	----------------------	----------------------	EPA 3050B

American Association for Laboratory Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

TESTAMERICA DENVER

Arvada, CO

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 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD 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 8 January 2009).

SEAL 1978
A2LA

Presented this 5th day of November 2013.

Peter Unger

President & CEO
For the Accreditation Council
Certificate Number 2907.01
Valid to november 30, 2015
Revised October 29, 2015

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

NEW YORK
STATE OF
OPPORTUNITY.

Department
of Health

ANDREW M. CUOMO
Governor

HOWARD A. ZUCKER, M.D., J.D.
Acting Commissioner

SALLY DRESLIN, M.S., R.N.
Executive Deputy Commissioner

LAB ID: 11964

April 01, 2015

MS. MARGARET S. SLEEVI
TESTAMERICA DENVER
4955 YARROW STREET
ARVADA, CO 80002

Certificate Expiration Date:
April 01, 2016

Dear Ms. Sleevi,

Enclosed are Certificate(s) of Approval issued to your environmental laboratory for the current permit year. The Certificate(s) supersede(s) any previously issued one(s) and is(are) in effect through the expiration date listed. Please carefully examine the Certificate(s) to insure that the categories, subcategories, analytes, and methods for which your laboratory is approved are correct. In addition, verify that your laboratory's name, address, lead technical director, and identification number are accurate.

Pursuant to NYCRR Subpart 55-2.2, original certificates must be posted conspicuously in the laboratory and copies shall be made available to any client of the laboratory upon request.

Pursuant to NYCRR Subpart 55-2.6, any misrepresentation of the Fields of Accreditation (Matrix - Method - Analyte) for which your laboratory is approved may result in denial, suspension, or revocation of your certification. Any use of the Environmental Laboratory Approval Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP) name, reference to the laboratory's approval status, and/or using the NELAP logo in any catalogs, advertising, business solicitations, proposals, quotations, laboratory analytical reports, or other materials must include the laboratory's ELAP identification number and distinguish between testing for which the laboratory is approved and testing for which the laboratory is not approved.

If you have any questions, please contact ELAP at the New York State Department of Health (NYS DOH), Wadsworth Center, PO Box 509, Albany NY, 12201-0509; by phone at (518) 485-5570; by facsimile at (518) 485-5568; and by email at elap@health.ny.gov.

Sincerely,

Michael P. Ryan, M.T. (ASCP), Ph.D.
Director, Division of Laboratory Quality Certification
Environmental Laboratory Approval Program

NEW YORK STATE OF OPPORTUNITY. | Department of Health

ANDREW M. CUOMO
Governor

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LAB ID: 11964

April 01, 2015

MS. MARGARET S. SLEEVI
TESTAMERICA DENVER
4955 YARROW STREET
ARVADA, CO 80002

Dear Ms. Sleevi,

A revised certificate has been generated because of the change(s) listed below.

If your laboratory has applied for a change in the laboratory's location and/or Technical Director, the approved change(s) will be reflected on the certificate.

If the changes to your certification are due to insufficient proficiency tests and/or proficiency test (PT) failures, the expired certificates must be returned to the Environmental Laboratory Approval Program (ELAP) office within 10 days of the date of this letter. In addition, your laboratory must investigate the root cause for any insufficient and/or unsatisfactory proficiency tests.

In addition, your laboratory must investigate and document the root cause for any insufficient and/or unsatisfactory proficiency tests. If your lab lost accreditation due to two PT failures, you must submit the corrective action response to ELAP for review before accreditation will be re-instated.

AppCat	Analyte Name	Method Name	Comments	Date
NW - NELAC	Phenols	EPA 420.1 Rev. 1978	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Strontium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Calcium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
PW - NELAC	Cadmium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Copper, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Fluoride, Total	EPA 300.0 Rev. 2.1	Dropped from Approved	01/23/2015
PW - NELAC	Nitrate (as N)	EPA 353.2 Rev. 2.0	Dropped from Approved	01/23/2015
NW - NELAC	Beryllium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Arsenic, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Silver, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Zinc, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Zinc, Total	EPA 3005A	Subcategory Name Changed	03/04/2015

AppCat	Analyte Name	Method Name	Comments	Date
NW - NELAC	Beryllium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Sodium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Aluminum, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Manganese, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Potassium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Manganese, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Selenium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Silica, Dissolved	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Organic Carbon, Total	EPA 9060A	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Molybdenum, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Titanium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Sodium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Barium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
PW - NELAC	Zinc, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Boron, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Color	SM 18-22 2120B (-01)	Dropped from Approved	01/23/2015
PW - NELAC	Nitrate (as N)	EPA 300.0 Rev. 2.1	Dropped from Approved	01/23/2015
PW - NELAC	Sulfate (as SO4)	EPA 300.0 Rev. 2.1	Dropped from Approved	01/23/2015
NW - NELAC	Barium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Beryllium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Selenium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Mercury, Total	EPA 245.1 Rev. 3.0	Subcategory Name Changed	03/04/2015
NW - NELAC	Magnesium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Copper, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Magnesium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Zinc, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Molybdenum, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Zinc, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Silver, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Sulfide (as S)	SM 4500-S2- F-00,-11	Subcategory Name Changed	03/04/2015
NW - NELAC	Color	SM 2120B-01,-11	Subcategory Name Changed	03/04/2015
NW - NELAC	Cyanide, Total	EPA 335.4 Rev. 1.0	Subcategory Name Changed	03/04/2015
NW - NELAC	Oil and Grease Total Recoverable (HEM)	EPA 1664A	Subcategory Name Changed	03/04/2015
NW - NELAC	Turbidity	EPA 180.1 Rev. 2.0	Subcategory Name Changed	03/04/2015
NW - NELAC	Barium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Strontium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015

AppCat	Analyte Name	Method Name	Comments	Date
PW - NELAC	Vanadium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Calcium Hardness	SM 18-22 2340B (-97)	Dropped from Approved	01/23/2015
PW - NELAC	Nitrite (as N)	EPA 300.0 Rev. 2.1	Dropped from Approved	01/23/2015
NW - NELAC	Copper, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium VI	EPA 7196A	Subcategory Name Changed	03/04/2015
NW - NELAC	Arsenic, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Cadmium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Cadmium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Tin, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Cadmium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Selenium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Molybdenum, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Manganese, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Arsenic, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Selenium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Sulfide (as S)	SM 4500-S2- D-00,-11	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Magnesium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Silver, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
PW - NELAC	Mercury, Total	EPA 245.1 Rev. 3.0	Dropped from Approved	01/23/2015
PW - NELAC	Nickel, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Calcium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Magnesium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Nitrite (as N)	SM 18-22 4500-NO2 B (-00)	Dropped from Approved	01/23/2015
PW - NELAC	Orthophosphate (as P)	EPA 300.0 Rev. 2.1	Dropped from Approved	01/23/2015
NW - NELAC	Silver, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Zinc, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Iron, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Aluminum, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Tin, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Molybdenum, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Cadmium, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Copper, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Beryllium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Antimony, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Silica, Dissolved	EPA 6010C	Subcategory Name Changed	03/04/2015

AppCat	Analyte Name	Method Name	Comments	Date
NW - NELAC	Boron, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Manganese, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Iron, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Calcium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
PW - NELAC	Barium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Chromium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Specific Conductance	SM 18-22 2510B (-97)	Dropped from Approved	01/23/2015
PW - NELAC	Silica, Dissolved	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	1,2-Dibromoethane	EPA 504.1	Dropped from Approved	01/23/2015
NW - NELAC	Cadmium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Selenium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Tin, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Magnesium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Molybdenum, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Barium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Aluminum, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Antimony, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Strontium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Boron, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Sodium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
PW - NELAC	Iron, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Silver, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Aluminum, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Alkalinity	SM 18-22 2320B (-97)	Dropped from Approved	01/23/2015
NW - NELAC	Chromium, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Aluminum, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Potassium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Arsenic, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Tin, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Selenium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Manganese, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Potassium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Uranium (Mass)	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium VI	SM 3500-Cr B-09,-11	Subcategory Name Changed	03/04/2015

AppCat	Analyte Name	Method Name	Comments	Date
NW - NELAC	Molybdenum, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Arsenic, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Bromide	EPA 9056A	Subcategory Name Changed	03/04/2015
NW - NELAC	Boron, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Titanium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Molybdenum, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Titanium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Organic Carbon, Total	SM 5310B-00,-11	Subcategory Name Changed	03/04/2015
NW - NELAC	Sodium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Iron, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Calcium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
PW - NELAC	Sodium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Chloride	EPA 300.0 Rev. 2.1	Dropped from Approved	01/23/2015
PW - NELAC	Orthophosphate (as P)	EPA 365.1 Rev. 2.0	Dropped from Approved	01/23/2015
PW - NELAC	Solids, Total Dissolved	SM 18-22 2540C (-97)	Dropped from Approved	01/23/2015
PW - NELAC	1,2-Dibromo-3-chloropropane	EPA 504.1	Dropped from Approved	01/23/2015
NW - NELAC	Potassium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Zinc, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Antimony, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Beryllium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Titanium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Barium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Cadmium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Beryllium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Mercury, Total	EPA 7470A	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Calcium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Beryllium, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Oil and Grease Total Recoverable (HEM)	EPA 1664B	Subcategory Name Changed	03/04/2015
NW - NELAC	Bromide	EPA 300.0 Rev. 2.1	Subcategory Name Changed	03/04/2015
NW - NELAC	Specific Conductance	SM 2510B-97,-11	Subcategory Name Changed	03/04/2015
NW - NELAC	Cobalt, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Phenols	EPA 9066	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Strontium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Copper, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Lead, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Manganese, Total	EPA 3010A	Subcategory Name Changed	03/04/2015

AppCat	Analyte Name	Method Name	Comments	Date
PW - NELAC			Director Information Changed	01/23/2015
PW - NELAC	Manganese, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Beryllium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Molybdenum, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
PW - NELAC	Potassium, Total	EPA 200.7 Rev. 4.4	Dropped from Approved	01/23/2015
NW - NELAC	Cadmium, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Antimony, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Nickel, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Copper, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Arsenic, Total	EPA 200.8 Rev. 5.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Thallium, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Iron, Total	EPA 200.7 Rev. 4.4	Subcategory Name Changed	03/04/2015
NW - NELAC	Barium, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium, Total	EPA 3010A	Subcategory Name Changed	03/04/2015
NW - NELAC	Chromium, Total	EPA 6010C	Subcategory Name Changed	03/04/2015
NW - NELAC	Copper, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Silver, Total	EPA 6020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Antimony, Total	EPA 3005A	Subcategory Name Changed	03/04/2015
NW - NELAC	Vanadium, Total	EPA 3020A	Subcategory Name Changed	03/04/2015
NW - NELAC	Phenols	EPA 420.4 Rev. 1.0	Subcategory Name Changed	03/04/2015

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WADSWORTH CENTER

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MS. MARGARET S. SLEEVI
TESTAMERICA DENVER
4955 YARROW STREET
ARVADA, CO 80002

NY Lab Id No: 11964

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 624
Acrylonitrile	EPA 624

Amines

1-Naphthylamine	EPA 8270D
2-Naphthylamine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
5-Nitro-o-toluidine	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Methapyrilene	EPA 8270D
Pronamide	EPA 8270D
Pyridine	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 625
	EPA 8270D
3,3'-Dimethylbenzidine	EPA 8270D
Benzidine	EPA 625
	EPA 8270D

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
	EPA 608

Chlorinated Hydrocarbon Pesticides

4,4'-DDE	EPA 8081B
	EPA 608
4,4'-DDT	EPA 8081B
	EPA 608
Aldrin	EPA 8081B
	EPA 608
alpha-BHC	EPA 8081B
	EPA 608
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B
	EPA 608
Chlordane Total	EPA 8081B
	EPA 608
Chlorobenzilate	EPA 8081B
	EPA 8270D
delta-BHC	EPA 8081B
	EPA 608
Diallate	EPA 8081B
	EPA 8270D
Dicofol	EPA 8081B
Dieldrin	EPA 8081B
	EPA 608
Endosulfan I	EPA 8081B
	EPA 608
Endosulfan II	EPA 8081B
	EPA 608

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Chlorinated Hydrocarbon Pesticides

Endosulfan sulfate	EPA 8081B
	EPA 608
Endrin	EPA 8081B
	EPA 608
Endrin aldehyde	EPA 8081B
	EPA 608
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
	EPA 608
Heptachlor epoxide	EPA 8081B
	EPA 608
Isodrin	EPA 8081B
	EPA 8270D
Kepone	EPA 8081B
Lindane	EPA 8081B
	EPA 608
Methoxychlor	EPA 8081B
	EPA 608
Mirex	EPA 8081B
PCNB	EPA 8270D
Toxaphene	EPA 8081B
	EPA 608

Chlorinated Hydrocarbons

1,2,4,5-Tetrachlorobenzene	EPA 8270D

Chlorinated Hydrocarbons

1,2,4-Trichlorobenzene	EPA 625
	EPA 8270D
2-Chloronaphthalene	EPA 625
	EPA 8270D
Hexachlorobenzene	EPA 8081B
	EPA 625
	EPA 8270D
Hexachlorobutadiene	EPA 625
	EPA 8270D
Hexachlorocyclopentadiene	EPA 625
	EPA 8270D
Hexachloroethane	EPA 625
	EPA 8270D
Hexachloropropene	EPA 8270D
Pentachlorobenzene	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
	EPA 8321B
2,4,5-TP (Silvex)	EPA 8151A
	EPA 8321B
2,4-D	EPA 8151A
	EPA 8321B
2,4-DB	EPA 8151A
	EPA 8321B
Dalapon	EPA 8151A

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Chlorophenoxy Acid Pesticides	
Dalapon	EPA 8321B
Dicamba	EPA 8151A EPA 8321B
Dichloroprop	EPA 8151A EPA 8321B
Dinoseb	EPA 8151A EPA 8270D EPA 8321B
Demand	
Biochemical Oxygen Demand	SM 5210B-01,-11
Carbonaceous BOD	SM 5210B-01,-11
Chemical Oxygen Demand	EPA 410.4 Rev. 2.0
Dissolved Gases	
Acetylene	RSK-175
Ethane	RSK-175
Ethene (Ethylene)	RSK-175
Methane	RSK-175
Propane	RSK-175
Fuel Oxygenates	
Ethanol	EPA 8015C
Methyl tert-butyl ether	EPA 8021B
Haloethers	
4-Bromophenylphenyl ether	EPA 625 EPA 8270D
Haloethers	
4-Chlorophenylphenyl ether	EPA 625 EPA 8270D
Bis(2-chloroethoxy)methane	EPA 625 EPA 8270D
Bis(2-chloroethyl)ether	EPA 625 EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 625 EPA 8270D
Low Level Polynuclear Aromatics	
Acenaphthene Low Level	EPA 8310 EPA 610 EPA 8270D EPA 8270D SIM
Acenaphthylene Low Level	EPA 8310 EPA 610 EPA 8270D EPA 8270D SIM
Anthracene Low Level	EPA 8310 EPA 610 EPA 8270D EPA 8270D SIM
Benzo(a)anthracene Low Level	EPA 8310 EPA 610 EPA 8270D EPA 8270D SIM

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Low Level Polynuclear Aromatics

Benzo(a)pyrene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Benzo(b)fluoranthene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Benzo(g,h,i)perylene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Benzo(k)fluoranthene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Chrysene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Dibenzo(a,h)anthracene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Fluoranthene Low Level	EPA 8310
	EPA 610

Low Level Polynuclear Aromatics

Fluoranthene Low Level	EPA 8270D
	EPA 8270D SIM
Fluorene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Indeno(1,2,3-cd)pyrene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Naphthalene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Phenanthrene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM
Pyrene Low Level	EPA 8310
	EPA 610
	EPA 8270D
	EPA 8270D SIM

Metals I

Barium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

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Metals I

Barium, Total	EPA 6020A
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Calcium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Lead, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Magnesium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

Metals I

Manganese, Total	EPA 6020A
	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Potassium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Sodium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Strontium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Antimony, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Arsenic, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

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Metals II

Arsenic, Total	EPA 6020A
	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Chromium VI	EPA 7196A
	SM 3500-Cr B-09,-11
Mercury, Total	EPA 245.1 Rev. 3.0
	EPA 7470A
Selenium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4

Metals III

Cobalt, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

Metals III

Cobalt, Total	EPA 6020A
	EPA 200.8 Rev. 5.4
Molybdenum, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Tin, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Titanium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Uranium (Mass)	EPA 200.8 Rev. 5.4

Mineral

Acidity	SM 2310B-97,-11
Alkalinity	SM 2320B-97,-11
Chloride	EPA 300.0 Rev. 2.1
	EPA 9056A
Fluoride, Total	EPA 300.0 Rev. 2.1
	EPA 9056A
Hardness, Total	SM 2340C-97,-11
	EPA 200.7 Rev. 4.4
	SM 2340B-97,-11

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Mineral

Sulfate (as SO4)	EPA 300.0 Rev. 2.1
	EPA 9056A

Miscellaneous

Boron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Bromide	EPA 300.0 Rev. 2.1
	EPA 9056A
Color	SM 2120B-01,-11
Cyanide, Total	EPA 335.4 Rev. 1.0
Oil and Grease Total Recoverable (HEM)	EPA 1664A
	EPA 1664B
Organic Carbon, Total	SM 5310B-00,-11
	EPA 9060A
Phenols	EPA 420.1 Rev. 1978
	EPA 420.4 Rev. 1.0
	EPA 9066
Silica, Dissolved	EPA 200.7 Rev. 4.4
	EPA 6010C
Specific Conductance	SM 2510B-97,-11
Sulfide (as S)	SM 4500-S2- F-00,-11
	SM 4500-S2- D-00,-11
Turbidity	EPA 180.1 Rev. 2.0

Nitroaromatics and Isophorone

1,3,5-Trinitrobenzene	EPA 8270D
	EPA 8330B

Nitroaromatics and Isophorone

1,3-Dinitrobenzene	EPA 8330B
1,4-Naphthoquinone	EPA 8270D
2,4,6-Trinitrotoluene	EPA 8330B
2,4-Dinitrotoluene	EPA 625
	EPA 8270D
	EPA 8330B
2,6-Dinitrotoluene	EPA 625
	EPA 8270D
	EPA 8330B
2-Amino-4,6-dinitrotoluene	EPA 8330B
2-Nitrotoluene	EPA 8330B
3,5-Dinitroaniline	EPA 8330B
3-Nitrotoluene	EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 8330B
4-Nitrotoluene	EPA 8330B
Hexahydro-1,3,5-trinitro-1,3,5-triazine	EPA 8330B
Isophorone	EPA 625
	EPA 8270D
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330B
Nitrobenzene	EPA 625
	EPA 8270D
	EPA 8330B
Nitroglycerine	EPA 8330B
Nitroquinoline-1-oxide	EPA 8270D
Octahydro-tetranitro-tetrazocine	EPA 8330B
Pentaerythritol tetranitrate	EPA 8330B

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Nitrosoamines	
N-Nitrosodiethylamine	EPA 8270D
N-Nitrosodimethylamine	EPA 625
	EPA 8270D
N-Nitrosodi-n-butylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625
	EPA 8270D
N-Nitrosodiphenylamine	EPA 625
	EPA 8270D
N-nitrosomethylethylamine	EPA 8270D
N-nitrosomorpholine	EPA 8270D
N-nitrosopiperidine	EPA 8270D
N-Nitrosopyrrolidine	EPA 8270D
Nutrient	
Ammonia (as N)	EPA 350.1 Rev. 2.0
Kjeldahl Nitrogen, Total	EPA 351.2 Rev. 2.0
Nitrate (as N)	EPA 353.2 Rev. 2.0
	EPA 300.0 Rev. 2.1
	EPA 9056A
Nitrite (as N)	EPA 300.0 Rev. 2.1
	SM 4500-NO2 B-00,-11
	EPA 9056A
Orthophosphate (as P)	EPA 365.1 Rev. 2.0
	EPA 300.0 Rev. 2.1
	EPA 9056A
Phosphorus, Total	EPA 365.1 Rev. 2.0

Organophosphate Pesticides	
Atrazine	EPA 8141B
Azinphos methyl	EPA 8141B
Chlorpyriphos	EPA 8141B
Demeton-O	EPA 8141B
Demeton-S	EPA 8141B
Diazinon	EPA 8141B
Dimethoate	EPA 8141B
	EPA 8270D
Disulfoton	EPA 8141B
	EPA 8270D
Famphur	EPA 8141B
	EPA 8270D
Malathion	EPA 8141B
Parathion ethyl	EPA 8141B
	EPA 8270D
Parathion methyl	EPA 8141B
	EPA 8270D
Phorate	EPA 8141B
	EPA 8270D
Simazine	EPA 8141B
Sulfotepp	EPA 8141B
Thionazin	EPA 8141B
	EPA 8270D
Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015C

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Petroleum Hydrocarbons

Gasoline Range Organics	EPA 8015C

Phthalate Esters

Benzyl butyl phthalate	EPA 625
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 625
	EPA 8270D
Diethyl phthalate	EPA 625
	EPA 8270D
Dimethyl phthalate	EPA 625
	EPA 8270D
Di-n-butyl phthalate	EPA 625
	EPA 8270D
Di-n-octyl phthalate	EPA 625
	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 8082A
	EPA 608
PCB-1221	EPA 8082A
	EPA 608
PCB-1232	EPA 8082A
	EPA 608
PCB-1242	EPA 8082A
	EPA 608
PCB-1248	EPA 8082A
	EPA 608

Polychlorinated Biphenyls

PCB-1254	EPA 8082A
	EPA 608
PCB-1260	EPA 8082A
	EPA 608
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A

Polynuclear Aromatics

2-Acetylaminofluorene	EPA 8270D
3-Methylcholanthrene	EPA 8270D
7,12-Dimethylbenzyl (a) anthracene	EPA 8270D
Acenaphthene	EPA 625
	EPA 8270D
Acenaphthylene	EPA 625
	EPA 8270D
Anthracene	EPA 625
	EPA 8270D
Benzo(a)anthracene	EPA 625
	EPA 8270D
Benzo(a)pyrene	EPA 625
	EPA 8270D
Benzo(b)fluoranthene	EPA 625
	EPA 8270D
Benzo(ghi)perylene	EPA 625
	EPA 8270D
Benzo(k)fluoranthene	EPA 625

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All approved analytes are listed below:

Polynuclear Aromatics

Benzo(k)fluoranthene	EPA 8270D
Chrysene	EPA 625
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 625
	EPA 8270D
Fluoranthene	EPA 625
	EPA 8270D
Fluorene	EPA 625
	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 625
	EPA 8270D
Naphthalene	EPA 625
	EPA 8270D
Phenanthrene	EPA 625
	EPA 8270D
Pyrene	EPA 625
	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 625
	EPA 8270D
2,4-Dichlorophenol	EPA 625
	EPA 8270D
2,4-Dimethylphenol	EPA 625

Priority Pollutant Phenols

2,4-Dimethylphenol	EPA 8270D
2,4-Dinitrophenol	EPA 625
	EPA 8270D
2,6-Dichlorophenol	EPA 8270D
2-Chlorophenol	EPA 625
	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625
	EPA 8270D
2-Methylphenol	EPA 8270D
2-Nitrophenol	EPA 625
	EPA 8270D
3-Methylphenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 625
	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 625
	EPA 8270D
Cresols, Total	EPA 625
	EPA 8270D
Pentachlorophenol	EPA 625
	EPA 8270D
Phenol	EPA 625
	EPA 8270D

Residue

Settleable Solids	SM 2540 F-97,-11

Serial No.: 52686

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

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Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MARGARET S. SLEEVI
TESTAMERICA DENVER
4955 YARROW STREET
ARVADA, CO 80002

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Residue

Solids, Total	SM 2540 B-97,-11
Solids, Total Dissolved	SM 2540 C-97,-11
Solids, Total Suspended	SM 2540 D-97,-11

Semi-Volatile Organics

1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
4-Amino biphenyl	EPA 8270D
Acetophenone	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Dibenzofuran	EPA 8270D
Ethyl methanesulfonate	EPA 8270D
Isosafrole	EPA 8270D
Methyl methanesulfonate	EPA 8270D
O,O,O-Triethyl phosphorothioate	EPA 8270D
Phenacetin	EPA 8270D
Safrole	EPA 8270D

Volatile Aromatics

1,2-Dichlorobenzene	EPA 8021B
	EPA 624
	EPA 602
1,3-Dichlorobenzene	EPA 8021B
	EPA 624
	EPA 602
1,4-Dichlorobenzene	EPA 8021B
	EPA 624
	EPA 602
Benzene	EPA 8021B
	EPA 624
	EPA 602
Chlorobenzene	EPA 8021B
	EPA 624
	EPA 602
Ethyl benzene	EPA 8021B
	EPA 624
	EPA 602
Naphthalene, Volatile	EPA 8021B
Toluene	EPA 8021B
	EPA 624
	EPA 602
Total Xylenes	EPA 8021B
	EPA 624
	EPA 602

Volatile Halocarbons

1,1,1-Trichloroethane	EPA 624
1,1,2,2-Tetrachloroethane	EPA 624
1,1,2-Trichloroethane	EPA 624
1,1-Dichloroethane	EPA 624

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Volatile Halocarbons

1,1-Dichloroethene	EPA 624
1,2-Dibromo-3-chloropropane	EPA 8011
1,2-Dibromoethane	EPA 8011
1,2-Dichloroethane	EPA 624
2-Chloroethylvinyl ether	EPA 624
Bromodichloromethane	EPA 624
Bromoform	EPA 624
Bromomethane	EPA 624
Carbon tetrachloride	EPA 624
Chloroethane	EPA 624
Chloroform	EPA 624
Chloromethane	EPA 624
cis-1,3-Dichloropropene	EPA 624
Dibromochloromethane	EPA 624
Methylene chloride	EPA 624
Tetrachloroethene	EPA 624
trans-1,2-Dichloroethene	EPA 624
trans-1,3-Dichloropropene	EPA 624
Trichloroethene	EPA 624
Trichlorofluoromethane	EPA 624
Vinyl chloride	EPA 624

Volatiles Organics

Isobutyl alcohol	EPA 8015C
o-Toluidine	EPA 8270D

Sample Preparation Methods

EPA 5030C
EPA 3010A
EPA 3005A
EPA 3510C
EPA 3520C
EPA 3020A
EPA 3535A

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All approved analytes are listed below:

Amines

1,2-Diphenylhydrazine	EPA 8270D
1,4-Phenylenediamine	EPA 8270D
1-Naphthylamine	EPA 8270D
2-Naphthylamine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
5-Nitro-o-toluidine	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Methapyrilene	EPA 8270D
Pronamide	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 8270D
3,3'-Dimethylbenzidine	EPA 8270D
Benzidine	EPA 8270D

Carbamate Pesticides

Aldicarb	EPA 8321B
Carbofuran	EPA 8321B

Characteristic Testing

Synthetic Precipitation Leaching Proc.	EPA 1312
TCLP	EPA 1311

Chlorinated Hydrocarbon Pesticides

2,4'-DDD (Mitotane)	EPA 8081B
4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B
4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B
alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
Chlorobenzilate	EPA 8081B
delta-BHC	EPA 8081B
Diallate	EPA 8081B
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Isodrin	EPA 8270D
Kepone	EPA 8081B
Lindane	EPA 8081B
Methoxychlor	EPA 8081B

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Chlorinated Hydrocarbon Pesticides

Pentachloronitrobenzene	EPA 8270D
Simazine	EPA 8141B
Toxaphene	EPA 8081B

Chlorinated Hydrocarbons

1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270D
1-Chloronaphthalene	EPA 8270D
2-Chloronaphthalene	EPA 8270D
Hexachlorobenzene	EPA 8270D
Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 8270D
Hexachloropropene	EPA 8270D
Pentachlorobenzene	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
	EPA 8321B
2,4,5-TP (Silvex)	EPA 8151A
	EPA 8321B
2,4-D	EPA 8151A
	EPA 8321B
2,4-DB	EPA 8151A
	EPA 8321B
Dalapon	EPA 8151A
	EPA 8321B

Chlorophenoxy Acid Pesticides

Dicamba	EPA 8151A
	EPA 8321B
Dichloroprop	EPA 8151A
	EPA 8321B
Dinoseb	EPA 8321B
MCPA	EPA 8151A
	EPA 8321B
MCPP	EPA 8151A
	EPA 8321B

Haloethers

4-Bromophenylphenyl ether	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 8270D

Low Level Polynuclear Aromatic Hydrocarbons

Acenaphthene Low Level	EPA 8310
	EPA 8270D
Acenaphthylene Low Level	EPA 8310
	EPA 8270D
Anthracene Low Level	EPA 8310
	EPA 8270D
Benzo(a)anthracene Low Level	EPA 8310
	EPA 8270D
Benzo(a)pyrene Low Level	EPA 8310

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Low Level Polynuclear Aromatic Hydrocarbons

Benzo(a)pyrene Low Level	EPA 8270D
Benzo(b)fluoranthene Low Level	EPA 8310
	EPA 8270D
Benzo(g,h,i)perylene Low Level	EPA 8310
	EPA 8270D
Benzo(k)fluoranthene Low Level	EPA 8310
	EPA 8270D
Chrysene Low Level	EPA 8310
	EPA 8270D
Dibenzo(a,h)anthracene Low Level	EPA 8310
	EPA 8270D
Fluoranthene Low Level	EPA 8310
	EPA 8270D
Fluorene Low Level	EPA 8310
	EPA 8270D
Indeno(1,2,3-cd)pyrene Low Level	EPA 8310
	EPA 8270D
Naphthalene Low Level	EPA 8310
	EPA 8270D
Phenanthrene Low Level	EPA 8310
	EPA 8270D
Pyrene Low Level	EPA 8310
	EPA 8270D

Metals I

Barium, Total	EPA 6010C
Barium, Total	EPA 6020A
Cadmium, Total	EPA 6010C
	EPA 6020A
Calcium, Total	EPA 6010C
Chromium, Total	EPA 6010C
	EPA 6020A
Copper, Total	EPA 6010C
	EPA 6020A
Iron, Total	EPA 6010C
Lead, Total	EPA 6010C
	EPA 6020A
Magnesium, Total	EPA 6010C
Manganese, Total	EPA 6010C
	EPA 6020A
Nickel, Total	EPA 6010C
	EPA 6020A
Potassium, Total	EPA 6010C
Silver, Total	EPA 6010C
	EPA 6020A
Sodium, Total	EPA 6010C
Strontium, Total	EPA 6010C

Metals II

Aluminum, Total	EPA 6010C
Antimony, Total	EPA 6010C
	EPA 6020A

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NELAP RECOGNIZED ACCREDITATION BODY TNI

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Metals II

Arsenic, Total	EPA 6010C
	EPA 6020A
Beryllium, Total	EPA 6010C
	EPA 6020A
Lithium, Total	EPA 6010C
Mercury, Total	EPA 7471B
Selenium, Total	EPA 6010C
	EPA 6020A
Vanadium, Total	EPA 6010C
	EPA 6020A
Zinc, Total	EPA 6010C
	EPA 6020A

Metals III

Cobalt, Total	EPA 6010C
	EPA 6020A
Molybdenum, Total	EPA 6010C
	EPA 6020A
Silica, Dissolved	EPA 6010C
Thallium, Total	EPA 6010C
	EPA 6020A
Tin, Total	EPA 6010C
Titanium, Total	EPA 6010C

Minerals

Bromide	EPA 9056A
Fluoride, Total	EPA 9056A

Minerals

Sulfate (as SO4)	EPA 9056A

Miscellaneous

Boron, Total	EPA 6010C
Cyanide, Total	EPA 9012B
Sulfide (as S)	EPA 9034

Nitroaromatics and Isophorone

1,3,5-Trinitrobenzene	EPA 8270D
	EPA 8330B
1,3-Dinitrobenzene	EPA 8270D
	EPA 8330B
1,4-Dinitrobenzene	EPA 8270D
1,4-Naphthoquinone	EPA 8270D
2,4,6-Trinitrotoluene	EPA 8330B
2,4-Dinitrotoluene	EPA 8270D
	EPA 8330B
2,6-Dinitrotoluene	EPA 8270D
	EPA 8330B
2-Amino-4,6-dinitrotoluene	EPA 8330B
2-Nitrotoluene	EPA 8330B
3-Nitrotoluene	EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 8330B
4-Nitrotoluene	EPA 8330B
Hexahydro-1,3,5-trinitro-1,3,5-triazine	EPA 8330B
Isophorone	EPA 8270D
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330B

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Nitroaromatics and Isophorone

Nitrobenzene	EPA 8270D EPA 8330B
Nitroglycerine	EPA 8330B
Nitroquinoline-1-oxide	EPA 8270D
Octahydro-tetranitro-tetrazocine	EPA 8330B
Pentaerythritol tetranitrate	EPA 8330B
Pyridine	EPA 8270D

Nitrosoamines

N-Nitrosodiethylamine	EPA 8270D
N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-butylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270D
N-nitrosomethylethylamine	EPA 8270D
N-nitrosomorpholine	EPA 8270D
N-nitrosopiperidine	EPA 8270D
N-Nitrosopyrrolidine	EPA 8270D

Nutrients

Nitrate (as N)	EPA 9056A
Nitrite (as N)	EPA 9056A
Orthophosphate (as P)	EPA 9056A

Organophosphate Pesticides

Azinphos ethyl	EPA 8141B
Azinphos methyl	EPA 8141B

Organophosphate Pesticides

Bolstar	EPA 8141B
Carbophenothion	EPA 8141B
Chlorpyriphos	EPA 8141B
Coumaphos	EPA 8141B
Demeton-O	EPA 8141B
Demeton-S	EPA 8141B
Diazinon	EPA 8141B
Dimethoate	EPA 8141B EPA 8270D
Disulfoton	EPA 8141B EPA 8270D
EPN	EPA 8141B
Ethoprop	EPA 8141B
Famphur	EPA 8141B EPA 8270D
Fensulfothion	EPA 8141B
Fenthion	EPA 8141B
Malathion	EPA 8141B
Mevinphos	EPA 8141B
NALED	EPA 8141B
Parathion ethyl	EPA 8141B EPA 8270D
Parathion methyl	EPA 8141B EPA 8270D
Phorate	EPA 8141B EPA 8270D

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Organophosphate Pesticides

Ronnel	EPA 8141B
Sulfotepp	EPA 8141B
	EPA 8270D
Thionazin	EPA 8141B
	EPA 8270D
Tokuthion	EPA 8141B
Trichloronate	EPA 8141B

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015C
Gasoline Range Organics	EPA 8015C
Oil and Grease Total Recoverable (HEM)	EPA 9071B (Solvent:Hexane)

Phthalate Esters

Benzyl butyl phthalate	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 8270D
Diethyl phthalate	EPA 8270D
Dimethyl phthalate	EPA 8270D
Di-n-butyl phthalate	EPA 8270D
Di-n-octyl phthalate	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 8082A
PCB-1221	EPA 8082A
PCB-1232	EPA 8082A
PCB-1242	EPA 8082A
PCB-1248	EPA 8082A

Polychlorinated Biphenyls

PCB-1254	EPA 8082A
PCB-1260	EPA 8082A
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A

Polynuclear Aromatic Hydrocarbons

3-Methylcholanthrene	EPA 8270D
7,12-Dimethylbenzyl (a) anthracene	EPA 8270D
Acenaphthene	EPA 8270D
Acenaphthylene	EPA 8270D
Anthracene	EPA 8270D
Benzo(a)anthracene	EPA 8270D
Benzo(a)pyrene	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D
Benzo(ghi)perylene	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D
Chrysene	EPA 8270D
Dibenzo(a,h)anthracene	EPA 8270D
Dibenzo(a,j)acridine	EPA 8270D
Fluoranthene	EPA 8270D
Fluorene	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D
Naphthalene	EPA 8270D
Phenanthrene	EPA 8270D
Pyrene	EPA 8270D

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Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D
2,4-Dichlorophenol	EPA 8270D
2,4-Dimethylphenol	EPA 8270D
2,4-Dinitrophenol	EPA 8270D
2,6-Dichlorophenol	EPA 8270D
2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270D
2-Methylphenol	EPA 8270D
2-Nitrophenol	EPA 8270D
3-Methylphenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 8270D
Pentachlorophenol	EPA 8270D
Phenol	EPA 8270D

Semi-Volatile Organics

1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
4-Amino biphenyl	EPA 8270D
Acetophenone	EPA 8270D
Aramite	EPA 8270D

Semi-Volatile Organics

Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Dibenzofuran	EPA 8270D
Ethyl methanesulfonate	EPA 8270D
Isosafrole	EPA 8270D
Methyl methanesulfonate	EPA 8270D
O,O,O-Triethyl phosphorothioate	EPA 8270D
Phenacetin	EPA 8270D
Safrole	EPA 8270D

Volatile Aromatics

1,2-Dichlorobenzene	EPA 8021B
1,3-Dichlorobenzene	EPA 8021B
1,4-Dichlorobenzene	EPA 8021B
Benzene	EPA 8021B
Chlorobenzene	EPA 8021B
Ethyl benzene	EPA 8021B
Toluene	EPA 8021B
Total Xylenes	EPA 8021B

Volatile Organics

Isobutyl alcohol	EPA 8015C
Methyl tert-butyl ether	EPA 8021B
o-Toluidine	EPA 8270D

Sample Preparation Methods

	EPA 5035A-L

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Issued April 01, 2015

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

NY Lab Id No: 11964

MS. MARGARET S. SLEEVI
TESTAMERICA DENVER
4955 YARROW STREET
ARVADA, CO 80002

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Sample Preparation Methods

EPA 5035A-H
EPA 9030B
EPA 3010A
EPA 3005A
EPA 3050B
EPA 3550C
EPA 3020A
EPA 3546

Serial No.: 52687

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SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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ENVIRONMENTAL

Valid To: December 31, 2015 Certificate Number: 2907.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories), 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, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon, Total Organic Halide

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Metals				
Aluminum	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Antimony	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Arsenic	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Barium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Beryllium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Boron	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Cadmium	EPA 6010C	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Calcium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Chromium	EPA 6010C	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Cobalt	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Copper	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Iron	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Lead	EPA 6010C	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Lithium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Magnesium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Manganese	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Mercury	----------------------	----------------------	EPA 7470A	EPA 7471A / 7471B
Molybdenum	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Nickel	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Potassium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Selenium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Silica	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Silicon	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Silver	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Sodium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Strontium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Thallium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Tin	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Titanium	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Vanadium	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Zinc	----------------------	----------------------	EPA 6010B / 6010C / 6020 / 6020A	EPA 6010B / 6010C / 6020 / 6020A
Nutrients				
Nitrate (as N)	----------------------	By calculation	By calculation / EPA 9056 / 9056A	By calculation / EPA 9056 / 9056A
Nitrate-nitrite (as N)	----------------------	EPA 353.2	EPA 353.2 / 9056 / 9056A	EPA 9056 / 9056A
Nitrite (as N)	----------------------	SM 4500-NO2 B	SM 4500-NO2 B; EPA 9056 / 9056A	EPA 9056 / 9056A
Orthophosphate (as P)	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Total phosphorus	----------------------	----------------------	EPA 6010B / 6010C	EPA 6010B / 6010C
Demands				
Total Organic Carbon	----------------------	----------------------	EPA 9060 / 9060A	EPA 9060 / 9060A
Total Organic Halides	----------------------	----------------------	EPA 9020B	----------------------
Wet Chemistry				----------------------
Alkalinity (Total Bicarbonate, Carbonate, and Hydroxide Alkalinty)	----------------------	SM 2320 B_1997	SM 2320 B	SM 2320 B
Ammonia	----------------------	EPA 350.1	EPA 350.1	----------------------
Biological Oxygen Demand	----------------------	SM 5210B	SM 5210B	----------------------
Bromide	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Chloride	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Chemical Oxygen Demand	----------------------	EPA 410.4	EPA 410.4	----------------------
Conductivity	----------------------	----------------------	EPA 9050 / 9050A	EPA 9050 / 9050A
Cyanide	----------------------	----------------------	9012A / 9012B	9012A / 9012B
Ferrous Iron	----------------------	SM 3500 Fe B, D	SM 3500 Fe B, D	----------------------
Fluoride	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Hexavalent Chromium	EPA 7196A	----------------------	EPA 7196A	----------------------
pH	----------------------	----------------------	EPA 9040B / 9045C	EPA 9045C / 9045D
Oil and Grease (HEM and SGT-HEM)	----------------------	----------------------	EPA 1664A/ 1664B	9071B
Percent Moisture	----------------------	----------------------	----------------------	ASTM D2216
Perchlorate	----------------------	----------------------	EPA 6860	EPA 6860
Phenols	----------------------	----------------------	EPA 9066	EPA 9066
Solids, Total	----------------------	SM 2540 B	SM 2540 B	SM 2540 B
Solids, Total Suspended	----------------------	SM 2540 D	SM 2540 D	SM 2540 D
Solids, Total Dissolved	----------------------	SM 2540 C	SM 2540 C	SM 2540 C
Sulfate	----------------------	----------------------	EPA 9056 / 9056A	EPA 9056 / 9056A
Sulfide, Total	----------------------	----------------------	EPA 9034	EPA 9034
Sulfide	----------------------	----------------------	EPA 9030B	EPA 9030B
Total Kjeldahl Nitrogen	----------------------	----------------------	EPA 351.2	----------------------

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Purgeable Organics (volatiles)				----------------------
Acetone	----------------------	----------------------	EPA 8260B	EPA 8260B
Acetonitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
Acrolein	----------------------	----------------------	EPA 8260B	EPA 8260B
Acrylonitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
Allyl Chloride	----------------------	----------------------	EPA 8260B	EPA 8260B
tert-Amyl Methyl Ether	EPA 8260B			
Benzene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101/ OK DEQ GRO/ 8260B SIM	EPA 8260B / 8021B / AK101/ OK DEQ GRO
Bromobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromochloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromodichloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromoform	----------------------	----------------------	EPA 8260B	EPA 8260B
Bromomethane	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Butanone	----------------------	----------------------	EPA 8260B	EPA 8260B
n-Butyl alcohol	----------------------	----------------------	EPA 8260B / 8015B / 8015C	EPA 8260B / 8015B / 8015C
tert-Butyl alcohol (2-Methyl-2-Propanol)	EPA 8260B		EPA 8260B / 8260B SIM	EPA 8260B
n-Butylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
sec-Butylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
tert-Butylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Carbon disulfide	----------------------	----------------------	EPA 8260B	EPA 8260B
Carbon tetrachloride	----------------------	----------------------	EPA 8260B	EPA 8260B
Chlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B
2-Chloro-1,3-butadiene	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Chloroethyl vinyl ether	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloroform	----------------------	----------------------	EPA 8260B	EPA 8260B
1-Chlorohexane	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Chloroprene	----------------------	----------------------	EPA 8260B	EPA 8260B
4-Chlorotoluene	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Chlorotoluene	----------------------	----------------------	EPA 8260B	EPA 8260B
Cyclohexane	----------------------	----------------------	EPA 8260B	EPA 8260B
Cyclohexanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Dibromochloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	----------------------	EPA 504.1	EPA 504.1 / 8260B / 8011	EPA 8260B / 8011
Dibromochloromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Dichlorodifluoromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Dibromomethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2 Dibromoethane (EDB)	EPA 8011	EPA 504.1	EPA 504.1 / 8260B / 8011	EPA 8260B / 8011
1,2-Dichlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
1,3-Dichlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B
1,4-Dichlorobenzene	----------------------	----------------------	EPA 8260B / 8021B	EPA 8260B / 8021B
cis-1,4-Dichloro-2-butene	----------------------	----------------------	EPA 8260B	EPA 8260B
trans-1,4-Dichloro-2-butene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1-Dichloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dichloroethane	EPA 8260B	----------------------	EPA 8260B	EPA 8260B
1,1-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
cis-1,2-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
trans-1,2-Dichloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
Dichlorofluoromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2-Dichloropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,3-Dichloropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
2,2-Dichloropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,3-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
cis-1,3-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
trans-1,3-Dichloropropene	----------------------	----------------------	EPA 8260B	EPA 8260B
Diethyl ether	----------------------	----------------------	EPA 8260B	EPA 8260B
Di-isopropylether	EPA 8260B	----------------------	EPA 8260B	EPA 8260B
1,4-Dioxane	----------------------	----------------------	EPA 8260B / 8260B SIM	EPA 8260B / 8260B SIM
Ethanol	----------------------	----------------------	EPA 8260B / 8015B / 8015C	EPA 8260B / 8015B / 8015C
Ethyl Acetate	----------------------	----------------------	EPA 8260B	EPA 8260B
Ethyl Benzene	EPA 8260B/8021B	----------------------	EPA 8260B / 8021B / AK101/ OK DEQ GRO	EPA 8260B / 8021B/ AK101/ OK DEQ GRO
Ethyl Methacrylate	----------------------	----------------------	EPA 8260B	EPA 8260B
Ethyl tert-Butyl Ether	EPA 8260B	----------------------	----------------------	----------------------
Ethylene Glycol	----------------------	----------------------	EPA 8015C	EPA 8015C
Gas Range Organics (GRO)	EPA 8015C	----------------------	EPA 8015B / 8015C / AK101 / 8015D/ OK DEQ GRO	EPA 8015B / 8015C / AK101 / 8015D/ OK DEQ GRO
Hexane	----------------------	----------------------	EPA 8260B	EPA 8260B
2-Hexanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Hexachlorobutadiene	----------------------	----------------------	EPA 8260B	EPA 8260B
Isobutyl Alcohol (2-Methyl-1-propanol)	----------------------	----------------------	EPA 8260B / 8015B / 8015C	EPA 8260B / 8015B / 8015C
Isopropyl Alcohol	----------------------	----------------------	EPA 8260B	EPA 8260B
Isopropylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,4-Isopropyltoluene	----------------------	----------------------	EPA 8260B	EPA 8260B
Iodomethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Methacrylonitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
Methanol	----------------------	----------------------	EPA 8015B / 8015C	EPA 8015B / 8015C
Methyl Acetate	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl Cyclohexane	----------------------	----------------------	EPA 8260B	EPA 8260B
Methylene Chloride	----------------------	----------------------	EPA 8260B	EPA 8260B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Methyl Ethyl Ketone (MEK)	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl Isobutyl Ketone	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl Methacrylate	----------------------	----------------------	EPA 8260B	EPA 8260B
Methyl tert-Butyl Ether (MtBE)	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / OK DEQ GRO	EPA 8260B / 8021B/ OK DEQ GRO
4-Methyl-2-Pentanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Naphthalene	EPA 8260B / 8021B	----------------------	EPA 8260B/ OK DEQ GRO	EPA 8260B / OK DEQ GRO
2-Nitropropane	----------------------	----------------------	EPA 8260B	EPA 8260B
2,2' Oxybisethanol	----------------------	----------------------	EPA 8015C	EPA 8015C
2-Pentanone	----------------------	----------------------	EPA 8260B	EPA 8260B
Propionitrile	----------------------	----------------------	EPA 8260B	EPA 8260B
n-Propylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Propylene Glycol	----------------------	----------------------	EPA 8015C	EPA 8015C
Styrene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,1,2-Tetrachloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,2,2-Tetrachloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Tetrachloroethene	----------------------	----------------------	EPA 8260B	EPA 8260B
Tetrahydrofuran	----------------------	----------------------	EPA 8260B	EPA 8260B
Toluene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO
Total Petroleum Hydrocarbons (TPH)	----------------------	EPA 1664A EPA 1664B	EPA 1664A EPA 1664B	----------------------
1,2,3-Trichlorobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,1-Trichloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,1,2-Trichloroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Trichloroethene	----------------------	----------------------	EPA 8260B / 8260B SIM	EPA 8260B
Trichlorofluoromethane	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,3-Trichlorobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,4-Trichlorobenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,3-Trichloropropane	----------------------	EPA 504.1	EPA 504.1 / 8260B / 8011	EPA 8260B / 8011
1,1,2-Trichloro-1,2,2-trifluoroethane	----------------------	----------------------	EPA 8260B	EPA 8260B
Triethylene Glycol	----------------------	----------------------	EPA 8015C	EPA 8015C
1,2,3-Trimethylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,2,4-Trimethylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
1,3,5-Trimethylbenzene	----------------------	----------------------	EPA 8260B	EPA 8260B
Vinyl Acetate	----------------------	----------------------	EPA 8260B	EPA 8260B
Vinyl Chloride	----------------------	----------------------	EPA 8260B / 8260B SIM	EPA 8260B
Xylenes, total	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO
1,2-Xylene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
M+P-Xylene	EPA 8260B / 8021B	----------------------	EPA 8260B / 8021B / AK101 / OK DEQ GRO	EPA 8260B / 8021B / AK101 / OK DEQ GRO
Methane	----------------------	----------------------	RSK-175	----------------------
Ethane	----------------------	----------------------	RSK-175	----------------------
Ethylene (Ethene)	----------------------	----------------------	RSK-175	----------------------
Acetylene	----------------------	----------------------	RSK-175	----------------------
Acetylene Ethane	----------------------	----------------------	RSK-175	----------------------
Extractable Organics (semivolatiles)				
Acenaphthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Acenaphthylene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Acetophenone	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Acetylaminofluorene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Alachlor	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Aminobiphenyl	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Aniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Anthracene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Aramite	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Atrazine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Azobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzaldehyde	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzoic acid	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Benzo (a) Anthracene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (b) Fluoranthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (k) Fluoranthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (ghi) Perylene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzo (a) Pyrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Benzyl Alcohol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Bis (2-chloroethoxy) methane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Bis (2-chloroethyl) Ether	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Bis (2-chloroisopropyl) Ether (2,2'Oxybis(1-chloropropane)	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Bis (2-ethylhexyl) Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Bromophenyl Phenyl Ether	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Butyl Benzyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-sec-Butyl-4,6-Dinitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Carbazole	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Chloroanilene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Chlorobenzilate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Chloro-3-Methylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1-Chloronaphthalene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Chloronaphthalene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Chlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Chlorophenyl Phenyl Ether	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Chrysene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Cresols	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diallate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Dibenzo (a,h) Anthracene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Dibenzofuran	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2-Dichlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,3-Dichlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,4-Dichlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3,3'-Dichlorobenzidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
2,6-Dichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diethyl phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Dimethoate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3,3-Dimethylbenzidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
p-Dimethylaminoazobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
7,12-Dimethylbenz(a)anthracene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Alpha-,alpha-Dimethylphenethylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dimethylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Dimethyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Di-n-Butyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Di-n-Octyl Phthalate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,3-Dinitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,4-Dinitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dinitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4-Dinitrotoluene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,6-Dinitrotoluene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,4-Dioxane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diphenylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2-Diphenylhydrazine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Disulfoton	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Diesel Range Organics (DRO)	EPA 8015C	----------------------	EPA 8015B / 8015C, AK102/ 8015D / OK DEQ DRO	EPA 8015B / 8015C, AK102 / 8015D / OK DEQ DRO
Ethyl Methanesulfonate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Famphur	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Fluoroanthene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Fluorene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Hexachlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachlorobutadiene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachlorocyclopentadiene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachloroethane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Hexachloropropene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Indeno (1,2,3-cd) Pyrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Isodrin	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Isophorone	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Isosafrole	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Methapyrilene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3-Methylcholanthrene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Methyl-4,6-Dinitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Methyl Methane Sulfonate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1-Methylnaphthalene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
2-Methylnaphthalene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
2-Methylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3+4-Methylphenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Naphthalene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
1,4-Naphthoquinone	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1-Naphthylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Naphthylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Nitroaniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
3-Nitroaniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
4-Nitroaniline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Nitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Nitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
4-Nitrophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Nitroquinoline-1-Oxide	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodiethylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodimethylamine	----------------------	----------------------	EPA 8270C / 8270D/ 8270D SIM	EPA 8270C / 8270D/ 8270D SIM
N-Nitrosodi-n-Butylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodi-n-Propylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosodiphenylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosomethylethylamine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosomorpholine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosopiperidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
N-Nitrosopyrrolidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
5-Nitro-o-Toluidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,2-oxybis(1-chloropropane)	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Parathion, Methyl	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Parathion, Ethyl	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachloroethane	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachloronitobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pentachlorophenol	----------------------	----------------------	EPA 8270C / 8270D / 8321A / 8321B	EPA 8270C / 8270D / 8321A / 8321B
Phenacetin	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Phenanthrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Phenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Phorate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2-Picoline	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Pronamide	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Pyrene	----------------------	----------------------	EPA 8270C / 8270D / 8270SIM	EPA 8270C / 8270D / 8270SIM
Pyridine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Safrole	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Sulfotepp	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2,4,5-Tetrachlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,3,4,6-Tetrachlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Thionazin	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
o-Toluidine	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,2,4-Trichlorobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4,5-Trichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
2,4,6-Trichlorophenol	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
o,o,o-Triethyl Phosphorothioate	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
1,3,5-Trinitrobenzene	----------------------	----------------------	EPA 8270C / 8270D	EPA 8270C / 8270D
Motor Oil (Residual Range Organics)	----------------------	----------------------	EPA 8015B / 8015C, 8015D, AK103 / OK DEQ RRO	EPA 8015B / 8015C, 8015D, AK103 / OK DEQ RRO
Pesticides/Herbicides/PCBs				
Aldrin	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Atrazine	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Azinophos ethyl	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Azinophos methyl	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
alpha-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
beta-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
delta-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
gamma-BHC	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Bolstar	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
alpha-Chlordane	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
gamma-Chlordane	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Chlordane (technical)	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Chloropyrifos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Coumaphos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
2,4-D	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A /8321A
Dalapon	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
2,4-DB	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
4,4’-DDD	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
4,4’-DDE	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
4,4’-DDT	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Demeton-O	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Demeton-S	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Demeton, total	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Diazinon	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Dicamba	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Dichlorovos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Dichloroprop	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Dieldrin	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Dimethoate	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Dinoseb	----------------------	----------------------	EPA 8151A / 8321A	EPA 8321A
Disulfoton	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Endosulfan I	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endosulfan II	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endonsulfan sulfate	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endrin	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Endrin aldehyde	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Endrin ketone	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
EPN	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Ethoprop	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Ethyl Parathion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Famphur	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Fensulfothion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Fenthion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Heptachlor	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Heptachlor Epoxide	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Hexachlorobenzene	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Malathion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
MCPA	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
MCPP	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Merphos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Methoxychlor	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Methyl parathion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Mevinphos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Naled	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
PCB-1016 (Arochlor)	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1221	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1232	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1242	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1248	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1254	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1260	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1262	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
PCB-1268	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
Total PCBs	----------------------	----------------------	EPA 8082 / 8082A	EPA 8082 / 8082A
Phorate	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Phosmet	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Propazine	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Ronnel	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Simazine	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Stirophos	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Sulfotepp	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
2,4,5-T	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Thionazin	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Tokuthion	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
2,4,5-TP	----------------------	----------------------	EPA 8151A / 8321A	EPA 8151A / 8321A
Toxaphene	----------------------	----------------------	EPA 8081A / 8081B	EPA 8081A / 8081B
Trichloronate	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
o,o,o-Triethylphos Phorothioate	----------------------	----------------------	EPA 8141A / 8141B	EPA 8141A / 8141B
Explosives				
1,3,5-Trinitrobenzene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
1,3-Dinitrobenzene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2,4,6-Trinitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
3,5-Dinitroaniline	----------------------	----------------------	EPA 8330B	EPA 8330B
2,4-Dinitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2,6-Dinitroltoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2-Amino-4,6-Dinitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
2-Nitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
3-Nitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
4-Amino-2,6-Dinitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
4-Nitrotoluene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Nitrobenzene	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Nitroglycerin	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Octahydro-1,3,5,7-Tetrabitro-1,3,5,7-Tetrazocine (HMX)	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Pentaerythritoltetranitrate (PETN)	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Picric acid	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
RDX (Hexahydro-1,3,5-Trinitro-1,3,5-Triazine)	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Tetryl (Methyl 2,4,6-Trinitrophenylnitramine	----------------------	----------------------	EPA 8330A / 8330B / 8321A / 8321B	EPA 8330A / 8330B / 8321A / 8321B
Perfluorinated Hydrocarbons (PFCs) and Perfluorinated Sulfonates (PFSs)				
Perfluorobutanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluoropentanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorohexanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluoroheptanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorooctanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorononanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorodecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluoroundecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorododecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorotridecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorotetradecanoic Acid	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorobutane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorohexane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorooctane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorodecane Sulfonate	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Perfluorooctane Sulfonamide	----------------------	SOP DV-LC-0012	SOP DV-LC-0012	SOP DV-LC-0012
Hazardous Waste Characteristics				
Conductivity	----------------------	----------------------	EPA 9050A	EPA 9050A
Corrosivity	----------------------	----------------------	EPA 9040B/ 9040C	EPA 9045C / 9045D
Ignitibility	----------------------	EPA 1010/EPA 1010A	EPA 1010 / 1010A	EPA 1010 / 1010A

Parameter/Analyte	WY Storage Tank Program	Non-Potable Water	Solid Hazardous Waste (Water)	Solid Hazardous Waste (Solid)
Paint Filter Liquids Test	----------------------	----------------------	EPA 9095A	EPA 9095A
Synthetic Precipitation Leaching Procedure (SPLP)	----------------------	----------------------	EPA 1312	EPA 1312
Toxicity Characteristic Leaching Procedure	----------------------	----------------------	EPA 1311	EPA 1311
Organic Prep Methods				
Separatory Funnel Liquid-Liquid Extraction	----------------------	----------------------	EPA 3510C	----------------------
Continuous Liquid-Liquid Extraction	----------------------	----------------------	EPA 3520C	----------------------
Soxhlet Extraction	----------------------	----------------------	----------------------	EPA 3540C
Microwave Extraction	----------------------	----------------------	----------------------	EPA 3546
Ultrasonic Extraction	----------------------	----------------------	----------------------	EPA 3550B
Ultrasonic Extraction	----------------------	----------------------	----------------------	EPA 3550C
Waste Dilution	----------------------	----------------------	EPA 3580A	EPA 3580A
Solid Phase Extraction Volatiles Purge and trap Volatiles Purge and Trap for Soils	----------------------	----------------------	EPA 3535A EPA 5030B	EPA 5030B EPA 5035
Organic Cleanup Procedures				
Florisil Cleanup	----------------------	----------------------	EPA 3620B	EPA 3620B
Florisil Cleanup	----------------------	----------------------	EPA 3620C	EPA 3620C
Sulfur Cleanup	----------------------	----------------------	EPA 3660B	EPA 3660B
Sulfuric Acid/Permanganate Cleanup	----------------------	----------------------	EPA 3665A	EPA 3665A
Metals Digestion				
Acid Digestion Total Recoverable or Dissolved Metals	----------------------	----------------------	EPA 3005A	----------------------
Acid Digestion for Total Metals	----------------------	----------------------	EPA 3010A	----------------------
Acid Digestion for Total Metals	----------------------	----------------------	EPA 3020A	----------------------
Acid Digestion of Sediments, Sludges and Soils	----------------------	----------------------	----------------------	EPA 3050B

Accredited Laboratory

A2LA has accredited

TESTAMERICA DENVER

Arvada, CO

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 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.0 of the DoD 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 8 January 2009).

Presented this 5th day of November 2013.

Peter Unger

President & CEO
For the Accreditation Council
Certificate Number 2907.01
Valid to December 31, 2015
Revised November 23, 2015

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

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Certificate of Accreditation

ISO/IEC 17025:2005 **Certificate Number L2305**

TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City Missouri 63045

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: January 10, 2016

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 31st of May 2013

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*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY
ACCREDITATION
BUREAU

Certificate # L2305

Scope of Accreditation
For
TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City, Missouri 63045
Marti Ward
314-298-8566

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to TestAmerica Laboratories, Inc. to perform the following tests:

Accreditation granted through: **January 10, 2016**

Testing - Environmental

Non-Potable Water

Technology	Method	Analyte
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium

Non-Potable Water

Technology	Method	Analyte
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS SIM	EPA 8260 SIM	1,4-Dioxane
GC/MS	EPA 624	Acetone
GC/MS	EPA 624	Acetonitrile
GC/MS	EPA 624	Acrolein
GC/MS	EPA 624	Acrylonitrile
GC/MS	EPA 624	Benzene
GC/MS	EPA 624	Benzyl chloride
GC/MS	EPA 624	Bromobenzene
GC/MS	EPA 624	Bromochloromethane
GC/MS	EPA 624	Bromodichloromethane
GC/MS	EPA 624	Bromoform
GC/MS	EPA 624	Bromomethane
GC/MS	EPA 624	n-Butanol
GC/MS	EPA 624	2-Butanone
GC/MS	EPA 624	n-Butylbenzene
GC/MS	EPA 624	sec-Butylbenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624	tert-Butylbenzene
GC/MS	EPA 624	Carbon disulfide
GC/MS	EPA 624	Carbon tetrachloride
GC/MS	EPA 624	Chlorobenzene
GC/MS	EPA 624	Chlorobromomethane
GC/MS	EPA 624	2-Chloro-1,3-butadiene
GC/MS	EPA 624	Chlorodibromomethane
GC/MS	EPA 624	Dibromochloromethane
GC/MS	EPA 624	Chloroethane
GC/MS	EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 624	Chloroform
GC/MS	EPA 624	Chloromethane
GC/MS	EPA 624	Allyl chloride
GC/MS	EPA 624	2-Chlorotoluene
GC/MS	EPA 624	4-Chlorotoluene
GC/MS	EPA 624	Cyclohexane
GC/MS	EPA 624	Cyclohexanone
GC/MS	EPA 624	1,2-Dibromo-3-chloropropane
GC/MS	EPA 624	1,2-Dibromoethane
GC/MS	EPA 624	Dibromomethane
GC/MS	EPA 624	1,2-Dichlorobenzene
GC/MS	EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624	Dichlorodifluoromethane
GC/MS	EPA 624	1,1-Dichloroethane
GC/MS	EPA 624	1,2-Dichloroethane
GC/MS	EPA 624	cis-1,2-Dichloroethene
GC/MS	EPA 624	trans-1,2-Dichloroethene
GC/MS	EPA 624	1,1-Dichloroethene
GC/MS	EPA 624	1,2-Dichloroethene (total)
GC/MS	EPA 624	1,2-Dichloropropane
GC/MS	EPA 624	1,3-Dichloropropane
GC/MS	EPA 624	2,2-Dichloropropane
GC/MS	EPA 624	cis-1,3-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 624	1,1-Dichloropropene
GC/MS	EPA 624	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 624	Dimethyl disulfide
GC/MS	EPA 624	1,4-Dioxane
GC/MS	EPA 624	Ethyl acetate
GC/MS	EPA 624	Ethylbenzene
GC/MS	EPA 624	Ethyl ether
GC/MS	EPA 624	Diethyl ether
GC/MS	EPA 624	Ethyl methacrylate
GC/MS	EPA 624	Freon 113
GC/MS	EPA 624	Hexachlorobutadiene
GC/MS	EPA 624	n-Hexane
GC/MS	EPA 624	2-Hexanone
GC/MS	EPA 624	Iodomethane
GC/MS	EPA 624	Isobutanol
GC/MS	EPA 624	Isopropylbenzene
GC/MS	EPA 624	p-Isopropyltoluene
GC/MS	EPA 624	Methacrylonitrile
GC/MS	EPA 624	Methyl acetate
GC/MS	EPA 624	Methyl butyl ketone
GC/MS	EPA 624	Methylcyclohexane
GC/MS	EPA 624	Dichloromethane
GC/MS	EPA 624	Methylene chloride
GC/MS	EPA 624	Methyl methacrylate
GC/MS	EPA 624	4-Methyl-2-pentanone
GC/MS	EPA 624	MTBE
GC/MS	EPA 624	Naphthalene
GC/MS	EPA 624	2-Nitropropane
GC/MS	EPA 624	Nonanal
GC/MS	EPA 624	Pentachloroethane
GC/MS	EPA 624	Propionitrile
GC/MS	EPA 624	n-Propylbenzene
GC/MS	EPA 624	Styrene
GC/MS	EPA 624	1,1,1,2-Tetrachloroethane

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624	Tetrachloroethene
GC/MS	EPA 624	Tetrahydrofuran
GC/MS	EPA 624	Toluene
GC/MS	EPA 624	1,3,5-Trichlorobenzene
GC/MS	EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 624	1,1,1-Trichloroethane
GC/MS	EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 624	Trichloroethene
GC/MS	EPA 624	Trichlorofluoromethane
GC/MS	EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624	Trichlorotrifluoroethane
GC/MS	EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 624	1,3,5-Trimethylbenzene
GC/MS	EPA 624	Vinyl acetate
GC/MS	EPA 624	Vinyl chloride
GC/MS	EPA 624	m-Xylene & p-Xylene
GC/MS	EPA 624	o-Xylene
GC/MS	EPA 624	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC/MS	EPA 625	Acenaphthene
GC/MS	EPA 625	Acenaphthylene
GC/MS	EPA 625	Acetophenone
GC/MS	EPA 625	2-Acetylaminofluorene
GC/MS	EPA 625	4-Aminobiphenyl
GC/MS	EPA 625	Aniline

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625	Anthracene
GC/MS	EPA 625	Aramite (total)
GC/MS	EPA 625	Atrazine
GC/MS	EPA 625	Azobenzene
GC/MS	EPA 625	Benzaldehyde
GC/MS	EPA 625	Benzidine
GC/MS	EPA 625	Benzo(a)anthracene
GC/MS	EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 625	Benzoic acid
GC/MS	EPA 625	Benzo(ghi)perylene
GC/MS	EPA 625	Benzo(a)pyrene
GC/MS	EPA 625	Benzyl alcohol
GC/MS	EPA 625	1,1'-Biphenyl
GC/MS	EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 625	bis(2-Chloroethyl) ether
GC/MS	EPA 625	bis(2-Chloroisopropyl) ether
GC/MS	EPA 625	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 625	n-Butylbenzenesulfonamide
GC/MS	EPA 625	Butyl benzyl phthalate
GC/MS	EPA 625	Caprolactam
GC/MS	EPA 625	Carbazole
GC/MS	EPA 625	4-Chloroaniline
GC/MS	EPA 625	Chlorobenzilate
GC/MS	EPA 625	p-Chlorobenzilate
GC/MS	EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 625	2-Chloronaphthalene
GC/MS	EPA 625	2-Chlorophenol
GC/MS	EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 625	Chrysene
GC/MS	EPA 625	Cresols (total)
GC/MS	EPA 625	Cyclohexanol
GC/MS	EPA 625	Diallate
GC/MS	EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 625	Dibenzo(a,h)anthracene
GC/MS	EPA 625	Dibenzofuran
GC/MS	EPA 625	Di-n-butyl phthalate

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 625	3,3'-Dichlorobenzidine
GC/MS	EPA 625	2,4-Dichlorophenol
GC/MS	EPA 625	2,6-Dichlorophenol
GC/MS	EPA 625	Diethyl phthalate
GC/MS	EPA 625	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 625	Dimethoate
GC/MS	EPA 625	p-Dimethylaminoazobenzene
GC/MS	EPA 625	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 625	3,3'-Dimethylbenzidine
GC/MS	EPA 625	Dimethylformamide
GC/MS	EPA 625	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 625	2,4-Dimethylphenol
GC/MS	EPA 625	Dimethyl phthalate
GC/MS	EPA 625	1,3-Dinitrobenzene
GC/MS	EPA 625	1,4-Dinitrobenzene
GC/MS	EPA 625	4,6-Dinitro-2-methylphenol
GC/MS	EPA 625	2,4-Dinitrophenol
GC/MS	EPA 625	2,4-Dinitrotoluene
GC/MS	EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 625	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 625	Dinoseb
GC/MS	EPA 625	Di-n-octyl phthalate
GC/MS	EPA 625	1,4-Dioxane
GC/MS	EPA 625	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 625	Disulfoton
GC/MS	EPA 625	Ethyl methacrylate
GC/MS	EPA 625	Ethyl methanesulfonate
GC/MS	EPA 625	Famphur
GC/MS	EPA 625	Fluoranthene
GC/MS	EPA 625	Fluorene
GC/MS	EPA 625	Hexachlorobenzene
GC/MS	EPA 625	Hexachlorobutadiene
GC/MS	EPA 625	Hexachlorocyclopentadiene
GC/MS	EPA 625	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 625	Hexachloroethane

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625	Hexachlorophene
GC/MS	EPA 625	Hexachloropropene
GC/MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 625	Isodrin
GC/MS	EPA 625	Isophorone
GC/MS	EPA 625	Isosafrole
GC/MS	EPA 625	Kepone
GC/MS	EPA 625	Methapyrilene
GC/MS	EPA 625	2-Methylbenzenamine
GC/MS	EPA 625	3-Methylcholanthrene
GC/MS	EPA 625	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 625	Methyl methacrylate
GC/MS	EPA 625	Methyl methanesulfonate
GC/MS	EPA 625	2-Methylnaphthalene
GC/MS	EPA 625	Methyl parathion
GC/MS	EPA 625	2-Methylphenol
GC/MS	EPA 625	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 625	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 625	Methylphenols (total)
GC/MS	EPA 625	Naphthalene
GC/MS	EPA 625	1,4-Naphthoquinone
GC/MS	EPA 625	1-Naphthylamine
GC/MS	EPA 625	2-Naphthylamine
GC/MS	EPA 625	2-Nitroaniline
GC/MS	EPA 625	3-Nitroaniline
GC/MS	EPA 625	4-Nitroaniline
GC/MS	EPA 625	Nitrobenzene
GC/MS	EPA 625	2-Nitrophenol
GC/MS	EPA 625	4-Nitrophenol
GC/MS	EPA 625	4-Nitroquinoline-1-oxide
GC/MS	EPA 625	N-Nitrosodi-n-butylamine
GC/MS	EPA 625	N-Nitrosodiethylamine
GC/MS	EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 625	N-Nitrosodiphenylamine
GC/MS	EPA 625	N-Nitrosodi-n-propylamine
GC/MS	EPA 625	N-Nitrosomethylethylamine
GC/MS	EPA 625	N-Nitrosomorpholine
GC/MS	EPA 625	N-Nitrosopiperidine

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625	N-Nitrosopyrrolidine
GC/MS	EPA 625	5-Nitro-o-toluidine
GC/MS	EPA 625	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 625	Parathion
GC/MS	EPA 625	Pentachlorobenzene
GC/MS	EPA 625	Pentachloroethane
GC/MS	EPA 625	Pentachloronitrobenzene
GC/MS	EPA 625	Pentachlorophenol
GC/MS	EPA 625	Phenacetin
GC/MS	EPA 625	Phenanthrene
GC/MS	EPA 625	Phenol
GC/MS	EPA 625	p-Phenylene diamine
GC/MS	EPA 625	Phorate
GC/MS	EPA 625	2-Picoline
GC/MS	EPA 625	Pronamide
GC/MS	EPA 625	Pyrene
GC/MS	EPA 625	Pyridine
GC/MS	EPA 625	Safrole
GC/MS	EPA 625	Sulfotepp
GC/MS	EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 625	Thionazin
GC/MS	EPA 625	o-Toluidine
GC/MS	EPA 625	Tributyl phosphate
GC/MS	EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 625	2,4,6-Trichlorophenol
GC/MS	EPA 625	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 625	1,3,5-Trinitrobenzene
GC/MS	EPA 625	Tris(2-chloroethyl)phosphate
GC/MS	EPA 625	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 608	Aldrin
GC-ECD	EPA 608	alpha-BHC
GC-ECD	EPA 608	beta-BHC
GC-ECD	EPA 608	delta-BHC
GC-ECD	EPA 608	gamma-BHC (Lindane)
GC-ECD	EPA 608	alpha-Chlordane
GC-ECD	EPA 608	gamma-Chlordane
GC-ECD	EPA 608	Chlordane (technical)
GC-ECD	EPA 608	4,4'-DDD
GC-ECD	EPA 608	2,4'-DDD
GC-ECD	EPA 608	4,4'-DDE
GC-ECD	EPA 608	2,4'-DDE
GC-ECD	EPA 608	4,4'-DDT
GC-ECD	EPA 608	2,4'-DDT
GC-ECD	EPA 608	Dieldrin
GC-ECD	EPA 608	Endosulfan I
GC-ECD	EPA 608	Endosulfan II

Non-Potable Water

Technology	Method	Analyte
GC-ECD	EPA 608	Endosulfan sulfate
GC-ECD	EPA 608	Endrin
GC-ECD	EPA 608	Endrin aldehyde
GC-ECD	EPA 608	Endrin ketone
GC-ECD	EPA 608	Heptachlor
GC-ECD	EPA 608	Heptachlor epoxide
GC-ECD	EPA 608	Methoxychlor
GC-ECD	EPA 608	Toxaphene
GC-ECD	EPA 608	Aroclor 1016
GC-ECD	EPA 608	Aroclor 1221
GC-ECD	EPA 608	Aroclor 1232
GC-ECD	EPA 608	Aroclor 1242
GC-ECD	EPA 608	Aroclor 1248
GC-ECD	EPA 608	Aroclor 1254
GC-ECD	EPA 608	Aroclor 1260
GC-ECD	EPA 608	Aroclor 1262
GC-ECD	EPA 608	Aroclor 1268
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	MCPA
GC-ECD	EPA 8151A	MCPP
GC-ECD	EPA 8151A	4-Nitrophenol
GC-ECD	EPA 8151A	Pentachlorophenol

Non-Potable Water

Technology	Method	Analyte
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
GC-FID	RSK-175	Methane
GC-FID	RSK-175	Ethane
GC-FID	RSK-175	Ethene
GC-FID	RSK-175	Acetylene
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene

Non-Potable Water

Technology	Method	Analyte
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Benzo(ghi)perylene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a,h)anthracene

Non-Potable Water

Technology	Method	Analyte
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
GC/MS SIM	EPA 8270D SIM	Acenaphthene
GC/MS SIM	EPA 8270D SIM	Acenaphthylene
GC/MS SIM	EPA 8270D SIM	Anthracene
GC/MS SIM	EPA 8270D SIM	Benzo(a)anthracene
GC/MS SIM	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS SIM	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS SIM	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS SIM	EPA 8270D SIM	Benzo(a)pyrene
GC/MS SIM	EPA 8270D SIM	Chrysene
GC/MS SIM	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS SIM	EPA 8270D SIM	Fluoranthene
GC/MS SIM	EPA 8270D SIM	Fluorene
GC/MS SIM	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS SIM	EPA 8270D SIM	Naphthalene
GC/MS SIM	EPA 8270D SIM	Phenanthrene
GC/MS SIM	EPA 8270D SIM	Pyrene
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Technetium-99
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233

Non-Potable Water

Technology	Method	Analyte
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Bismuth
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Cerium
ICP-MS	EPA 200.8	Cesium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Hafnium
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lanthanum
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Neodymium
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Niobium
ICP-MS	EPA 200.8	Palladium
ICP-MS	EPA 200.8	Phosphorus
ICP-MS	EPA 200.8	Platinum

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Praseodymium
ICP-MS	EPA 200.8	Rhodium
ICP-MS	EPA 200.8	Ruthenium
ICP-MS	EPA 200.8	Samarium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silicon
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Sulfur
ICP-MS	EPA 200.8	Tantalum
ICP-MS	EPA 200.8	Tellurium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Thorium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Tungsten
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Yttrium
ICP-MS	EPA 200.8	Zinc
ICP-MS	EPA 200.8	Zirconium
ICP-AES	EPA 200.7	Aluminum
ICP-AES	EPA 200.7	Antimony
ICP-AES	EPA 200.7	Arsenic
ICP-AES	EPA 200.7	Barium
ICP-AES	EPA 200.7	Beryllium
ICP-AES	EPA 200.7	Bismuth
ICP-AES	EPA 200.7	Boron
ICP-AES	EPA 200.7	Cadmium
ICP-AES	EPA 200.7	Calcium
ICP-AES	EPA 200.7	Chromium
ICP-AES	EPA 200.7	Cobalt
ICP-AES	EPA 200.7	Copper
ICP-AES	EPA 200.7	Iron

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 200.7	Lead
ICP-AES	EPA 200.7	Lithium
ICP-AES	EPA 200.7	Magnesium
ICP-AES	EPA 200.7	Manganese
ICP-AES	EPA 200.7	Molybdenum
ICP-AES	EPA 200.7	Nickel
ICP-AES	EPA 200.7	Phosphorus
ICP-AES	EPA 200.7	Potassium
ICP-AES	EPA 200.7	Selenium
ICP-AES	EPA 200.7	Silicon
ICP-AES	EPA 200.7	Silver
ICP-AES	EPA 200.7	Sodium
ICP-AES	EPA 200.7	Strontium
ICP-AES	EPA 200.7	Sulfur
ICP-AES	EPA 200.7	Thallium
ICP-AES	EPA 200.7	Thorium
ICP-AES	EPA 200.7	Tin
ICP-AES	EPA 200.7	Titanium
ICP-AES	EPA 200.7	Uranium
ICP-AES	EPA 200.7	Vanadium
ICP-AES	EPA 200.7	Zinc
CVAA	EPA 7470A	Mercury
Colormetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0/9056A	Bromide
Ion Chromatrography	EPA 300.0/9056A	Chloride
Ion Chromatrography	EPA 300.0/9056A	Fluoride
Ion Chromatrography	EPA 300.0/9056A	Nitrate
Ion Chromatrography	EPA 300.0/9056A	Nitrite
Ion Chromatrography	EPA 300.0/9056A	Sulfate
Ion Chromatrography	EPA 300.0/9056A	Ortho-phosph
Ion Chromatrography	EPA 300.0/9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate

Non-Potable Water

Technology	Method	Analyte
Gravimetric	EPA 2540B EPA 2540C EPA 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA 1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 365.2	Total phosph
Colormetric	EPA 350.1	Ammonia
Colormetric	EPA 351.2	TKN
TOC Analyzer	EPA 9060	TOC
Tritrmetric	EPA 9020	TOX
Colormetric	EPA 7196A	Hex Chromium
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Probe	SM 5210B EPA 405.1	BOD/CBOD
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137

Non-Potable Water

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83

Non-Potable Water

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230

Non-Potable Water

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63

Non-Potable Water		
Technology	**Method**	**Analyte**
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Purge & Trap	EPA 5030B	Purge & Trap for Aqueous Volatile Samples
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Continuous Liquid-Liquid Extraction	EPA 3520C	Continuous Liquid-Liquid Extraction
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction

Drinking Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226

Drinking Water

Technology	Method	Analyte
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45

Drinking Water

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212

Drinking Water

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95

Solid and Chemical Materials

Technology	Method	Analyte
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260

Solid and Chemical Materials

Technology	Method	Analyte
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	MCPA
GC-ECD	EPA 8151A	MCPP
GC-ECD	EPA 8151A	4-Nitrophenol
GC-ECD	EPA 8151A	Pentachlorophenol
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Benzo(ghi)perylene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a,h)anthracene

Solid and Chemical Materials

Technology	Method	Analyte
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
GC/MS SIM	EPA 8270D	Acenaphthene
GC/MS SIM	EPA 8270D	Acenaphthylene
GC/MS SIM	EPA 8270D	Anthracene
GC/MS SIM	EPA 8270D	Benzo(a)anthracene
GC/MS SIM	EPA 8270D	Benzo(b)fluoranthene
GC/MS SIM	EPA 8270D	Benzo(k)fluoranthene
GC/MS SIM	EPA 8270D	Benzo(ghi)perylene
GC/MS SIM	EPA 8270D	Benzo(a)pyrene
GC/MS SIM	EPA 8270D	Chrysene
GC/MS SIM	EPA 8270D	Dibenz(a,h)anthracene
GC/MS SIM	EPA 8270D	Fluoranthene
GC/MS SIM	EPA 8270D	Fluorene
GC/MS SIM	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS SIM	EPA 8270D	Naphthalene
GC/MS SIM	EPA 8270D	Phenanthrene
GC/MS SIM	EPA 8270D	Pyrene
GC/MS SIM	EPA 8260C	1,4- dioxane
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium

Solid and Chemical Materials

Technology	Method	Analyte
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum

Solid and Chemical Materials

Technology	Method	Analyte
ICP-MS	EPA 6020A	Technetium-99
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
CVAA	EPA 7471B	Mercury
Colormetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0 EPA 9056A	Bromide
Ion Chromatrography	EPA 300.0 EPA 9056A	Chloride
Ion Chromatrography	EPA 300.0 EPA 9056A	Fluoride
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrate
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrite
Ion Chromatrography	EPA 300.0 EPA 9056A	Sulfate
Ion Chromatrography	EPA 300.0 EPA 9056A	Ortho-phosph
Ion Chromatrography	EPA 300.0 EPA 9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate
Gravimetric	EPA 2540B EPA 2540C EPA 2540D	Solids

Solid and Chemical Materials

Technology	Method	Analyte
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
Colormetric	EPA 351.2	TKN
TOC Analyzer	EPA 9060	TOC
Tritrmetric	EPA 9020	TOX
Colormetric	EPA 7196A	Hex Chromium
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Probe	SM 5210B EPA 405.1	BOD/CBOD
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228

Solid and Chemical Materials

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58

Solid and Chemical Materials

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40

Solid and Chemical Materials

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234

Solid and Chemical Materials

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129

Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Acid Digestion (solids)	EPA 3050B	Acid Digestion for Metals of Sedimtent/Soils
Purge & Trap	EPA 5030B	Purge & Trap for Aqueous Volatile Samples
Closed System Purge & Trap and Extraction for Volatiles	EPA 5035	Closed System Purge & Trap and Extraction for Volatiles
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Ultrasonic Extraction	EPA 3550C	Ultrasonic Extraction Organic Soils
Continuous Liquid-Liquid Extraction	EPA 3520C	Continuous Liquid-Liquid Extraction
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Waste Dilution	EPA 3585	Waste Dilution Volatile Organics
Waste Dilution	EPA 3580A	Waste Dilution SemiVolatile Organics
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Alkaline Digestion	EPA 3060A	Alkaline Digestion for Hexavalent Chromium

Notes:

1) This laboratory offers commercial testing service.

Approved by: ______________________

R. Douglas Leonard
Chief Technical Officer

Date: May 31, 2013

ReIssued: 5/31/13

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

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Issued in accordance with and pursuant to section 502 Public Health Law of New York State

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TESTAMERICA ST LOUIS
13715 RIDER TRAIL NORTH
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NY Lab Id No: 11616

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Metals III

Uranium (Mass)	EPA 200.8 Rev. 5.4

Radiological Analytes

Gross Alpha	EPA 900.0
Photon Emitters	EPA 901.1
Radioactive Cesium	EPA 901.1
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Strontium-90	EPA 905.0
Tritium	EPA 906.0

Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2

Volatile Aromatics

1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2

Volatile Aromatics

Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
sec-Butylbenzene	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2

Serial No.: 52452

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Volatile Halocarbons	
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

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Acrylates

Acrolein (Propenal)	EPA 8260C EPA 624
Acrylonitrile	EPA 8260C EPA 624
Ethyl methacrylate	EPA 8260C
Methyl acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C

Amines

1-Naphthylamine	EPA 8270D
2-Naphthylamine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
a,a-Dimethylphenethylamine	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Methapyrilene	EPA 8270D
Propionitrile	EPA 8260C
Pyridine	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 625 EPA 8270D
3,3'-Dimethylbenzidine	EPA 8270D

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B EPA 608
4,4'-DDE	EPA 8081B EPA 608
4,4'-DDT	EPA 8081B EPA 608
Aldrin	EPA 8081B EPA 608
alpha-BHC	EPA 8081B EPA 608
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B EPA 608
Chlordane Total	EPA 8081B EPA 608
delta-BHC	EPA 8081B EPA 608
Diallate	EPA 8270D
Dieldrin	EPA 8081B EPA 608
Endosulfan I	EPA 8081B EPA 608
Endosulfan II	EPA 8081B EPA 608
Endosulfan sulfate	EPA 8081B EPA 608

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Chlorinated Hydrocarbon Pesticides

Endrin	EPA 8081B
	EPA 608
Endrin aldehyde	EPA 8081B
	EPA 608
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
	EPA 608
Heptachlor epoxide	EPA 8081B
	EPA 608
Isodrin	EPA 8270D
Lindane	EPA 8081B
	EPA 608
Methoxychlor	EPA 8081B
Toxaphene	EPA 8081B
	EPA 608

Chlorinated Hydrocarbons

1,2,4-Trichlorobenzene	EPA 625
	EPA 8270D
2-Chloronaphthalene	EPA 625
	EPA 8270D
Hexachlorobenzene	EPA 625
	EPA 8270D
Hexachlorobutadiene	EPA 625
	EPA 8270D

Chlorinated Hydrocarbons

Hexachlorocyclopentadiene	EPA 625
	EPA 8270D
Hexachloroethane	EPA 625
	EPA 8270D
Hexachloropropene	EPA 8270D
Pentachlorobenzene	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dalapon	EPA 8151A
Dicamba	EPA 8151A
Dinoseb	EPA 8151A

Demand

Biochemical Oxygen Demand	SM 5210B-01,-11
Chemical Oxygen Demand	EPA 410.4 Rev. 2.0

Dissolved Gases

Acetylene	RSK-175
Ethane	RSK-175
Ethene (Ethylene)	RSK-175
Methane	RSK-175

Fuel Oxygenates

Methyl tert-butyl ether	EPA 8260C

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Haloethers

4-Bromophenylphenyl ether	EPA 625
	EPA 8270D
4-Chlorophenylphenyl ether	EPA 625
	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 625
	EPA 8270D
Bis(2-chloroethyl)ether	EPA 625
	EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 625
	EPA 8270D

Metals I

Barium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Calcium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4

Metals I

Copper, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
Lead, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Magnesium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Potassium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A

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Metals I

Silver, Total	EPA 200.8 Rev. 5.4
Sodium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Strontium, Total	EPA 6010C
	EPA 6020A

Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Arsenic, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Chromium VI	EPA 7196A
Mercury, Total	EPA 245.1 Rev. 3.0
	EPA 7470A

Metals II

Selenium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4

Metals III

Cobalt, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Molybdenum, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
	EPA 6020A
	EPA 200.8 Rev. 5.4

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Metals III

Tin, Total	EPA 6010C
	EPA 6020A
Titanium, Total	EPA 6010C
	EPA 6020A
Uranium (Mass)	EPA 6020A

Mineral

Alkalinity	SM 2320B-97,-11
Chloride	EPA 300.0 Rev. 2.1
Fluoride, Total	EPA 300.0 Rev. 2.1
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Miscellaneous

Boron, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Bromide	EPA 300.0 Rev. 2.1
Cyanide, Total	EPA 335.4 Rev. 1.0
	EPA 9012B
Oil and Grease Total Recoverable (HEM)	EPA 1664A
Perchlorate	EPA 6850
	EPA 314.0
Silica, Dissolved	EPA 200.7 Rev. 4.4
Specific Conductance	EPA 120.1 Rev. 1982
Total Organic Halides	EPA 9020B

Nitroaromatics and Isophorone

1,3,5-Trinitrobenzene	EPA 8330B

Nitroaromatics and Isophorone

1,3-Dinitrobenzene	EPA 8330B
1,4-Naphthoquinone	EPA 8270D
2,4,6-Trinitrotoluene	EPA 8330B
2,4-Dinitrotoluene	EPA 625
	EPA 8270D
	EPA 8330B
2,6-Dinitrotoluene	EPA 625
	EPA 8270D
	EPA 8330B
2-Amino-4,6-dinitrotoluene	EPA 8330B
2-Nitrotoluene	EPA 8330B
3-Nitrotoluene	EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 8330B
4-Nitrotoluene	EPA 8330B
Hexahydro-1,3,5-trinitro-1,3,5-triazine	EPA 8330B
Isophorone	EPA 625
	EPA 8270D
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330B
Nitrobenzene	EPA 625
	EPA 8270D
	EPA 8330B
Octahydro-tetranitro-tetrazocine	EPA 8330B

Nitrosoamines

N-Nitrosodiethylamine	EPA 8270D
N-Nitrosodimethylamine	EPA 625

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Nitrosoamines

N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-butylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625
	EPA 8270D
N-Nitrosodiphenylamine	EPA 625
	EPA 8270D
N-nitrosomethylethylamine	EPA 8270D
N-nitrosomorpholine	EPA 8270D
N-nitrosopiperidine	EPA 8270D
N-Nitrosopyrrolidine	EPA 8270D

Nutrient

Ammonia (as N)	EPA 350.1 Rev. 2.0
Nitrate (as N)	EPA 300.0 Rev. 2.1
Nitrite (as N)	EPA 300.0 Rev. 2.1
Orthophosphate (as P)	EPA 300.0 Rev. 2.1

Phthalate Esters

Benzyl butyl phthalate	EPA 625
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 625
	EPA 8270D
Diethyl phthalate	EPA 625
	EPA 8270D
Dimethyl phthalate	EPA 625
	EPA 8270D
Di-n-butyl phthalate	EPA 625
	EPA 8270D
Di-n-octyl phthalate	EPA 625
	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 8082A
	EPA 608
PCB-1221	EPA 8082A
	EPA 608
PCB-1232	EPA 8082A
	EPA 608
PCB-1242	EPA 8082A
	EPA 608
PCB-1248	EPA 8082A
	EPA 608
PCB-1254	EPA 8082A
	EPA 608
PCB-1260	EPA 8082A
	EPA 608

Polynuclear Aromatics

3-Methylcholanthrene	EPA 8270D
Acenaphthene	EPA 625
	EPA 8270D
Acenaphthylene	EPA 625
	EPA 8270D
Anthracene	EPA 625

Serial No.: 52453

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

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CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. ELAINE WILD
TESTAMERICA ST LOUIS
13715 RIDER TRAIL NORTH
EARTH CITY, MO 63045

NY Lab Id No: 11616

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Polynuclear Aromatics

Anthracene	EPA 8270D
Benzo(a)anthracene	EPA 625
	EPA 8270D
Benzo(a)pyrene	EPA 625
	EPA 8270D
Benzo(b)fluoranthene	EPA 625
	EPA 8270D
Benzo(ghi)perylene	EPA 625
	EPA 8270D
Benzo(k)fluoranthene	EPA 625
	EPA 8270D
Chrysene	EPA 625
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 625
	EPA 8270D
Fluoranthene	EPA 625
	EPA 8270D
Fluorene	EPA 625
	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 625
	EPA 8270D
Naphthalene	EPA 625
	EPA 8270D
Phenanthrene	EPA 625
	EPA 8270D
Pyrene	EPA 625

Polynuclear Aromatics

Pyrene	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 625
	EPA 8270D
2,4-Dichlorophenol	EPA 625
	EPA 8270D
2,4-Dimethylphenol	EPA 625
	EPA 8270D
2,4-Dinitrophenol	EPA 625
	EPA 8270D
2,6-Dichlorophenol	EPA 8270D
2-Chlorophenol	EPA 625
	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625
	EPA 8270D
2-Methylphenol	EPA 8270D
2-Nitrophenol	EPA 625
	EPA 8270D
3-Methylphenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 625
	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 625

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Priority Pollutant Phenols

4-Nitrophenol	EPA 8270D
Pentachlorophenol	EPA 625
	EPA 8270D
Phenol	EPA 625
	EPA 8270D

Radiological Analytes

Gross Alpha	EPA 900.0
Gross Beta	EPA 900.0
Photon Emitters	EPA 901.1
	HASL 300 1997 GA-01-R sec 4.5.2.3
Radioactive Cesium	EPA 901.1
Radium-226	EPA 903.0
Radium-228	EPA 904.0
Strontium-89	HASL 300 1997 Sr-01,02-RC (GPC)
Strontium-90	EPA 905.0
	HASL 300 1997 Sr-01,02-RC (GPC)
Tritium	EPA 906.0

Residue

Solids, Total	SM 2540 B-97,-11
Solids, Total Dissolved	SM 2540 C-97,-11
Solids, Total Suspended	SM 2540 D-97,-11

Semi-Volatile Organics

1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D

Semi-Volatile Organics

1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
4-Amino biphenyl	EPA 8270D
Acetophenone	EPA 8270D
Aramite	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Dibenzofuran	EPA 8270D
Isosafrole	EPA 8270D
Phenacetin	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
	EPA 624
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
	EPA 624
1,4-Dichlorobenzene	EPA 8260C
	EPA 624
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
	EPA 624
Bromobenzene	EPA 8260C

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Volatile Aromatics	
Chlorobenzene	EPA 8260C EPA 624
Ethyl benzene	EPA 8260C EPA 624
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C EPA 624
Total Xylenes	EPA 8260C EPA 624

Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C EPA 624
1,1,2,2-Tetrachloroethane	EPA 8260C EPA 624
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C

Volatile Halocarbons	
1,1,2-Trichloroethane	EPA 8260C EPA 624
1,1-Dichloroethane	EPA 8260C EPA 624
1,1-Dichloroethene	EPA 8260C EPA 624
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C EPA 624
1,2-Dichloropropane	EPA 8260C EPA 624
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloro-1,3-butadiene (Chloroprene)	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C EPA 624
3-Chloropropene (Allyl chloride)	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C EPA 624
Bromoform	EPA 8260C EPA 624
Bromomethane	EPA 8260C

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Volatile Halocarbons

Bromomethane	EPA 624
Carbon tetrachloride	EPA 8260C
	EPA 624
Chloroethane	EPA 8260C
	EPA 624
Chloroform	EPA 8260C
	EPA 624
Chloromethane	EPA 8260C
	EPA 624
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
	EPA 624
Dibromochloromethane	EPA 8260C
	EPA 624
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methyl iodide	EPA 8260C
Methylene chloride	EPA 8260C
	EPA 624
Tetrachloroethene	EPA 8260C
	EPA 624
trans-1,2-Dichloroethene	EPA 8260C
	EPA 624
trans-1,3-Dichloropropene	EPA 8260C
	EPA 624

Volatile Halocarbons

trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 8260C
	EPA 624
Trichlorofluoromethane	EPA 8260C
	EPA 624
Vinyl chloride	EPA 8260C
	EPA 624

Volatiles Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Acetonitrile	EPA 8260C
Carbon Disulfide	EPA 8260C
Di-ethyl ether	EPA 8260C
Ethyl Acetate	EPA 8260C
Isobutyl alcohol	EPA 8260C
n-Butanol	EPA 8260C
o-Toluidine	EPA 8270D
Vinyl acetate	EPA 8260C

Sample Preparation Methods

	EPA 5030C
	EPA 3010A
	EPA 3510C

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All approved analytes are listed below:

Sample Preparation Methods

EPA 3520C
EPA 9010C

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All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 8260C
Acrylonitrile	EPA 8260C
Ethyl methacrylate	EPA 8260C
Methyl acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C

Amines

1-Naphthylamine	EPA 8270D
2-Naphthylamine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
a,a-Dimethylphenethylamine	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Methapyrilene	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 8270D

Characteristic Testing

Free Liquids	EPA 9095B
Ignitability	EPA 1010A
Synthetic Precipitation Leaching Proc.	EPA 1312
TCLP	EPA 1311

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B
4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B
alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	EPA 8081B
Diallate	EPA 8270D
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Isodrin	EPA 8270D
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Pentachloronitrobenzene	EPA 8270D
Toxaphene	EPA 8081B

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All approved analytes are listed below:

Chlorinated Hydrocarbons	
1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270D
2-Chloronaphthalene	EPA 8270D
Hexachlorobenzene	EPA 8270D
Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 8270D
Hexachloropropene	EPA 8270D
Pentachlorobenzene	EPA 8270D
Chlorophenoxy Acid Pesticides	
2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
2,4-DB	EPA 8151A
Dicamba	EPA 8151A
Dinoseb	EPA 8151A
MCPA	EPA 8151A
MCPP	EPA 8151A
Haloethers	
4-Bromophenylphenyl ether	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270D
Bis(2-chloroisopropyl) ether	EPA 8270D

Metals I	
Barium, Total	EPA 6010C
	EPA 6020A
Cadmium, Total	EPA 6010C
	EPA 6020A
Calcium, Total	EPA 6010C
	EPA 6020A
Chromium, Total	EPA 6010C
	EPA 6020A
Copper, Total	EPA 6010C
	EPA 6020A
Iron, Total	EPA 6010C
	EPA 6020A
Lead, Total	EPA 6010C
	EPA 6020A
Magnesium, Total	EPA 6010C
	EPA 6020A
Manganese, Total	EPA 6010C
	EPA 6020A
Nickel, Total	EPA 6010C
	EPA 6020A
Potassium, Total	EPA 6010C
	EPA 6020A
Silver, Total	EPA 6010C
	EPA 6020A
Sodium, Total	EPA 6010C
	EPA 6020A

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Metals I

Strontium, Total	EPA 6010C
	EPA 6020A

Metals II

Aluminum, Total	EPA 6010C
	EPA 6020A
Antimony, Total	EPA 6010C
	EPA 6020A
Arsenic, Total	EPA 6010C
	EPA 6020A
Beryllium, Total	EPA 6010C
	EPA 6020A
Chromium VI	EPA 7196A
Lithium, Total	EPA 6010C
	EPA 6020A
Mercury, Total	EPA 7471B
Selenium, Total	EPA 6010C
	EPA 6020A
Vanadium, Total	EPA 6010C
	EPA 6020A
Zinc, Total	EPA 6010C
	EPA 6020A

Metals III

Cobalt, Total	EPA 6010C
	EPA 6020A
Molybdenum, Total	EPA 6010C

Metals III

Molybdenum, Total	EPA 6020A
Thallium, Total	EPA 6010C
	EPA 6020A
Tin, Total	EPA 6010C
	EPA 6020A
Titanium, Total	EPA 6010C
	EPA 6020A

Minerals

Bromide	EPA 9056A
Chloride	EPA 9056A
Fluoride, Total	EPA 9056A
Sulfate (as SO4)	EPA 9056A

Miscellaneous

Boron, Total	EPA 6010C
Cyanide, Total	EPA 9012B

Nitroaromatics and Isophorone

1,3,5-Trinitrobenzene	EPA 8330B
1,3-Dinitrobenzene	EPA 8330B
1,4-Naphthoquinone	EPA 8270D
2,4,6-Trinitrotoluene	EPA 8330B
2,4-Dinitrotoluene	EPA 8270D
	EPA 8330B
2,6-Dinitrotoluene	EPA 8270D
	EPA 8330B

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Nitroaromatics and Isophorone

2-Amino-4,6-dinitrotoluene	EPA 8330B
2-Nitrotoluene	EPA 8330B
3-Nitrotoluene	EPA 8330B
4-Amino-2,6-dinitrotoluene	EPA 8330B
4-Nitrotoluene	EPA 8330B
Hexahydro-1,3,5-trinitro-1,3,5-triazine	EPA 8330B
Isophorone	EPA 8270D
Methyl-2,4,6-trinitrophenylnitramine	EPA 8330B
Nitrobenzene	EPA 8270D
	EPA 8330B
Octahydro-tetranitro-tetrazocine	EPA 8330B
Pyridine	EPA 8270D

Nitrosoamines

N-Nitrosodiethylamine	EPA 8270D
N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-butylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270D
N-nitrosomethylethylamine	EPA 8270D
N-nitrosomorpholine	EPA 8270D
N-nitrosopiperidine	EPA 8270D
N-Nitrosopyrrolidine	EPA 8270D

Nutrients

Nitrate (as N)	EPA 9056A
Nitrite (as N)	EPA 9056A
Orthophosphate (as P)	EPA 9056A

Phthalate Esters

Benzyl butyl phthalate	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 8270D
Diethyl phthalate	EPA 8270D
Dimethyl phthalate	EPA 8270D
Di-n-butyl phthalate	EPA 8270D
Di-n-octyl phthalate	EPA 8270D

Polychlorinated Biphenyls

PCB-1016	EPA 8082A
PCB-1221	EPA 8082A
PCB-1232	EPA 8082A
PCB-1242	EPA 8082A
PCB-1248	EPA 8082A
PCB-1254	EPA 8082A
PCB-1260	EPA 8082A

Polynuclear Aromatic Hydrocarbons

7,12-Dimethylbenzyl (a) anthracene	EPA 8270D
Acenaphthene	EPA 8270D
Acenaphthylene	EPA 8270D
Anthracene	EPA 8270D
Benzo(a)anthracene	EPA 8270D
Benzo(a)pyrene	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D

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Polynuclear Aromatic Hydrocarbons

Benzo(ghi)perylene	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D
Chrysene	EPA 8270D
Dibenzo(a,h)anthracene	EPA 8270D
Fluoranthene	EPA 8270D
Fluorene	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D
Naphthalene	EPA 8270D
Phenanthrene	EPA 8270D
Pyrene	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D
2,4-Dichlorophenol	EPA 8270D
2,4-Dimethylphenol	EPA 8270D
2,4-Dinitrophenol	EPA 8270D
2,6-Dichlorophenol	EPA 8270D
2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270D
2-Methylphenol	EPA 8270D
2-Nitrophenol	EPA 8270D
3-Methylphenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D
4-Methylphenol	EPA 8270D

Priority Pollutant Phenols

4-Nitrophenol	EPA 8270D
Pentachlorophenol	EPA 8270D
Phenol	EPA 8270D

Semi-Volatile Organics

1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
4-Amino biphenyl	EPA 8270D
Acetophenone	EPA 8270D
Aramite	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Isosafrole	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C

Serial No.: 52454

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2016
Issued April 01, 2015

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. ELAINE WILD
TESTAMERICA ST LOUIS
13715 RIDER TRAIL NORTH
EARTH CITY, MO 63045

NY Lab Id No: 11616

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Volatile Aromatics

Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
Total Xylenes	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
1,1-Dichloroethane	EPA 8260C
1,1-Dichloroethene	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C

Volatile Halocarbons

1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloro-1,3-butadiene (Chloroprene)	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
3-Chloropropene (Allyl chloride)	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
Bromoform	EPA 8260C
Bromomethane	EPA 8260C
Carbon tetrachloride	EPA 8260C
Chloroethane	EPA 8260C
Chloroform	EPA 8260C
Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260C
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methyl iodide	EPA 8260C
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C

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All approved analytes are listed below:

Volatile Halocarbons

trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 8260C
Trichlorofluoromethane	EPA 8260C
Vinyl chloride	EPA 8260C

Volatile Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Acetonitrile	EPA 8260C
Carbon Disulfide	EPA 8260C
Di-ethyl ether	EPA 8260C
Ethyl Acetate	EPA 8260C
Isobutyl alcohol	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
o-Toluidine	EPA 8270D
Propionitrile	EPA 8260C
Vinyl acetate	EPA 8260C

Sample Preparation Methods

EPA 5035A-L
EPA 5035A-H
EPA 3010A
EPA 3050B
EPA 3550C

Sample Preparation Methods

EPA 3060A
EPA 9010C

Serial No.: 52454

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APPENDIX F
ACCIDENT PREVENTION PLAN

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Accident Prevention Plan
Appendix F to the Remedial Investigation Work Plan: Uniform Federal Policy Quality Assurance Project Plan

Newly Eligible Restoration Sites (NERS)
Remedial Investigations/Feasibility Studies (RI/FS)
at
Multiple Air National Guard Installations
New England Region

Prepared for:

National Guard Bureau

Logistics and Installations Directorate
Operations Division, Restoration Branch
NGB/A4OR

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903

Project Number ANG2015NEWENGLAND

Contract Number W9133L-14-D-0008, Delivery Order 0005

May 2016

Accident Prevention Plan
Appendix F to the Remedial Investigation Work Plan:
Uniform Federal Policy Quality Assurance Project Plan

Newly Eligible Restoration Sites (NERS)
Remedial Investigations/Feasibility Studies (RI/FS)
at
Multiple Air National Guard Installations
New England Region

Contract No. W9133L-14-D-0008
Delivery Order No. 0005

1. SIGNATURE SHEET

Plan Prepared by:

Louise Kritzberger, CHST — 2/5/2016
Louise Kritzberger — Date
Certified Construction Health and Safety Technician (CHST)
(610) 701-3618

Plan Approved by:

Lawrence J Werts III — 2/5/2016
Larry Werts — Date
East Environmental Health and Safety (EHS) Leader
(610) 701-3912

2/5/2016
Thomas Koch, CIH — Date
Program Health & Safety Officer
(303) 273-0231

Plan Review and Concurrence by:

2/5/2016
Chris Kane, PMP — Date
Project Manager
(603) 656-5428

2/5/2016
Joseph Gross, P.E. — Date
Project Manager
(410) 612-5910

ACCIDENT PREVENTION PLAN APPROVAL/SIGNOFF

Site Name: **Newly Eligible Restoration Sites (NERS)**
Remedial Investigations/Feasibility Studies (RI/FS)
at Multiple Air National Guard Installations, New England Region

Work Locations: **Bradley, Connecticut (CT); Burlington, Vermont (VT); Gabreski, New York (NY); Hancock, NY; Harrisburg, Pennsylvania (PA); Martin State, Maryland (MD); McLaughlin, West Virginia (WV); Pease, New Hampshire (NH); Quonset, Rhode Island (RI); Schenectady, NY; South Portland, Maine (ME); and Stewart, NY.**

I have read, understood, and agree to abide by the information set forth in this Accident Prevention Plan and discussed in the Personnel Health and Safety briefings.

Name	**Signature**	**Date**
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LIST OF ATTACHMENTS

LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
AL	Action Level
APP	Accident Prevention Plan
APR	air-purifying respirator
BBP	bloodborne pathogens
BBS	Behavior-Based Safety
BEIs	Biological Exposure Indices
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CHST	Construction Health and Safety Technician
COR	Contracting Officer’s Representative
CPR	cardiopulmonary resuscitation
dBA	A-weighted decibels
DOT	Department of Transportation
ECP	Exposure Control Plan
ECT	equivalent chill temperature
EHS	Environmental Health and Safety
EM	Engineering Manual
EMT	emergency medical technician
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FM	Factory Mutual Research Corp.
GDA	Government Designated Authority
HAZCOM	Hazard Communication
HCP	Hearing Conservation Program
HPD	hearing protection device
HTRW	hazardous, toxic, and radioactive waste
KO	Contracting Officer
LOP	level of protection
NERS	Newly Eligible Restoration Sites
NFPA	National Fire Protection Association
NGB	National Guard Bureau
NIOSH	National Institute for Occupational Safety and Health

LIST OF ACRONYMS (Continued)

NOI	Notice of Incident
NRR	noise reduction rating
OMC	Occupational Medical Consultant
PAN	Preliminary Accident Notification
PEL	permissible exposure limit
PM	Project Manager
PPE	personal protective equipment
RAC	Risk Assessment Code
RI/FS	Remedial Investigations/Feasibility Studies
RPP	Respiratory Protection Plan
SOH	safety and occupational health
SOHO	Safety and Occupational Health Office
SOO	scope of objectives
SPF	sun protection factor
SSHP	Site Safety and Health Plan
TEC-Weston JV	TEC-Weston Joint Venture
TLV	Threshold Limit Value
TWA	time-weighted average
UL	Underwriters Laboratories, Inc.
USACE	U.S. Army Corps of Engineers
WBGT	Wet-Bulb Globe Temperature

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2. BACKGROUND INFORMATION

Contractor:	TEC-Weston Joint Venture (TEC-Weston JV)
Contract Number:	Contract No. W9133L-14-D-0008, Delivery Order No. 0005
Project Name:	Newly Eligible Restoration Sites (NERS) Remedial Investigations/Feasibility Studies (RI/FS) at Multiple Air National Guard Installations – New England Region

The TEC-Weston JV has prepared this Accident Prevention Plan (APP) under contract number W9133L-14-D-0008 for the Newly Eligible Restoration Sites (NERS) Remedial Investigations/Feasibility Studies (RI/FS) at Multiple Air National Guard Installations – New England Region project (**Figure 2-1**). The TEC-Weston JV is the contracting entity, with WESTON and Cardno as the JV team partners. All project activities will be performed in accordance with this APP. This APP is a dynamic document and is subject to change based on the review and implementation of additional tasks.

This APP presents the minimum requirements for safety and health that must be met by site personnel engaged in site operations. This APP does not in any way relieve site personnel, contractors, or subcontractors from responsibility for the safety and health of their personnel. Contractors shall be required to review site conditions and the work to be performed and to determine specific safety and health requirements for their personnel. During the project field work, site visitors shall receive a safety briefing by the Site Safety and Health Officer (SSHO) prior to gaining entry to the work area. The SSHO will ensure all visitors have appropriate personal protective equipment (PPE), are appropriately escorted while on-site, and have properly signed an on-site visitor's log.

2.1 PROJECT DESCRIPTION

The objective of this project, in accordance with the scope of objectives (SOO), is to conduct tasks associated with RIs at multiple NERS.

The primary tasks to be performed during this project are as follows:

- Activity 1: Mobilization/Demobilization
- Activity 2: Soil Borings

- Activity 3: Monitoring Well Installation
- Activity 4: Well Development and Groundwater Sampling
- Activity 5: Surface Water and Sediment Sampling
- Activity 6: Soil Sampling
- Activity 7: Surveying
- Activity 8: Temporary Well Abandonment

All activities may not be performed at every base. Tasks specific to the individual bases will be noted in the SSHP Table 2-1 for that base.

All applicable federal, state, local, and environmental permits, licenses, and certificates will be applied for and obtained prior to field activities.

2.2 REGULATIONS AND GUIDELINES

To ensure the safety and health of on-site personnel, visitors, client personnel, and the local community, all local, state, and federal regulations and guidelines will be met as necessary. However, specific focus will be on the following regulations because they directly apply to the project:

- 29 Code of Federal Regulation (CFR) 1904, 1910, and 1926 (Occupational Safety and Health Administration [OSHA] General Industry and Construction Standards, respectively).
- Engineering Manual (EM) 385-1-1 U.S. Army Corps of Engineers (USACE) Health and Safety Requirements Manual, 28 Nov 2014.
- ER 385-1-92 Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities.
- National Fire Protection Association (NFPA) Standards.
- Environmental Health and Safety (EHS) Program guidelines.

2.3 ACTIVITY HAZARD ANALYSIS

The Activity Hazard Analysis (AHA) will define the activities being performed and identify the sequences of work, the specific hazards anticipated, site-specific conditions, equipment and materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.

AHAs for all field operations will be developed to comply with EM 385-1-1 and will be completed immediately prior to field work activities by the competent person for that task in accordance with EM 385-1-1. These AHAs will be submitted separately as additions to Section 12 of the APP.

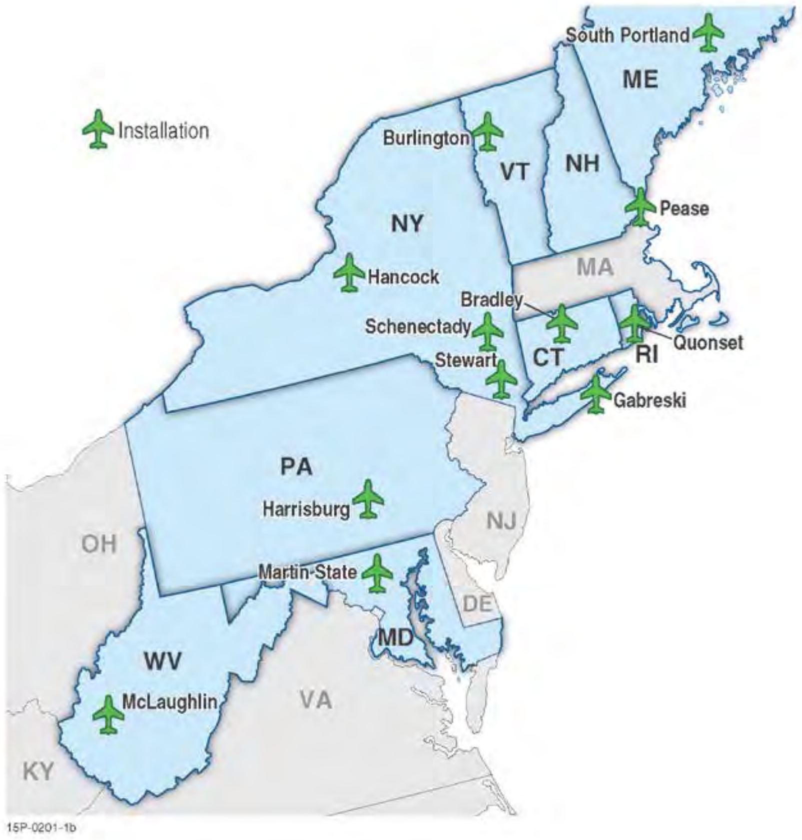


Figure 2-1 Site Locations

3. STATEMENT OF SAFETY AND HEALTH POLICY

3.1 HEALTH AND SAFETY POLICIES

Project personnel operate in a culture where safety, health, and protection of personnel and the environment take precedence over expediency. A fundamental premise of the Behavior-Based Safety (BBS) culture is that accidents are preventable through choosing safe proactive behaviors. The Health and Safety policy emphasizes several important points:

- We have a goal of working safely 100% of the time (employees and contractors) with the expected outcome being zero incidents that result in injuries, illnesses, property damage, or environmental damage or contamination.
- Managers and workers accept as their responsibility a concerted and sustained effort to achieve a goal of Safety Every Minute of Every Day.
- Managers and workers assume a safety leadership role.
- Managers and workers take action for safety, coach peers in safe practices, and share experiences, successes, and failures.
- Workers are involved in the identification and control of workplace hazards during work planning, work execution, and feedback activities.
- Management is committed to a work environment that allows free and open expression of safety concerns, and where workers fear no reprisals or retaliation.

3.2 100% SAFE WORK AND STOP WORK POLICY STATEMENT

For each activity and contract under which work is performed, a policy is implemented clearly stating that employees have the responsibility and right to stop or curtail any work they perceive to be unsafe (a threat to public health, the safety and health of workers, or the environment). Employees must be free to voice concerns about safety and health without fear of reprisal, retaliation, or harassment.

To support the goal of all employees and subcontractors working safely – 100% of the time, all managers will use every available resource to maintain safe, hazard-controlled work environments characterized by a vigorous emphasis on accident prevention. Standards, requirements, and best practices will be implemented in a manner that maximizes the prevention of accidents. Managers will ensure that all employees are knowledgeable of those standards, requirements, and best practices that pertain to their safety.

Managers and supervisors are held directly accountable for the health and safety of their employees, subcontractor activities, and other resources employed to maintain employee health and safety, and the continual communication of hazards and hazard controls to the workforce.

3.3 PROGRAM GOALS

In the BBS program, employees assume a safety leadership role and are responsible for the safety of coworkers, team members, visitors, and stakeholders. As part of the BBS program, employees create high-quality connections with one another, team members, and stakeholders to foster an active, caring culture. Commitment is high, and employees help each other be Safe Every Minute of Every Day to achieve the goal of *Zero Accidents* involving personnel and the environment.

3.4 PROGRAM OBJECTIVES

The EHS Program has the following objectives:

1. EHS staff, resources, and procedures are provided as necessary and used in an efficient and cost-effective manner to establish a safe work environment for employees, subcontractors, clients, and the general public.
2. Compliance with environmental, health and safety regulations is assured, and risk is managed and minimized for all employees, as well as the corporation.
3. Management involvement is established and maintained within the EHS Program.
4. Clear lines of reporting, authorities, responsibilities, and performance expectations are established.
5. World-class EHS culture is attained at our places of employment, in our homes, and in our communities through the elimination of at-risk behavior.

3.5 ACCIDENT EXPERIENCE GOAL

Information on all incidents is stored in an electronic database that allows the assessment of trends and the causes of incidents. By learning from past experience, employees can avoid the recurrence of incidents. This information is used in training as well as in the development of APPs and AHAs. This is in keeping with the goal of working safely 100% of the time and of continuous improvement.

3.6 DRUG AWARENESS AND DRUG-FREE WORKPLACE

A Drug and Alcohol Testing Procedure, which is in accordance with Federal Acquisition Regulation (FAR) Subpart 23.500, will be enforced. Strict disciplinary actions will be enforced for any violation of the Drug-Free Workplace policy.

Subcontractors are expected to comply fully with the requirements of this policy and all provisions and clauses of the contract. Employee drug testing is not required in the performance of this contract.

4. PERSONNEL RESPONSIBILITIES AND LINES OF AUTHORITY

4.1 STATEMENT OF EMPLOYER'S RESPONSIBILITY

As the prime contractor for Contract No. W9133L-14-D-0008, the TEC-Weston JV is ultimately responsible for the implementation of the EHS Program through enforcing the safety and occupational health (SOH) procedures for this project as stated in this APP. The TEC-Weston JV's senior and corporate management is committed to operating projects in a manner consistent with controlling EHS legislative, regulatory, and client requirements, and other applicable requirements administered by federal agencies.

4.2 IDENTIFICATION OF PERSONNEL RESPONSIBLE FOR SAFETY

Table 4-1 presents the key project personnel responsible for Safety Program implementation on the NERS RI projects. Resumes for key safety personnel are included in **Attachment B**. The key responsibilities of each position are provided in **Table 4-2**.

Table 4-1 Project Safety Team

Name	Position	Phone No.*
Chris Kane, PMP®	Project Manager (PM) (ME, VT, CT, NH, and RI)	(603) 656-5428 – office (603) 566-4658 – cell
Joseph Gross, P.E.	Project Manager (PA, MD, NY, and WV)	(410) 612-5910 – office (410) 937-9697 – cell
Thomas Koch, CIH	Program Health & Safety Officer	(303) 273-0231 – office (303) 503-0442 – cell
Larry Werts	East EHS Leader	(610) 701-3912 – office (215) 815-6237 – cell
Louise Kritzberger, CHST	Site Safety and Health Officer (SSHO)	(610) 701-3618 – office (484) 571-9441 – cell
Dan Locurcio	Site Safety and Health Officer (SSHO)	(610) 701-3465 – office (610) 247-6454 – cell
Tom Dakin	Site Safety and Health Officer (SSHO)	(610) 701-3164 – office (302) 415-1496 – cell
Robert Wagner	Site Safety and Health Officer (SSHO)	(570) 466-4026 – cell
Michael Argue	Site Safety and Health Officer (SSHO)	(603) 656-5403 – office (413) 281-9572 – cell
Brenden Beaumont	Site Safety and Health Officer (SSHO)	(410) 612-5964 – office (443) 417-6398 – cell

Notes:
CIH = Certified Industrial Hygienist.
PMP = Project Management Professional
P.E. = Professional Engineer
*Phone numbers will be confirmed/revised prior to field mobilization and revised during the project, as necessary.

Table 4-2 Position Descriptions

Position	Description of Key Responsibilities
Project Manager (PM) Chris Kane, PMP Joseph Gross, P.E.	▪ Overall responsibility for the management and completion of the project. ▪ Responsible and accountable for project safety. ▪ Overall responsibility for ensuring that project personnel (including subcontractor personnel) comply with EHS regulations, program requirements, and procedures. ▪ Ensure development and implementation of project APP and indicate concurrence with final plans after required EHS reviews. ▪ Ensure project personnel meet applicable safety certification requirements. ▪ Ensure project support is acquired from appropriately qualified safety personnel such as the Program Health & Safety Officer, East EHS Leader, and SSHO. ▪ Ensure project personnel comply with applicable EHS requirements and corporate or client procedures. ▪ Halt any project work activities that represent an imminent hazard. ▪ Ensure appropriate safety equipment and materials are provided to the project. ▪ Ensure timely and accurate reporting and investigation of incidents, accident, or injuries involving project personnel, with support from the risk management department. Ensure corrective actions are implemented completely. ▪ Ensure proper response and internal notification regarding inspections by regulatory agencies. ▪ Ensure all project personnel have met the site-specific experience and training requirements.
Program Health and Safety Officer Thomas Koch, CIH	▪ Approve and support the implementation of the APP/SSHP and any amendments. ▪ Conduct field audits to assess the effectiveness and implementation of the APP, as necessary. ▪ Evaluate and authorize changes to the APP/SSHP based on field and occupational exposure, as necessary. • Function as a QC staff member.
East EHS Leader Larry Werts	▪ Oversee and maintain the EHS Program, the APP, SSHP, and any amendments. ▪ Conduct site visits, as necessary, to audit the effectiveness of the APP and SSHP. ▪ Serve as a technical safety advisor and provide technical assistance and support.

Table 4-2 Position Descriptions (Continued)

Position	Description of Key Responsibilities
Site Safety and Health Officer (SSHO) Louise Kritzberger, CHST Dan Locurcio Tom Dakin Robert Wagner Michael Argue Brenden Beaumont	▪ Responsible for implementing the APP by ensuring that all project personnel follow the requirements of the APP. ▪ Responsible for the development of AHAs. ▪ Be present during all field operations. ▪ Directly communicate with the PM and Program Health & Safety Officer, and East EHS Leader. ▪ Conduct daily safety meetings for site personnel to discuss the day's activities and associated hazards. ▪ Review site personnel training and experience documentation to ensure compliance with the APP. ▪ Coordinate changes/modifications to the APP with the appropriate site personnel. ▪ Conduct or coordinate project-specific training. ▪ Report any incidents that occur on-site to the PM, East EHS Leader and Program Health & Safety Officer. ▪ Implement safety corrective actions through training and reinforced awareness. ▪ Maintain exposure data. ▪ Has stop-work authority for all safety issues.

4.3 COMPETENT PERSON

At a minimum, in accordance with OSHA Regulation 29 CFR 1926.32, site personnel will include a Competent Person (i.e., a person who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate these hazards). **No work will be performed without a Competent Person on-site.** A list of competent person requirements and regulatory references is presented in **Table 4-3**.

The SSHO is the competent person as defined by OSHA 29 CFR 1926. 32. As required by EM 385-1-1, the SSHO has at least 5 years of continuous construction industry safety experience in supervising and managing projects of similar hazards, risk, and complexity to the task assignment. The SSHO has successfully completed the OSHA 30-hour construction safety course. The SSHO certified in first aid and cardiopulmonary resuscitation (CPR). Additionally, the SSHO has completed a minimum of 24 hours of safety training every 4 years. The SSHO also has 5 years of experience implementing safety and occupational health procedures and experience conducting exposure monitoring to select and to adjust PPE; however, it is unlikely that such adjustments will be needed. The SSHO resumes and copies of their certifications are presented in **Attachment B**.

The certifications and overall qualifications of personnel are maintained in a database. The qualifications of all site-specific personnel will be maintained on-site. Qualifications for all competent persons will be submitted prior to the start of work. No work shall be performed unless the designated competent person is present on the job site.

Table 4-3 Competent Person Requirements

Competent Person Requirement	Regulatory Reference	Designated Person
SSHO Identification	EM 385-1-1 Sec. 01.A.17	Louise Kritzberger, CHST Dan Locurcio Tom Dakin Robert Wagner Michael Argue Brenden Beaumont
General Inspections of Construction Sites	29 CFR 1926.20, EM 385-1-1, 01	SSHO
Unsanitary Conditions	29 CFR 1926.27, EM 385-1-1, 02	SSHO
Hearing Protection	29 CFR 1926.101 EM 385-1-1, 05.C	SSHO, Subcontractor
Respiratory Protection	29 CFR 1926.103, EM 385-1-1, 05.G	SSHO
Hot Work	29 CFR 195.14, EM 385-1-1, 09	SSHO
Hazardous Energy Control	29 CFR 1910.147, EM 385-1-1, 12	SSHO

EM 385-1-1 is USACE Health and Safety Requirements Manual; CFR is Code of Federal Regulations.

4.4 QUALIFIED PERSON

Site personnel will also include a Qualified Person. The TEC-Weston JV will permit only those employees qualified by training or experience to operate equipment and machinery in compliance with OSHA 29 CFR 1926.20(b)(4). According to OSHA 29 CFR 1926.32, “Qualified” means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project. **Table 4-4** presents a qualified person requirements list.

Table 4-4 Qualified Person Requirements

Qualified Person Requirement	Regulatory Reference	Designated Person
Brief Visitors on Site Hazards and PPE	X	L. Kritzberger; D. Locurcio; T. Dakin, R. Wagner, M. Argue, B. Beaumont
Drilling Rig	1926.5500 EM 385-1-1, 16	Rig Operator*
Geoprobe Operator	X	Probe Operator*
Surveyor	X	Surveyor*
Utility Clearance	X	TBD*

*Note: Specific subcontractor information is provided in the site-specific SSHPs.

A “qualified person” means a person with specific training, knowledge, and experience in the area for which the person has the responsibility and the authority to control. The site qualified person(s) are identified in **Table 4-4**.

The qualifications of all site-specific personnel will be maintained on-site. The certifications and overall qualifications of personnel are maintained in a database.

4.5 PRE-TASK SAFETY AND HEALTH ANALYSIS

Prior to each phase of work, the applicable AHA will be developed and reviewed with all supervisors responsible for the activity, and based on this pre-task safety and health analysis, the AHA will be updated as necessary. The SSHO will evaluate the AHA to determine if it appropriate for the tasks to be completed and current site conditions.

4.6 LINES OF AUTHORITY

Figure 4-1, presented at the end of the section, presents the project organization.

4.7 ACCOUNTABILITY FOR SAFETY

The TEC-Weston JV managers and supervisors are held directly accountable for the health and safety of their employees, subcontractor activities and other resources employed to maintain employee health and safety, and the continual communication of hazards and hazard controls to the workforce.

4.8 TEC-WESTON JV SUBCONTRACTORS

Qualified subcontractors and associate personnel will be brought on-site for specialty services. These subcontractors will be under the ultimate direction of the Site Manager(s) and are required to adhere to all aspects of the APP.

4.9 PERSONNEL ASSIGNED TO THE PROJECT

All the TEC-Weston JV and subcontractor personnel who will be involved in on-site activities are responsible for the following:

- Ensuring prior to the start of any work; they have signed in and received a safety briefing for the day’s tasks.
- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees, and being alert to potentially harmful situations.
- Performing only those tasks that they believe they can do safely and have been trained to do.
- Notifying the SSHO of any special medical conditions (i.e., allergies, contact lenses).
- Notifying the SSHO of any prescription and/or nonprescription medication, which the worker may be taking, that might cause drowsiness, anxiety, or other unfavorable side effects.
- Preventing spillage and splashing of materials to the greatest extent possible.
- Practicing good housekeeping by keeping the work area neat, clean, and orderly.
- Immediately reporting all injuries to the SSHO.
- Complying with the APP and all safety and health recommendations and precautions, properly using PPE as determined by the APP and/or the SSHO.

4.10 EXPECTATIONS

The TEC-Weston JV utilizes integrated EHS management systems to implement its corporate goal for Zero Accidents involving personnel and the environment.

4.11 INCENTIVE PROGRAMS

Project-specific financial and other incentive plans are developed and integrated with Safety and Health goals as an overriding component.

4.11.1 Safety Solutions Program

The Safety Solutions Program is a program that provides the TEC-Weston JV’s employees positive opportunities to become engaged in the Safety and Health Program. Employees are encouraged to utilize the Safety Solutions Program to report near incidents or to identify workplace hazards and their proposed solutions.

4.12 NONCOMPLIANCE, DISCIPLINARY ACTIONS, AND COMPANY SAFETY INCENTIVE PROGRAMS

4.12.1 Noncompliance

Although noncompliance is not expected, safety and health program violations can, and will, result in disciplinary action up to, and including, dismissal. Employees understand that safety is of the utmost importance to the TEC-Weston JV. Personnel understand the importance of compliance with applicable regulations and project requirements.

4.12.2 Disciplinary Actions

Personnel violating safety procedures are subject to dismissal/removal from the project site.

4.12.3 Incentive Programs

Project-specific financial and other incentive plans are developed and integrated with safety and health goals as an overriding component.

4.12.3.1 Safety Solutions Program

The Safety Solutions Program provides the TEC-Weston JV employees with opportunities to become engaged in the Safety and Health Program. Employees are encouraged to use the Safety Solutions Program to report near incidents or to identify workplace hazards and their proposed solutions. The submitted Safety Solutions are evaluated, and the authors of the most highly regarded solutions are eligible for a financial bonus and other rewards.

4.13 MANAGEMENT ACCOUNTABILITY FOR SAFETY

The TEC-Weston JV managers and supervisors are held directly accountable for the health and safety of their employees, for subcontractor activities, and for the continual communication of hazards and hazard controls to the workforce. The SSHO and the Program Health & Safety Officer assess the health and safety performance of employees.

The accountability of supervisors and managers for the implementation of the health and safety program is ensured through monthly project life cycle reviews with senior management and through annual employee performance reviews.

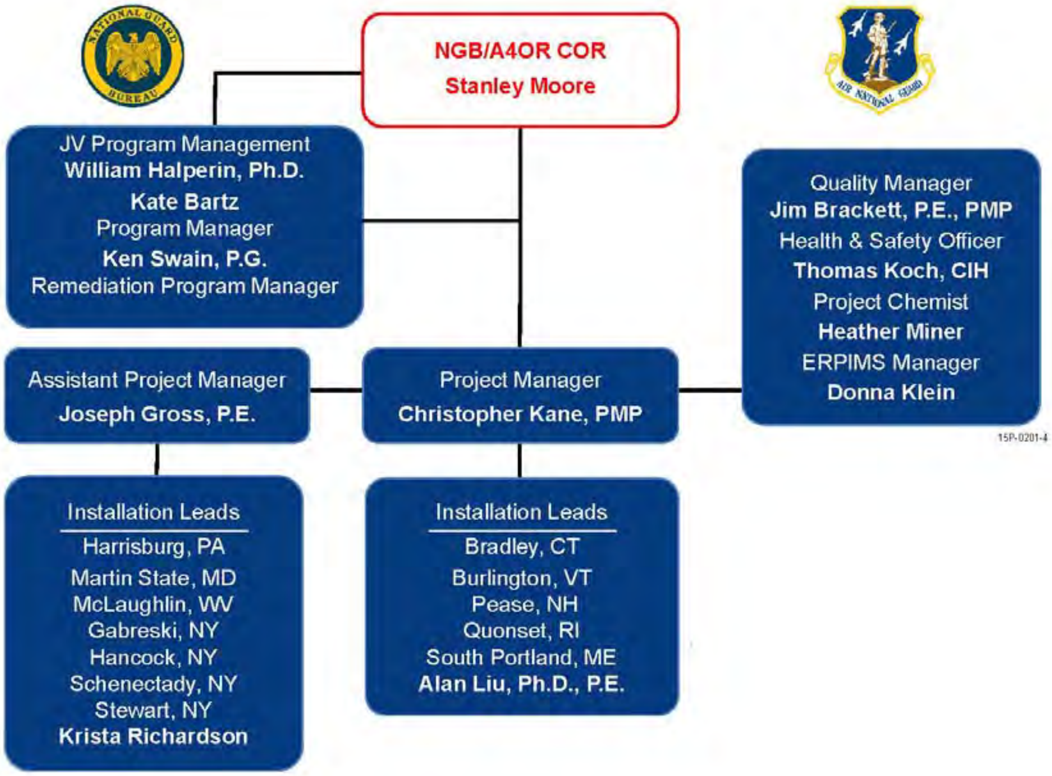


Figure 4-1 Project Organization

5. SUBCONTRACTORS AND SUPPLIERS

5.1 GENERAL

Subcontractors are required to review this APP with their employees and supervisors. Each individual is expected to sign the signature sheet, certifying that they have read, understand, and will comply with the requirements of this plan. Subcontractors will provide Company Specific Programs and AHAs to the TEC-Weston JV for inclusion in the APP. Subcontractor personnel are expected to conduct task specific health and safety briefings and attend the routine Daily Safety Meeting.

Subcontractors are expected to work in a responsible and safe manner. Subcontractors for this project will be required to adhere to applicable requirements set forth in the USACE Safety and Health Requirements Manual, EM 385-1-1 and 29 CFR 1910 and 1926 in their work and safety plans.

Subcontractors will be used on-site during this project and are responsible for:

- Providing documentation that on-site personnel have appropriate training and certifications and assuring that personnel have read, understand, and will comply with this APP.
- Providing equipment that is safe for operations, clean, and free from any obvious hazards or defects.
- Providing and documenting inspections of equipment and tasks, as necessary, to comply with applicable regulations.

5.2 IDENTIFICATION OF SUBCONTRACTORS AND SUPPLIERS

Subcontractors to the TEC-Weston JV will be selected only after their safety and health program is thoroughly evaluated; they complete an EHS questionnaire; and meet specific safety and occupational health selection criteria. The subcontractors selected to perform work activities under this APP are listed in **Table 5-1**.

Table 5-1 List of Subcontractors

Subcontractor	Activity
TBD*	Drilling
TBD*	Soil borings
TBD*	Surveyor
TBD*	Utility Clearance

*Note: Specific subcontractor information is provided in the site-specific SSHPs.

5.3 CONTROL AND COORDINATION OF SUBCONTRACTORS AND SUPPLIERS

Each subcontractor will assign a Site Safety Representative who will be responsible for coordinating projects and safety responsibilities for their personnel as designated and coordinated by the TEC-Weston JV SSHO. The TEC-Weston JV is ultimately responsible for ensuring subcontractor compliance with the APP. Non-compliance with this plan will result in a stop work order, as determined by the SSHO.

5.4 SAFETY RESPONSIBILITIES OF SUBCONTRACTORS AND SUPPLIERS

The subcontractor's Site Safety Representative will interact with the TEC-Weston JV SSHO to ensure compliance with this APP. Subcontractor employees are expected to comply with this APP, USACE EM 385-1-1, and other applicable regulations governing their safety while working on the project. Subcontractors will complete AHAs for their features of work. In the event of a conflict, the more stringent requirements will apply.

The Site Safety Representative will:

- Attend and lead their task specific health and safety tailgate meetings, weekly meetings and monthly supervisor meetings.
- Address worker issues and immediately stop work if unsafe acts/conditions exist or if uncertainty associated with how a task is to be performed exists.
- Coordinate corrective actions with the SSHO prior to resuming operations.
- Participate in any incident investigations.
- Ensure subcontract workers have the proper PPE.
- Control hazardous material brought on-site.

5.5 SUBCONTRACTOR SAFETY PLANS

The TEC-Weston JV’s subcontractor employees will be required to sign the Acknowledgement Form (**Figure 5-1**) indicating that they have read and understand the APP and agree to follow the requirements in this document. Subcontractors are required to develop their own means and methods for their scope of work. The SSHO will obtain and verify the subcontractor personnel training records prior to work commencing.

Figure 5-1 Subcontractor Acknowledgement
Supervisory Personnel, Competence of Personnel, and Task Understanding

Site: ____

Work Order Number: ______________________________ Date: ______________________

1) In accordance with Contract terms, Subcontractor acknowledges it is responsible for performance of work in accordance with contract documentation. Subcontractor further acknowledges and agrees that it bears sole responsibility for implementing an Environmental, Health, and Safety (EHS) Program. Subcontractor shall implement the EHS Program in one of the following ways:

(A) Prepare and submit to the TEC-Weston JV an EHS Program (or Plan). Subcontractor shall acknowledge by signing below that all programs and documentation required by applicable law, rules and regulations are maintained and implemented in conjunction with Subcontractor's performance of its work; or

(B) Implement the TEC-Weston JV EHS Program for the work to be accomplished. Notwithstanding Subcontractor's use of the TEC-Weston JV EHS Program, Subcontractor shall still be responsible for maintaining all programs and documentation required by applicable law, rules and regulations.

2) Subcontractor is responsible for supervising its employees (as defined by 29 CFR Part 1904) and providing qualified and competent personnel as and where required by law, rules, and regulation. Unless otherwise agreed to in writing, Subcontractor will be responsible for managing and recording all injuries and incidents involving its employees as required by OSHA or other applicable laws, rules and regulations. A listing of OSHA standards requiring the services of a competent person is attached this document.

3) Subcontractor has viewed the TEC-Weston JV EHS Team Expectations Video and agrees to fulfill the expectations and requirements for EHS.

Subcontractor Name: ____

Subcontractor Task(s): ____

____

____

Program/Plan Option (circle): (A) or (B).

Subcontractor Supervisor Name: ____

Subcontractor Safety Officer Name: ____

Subcontractor Competent Person(s) and role (as necessary): _______________________

____

This form is to be completed, filed on site, and maintained up to date.

6. TRAINING

6.1 GENERAL

All personnel assigned to or regularly entering a project site will have received required training. Personnel training records are maintained in an EHS database. Contractors' training records will be verified prior to the start of work, and a copy of the training records will be kept on-site. As required by EM 385-1-1 and in accordance with 29 CFR 1910 and 1926 and other federal, state and local regulations, applicable required training for all site workers shall be in accordance with the following subsections.

6.2 NEW HIRE SAFETY ORIENTATION

When hired, staff members are required to complete EHS training appropriate to their role and responsibility level. New hires that have previously completed such training are required to provide documentation of training. All training, including refresher training, is documented in an EHS database.

New employees also participate in an orientation training program. Personnel receive training on EHS policies, including environmental aspects, emergency action plans, security plans, ergonomics, incident reporting procedures software, BBS, and site-/job-specific training. Site-specific topics will include:

- Accident prevention.
- Accident reporting (how and to whom).
- Location of medical facilities for emergency treatment and/or assistance.
- Reporting and correcting unsafe conditions.
- Job hazards/hazard control.
- Site-specific biological, physical, chemical, and/or ionizing/nonionizing radiation hazards as listed in the AHAs.
- Company safety policies.
- Site briefings conducted prior to being granted site access.
- Site layout.
- Base policies (smoking area, cell phone use and texting while driving)
- Hazard control.

- Emergency response and notification.
- Hearing conservation.
- PPE.
- Buddy system.
- Spills.
- Fires.
- Hazard communication.
- Visitor access.
- Public communication guidelines.
- Specific training required by regulations.

6.3 MANDATORY TRAINING AND CERTIFICATIONS

The TEC-Weston JV will staff the project with individuals who have the following training and certifications:

- OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Training – All field personnel will have this training.
- OSHA 8-hour HAZWOPER Refresher – All field personnel will have this training when applicable.
- OSHA 30-hour Construction Safety Training – At a minimum, the SSHO will have this training.
- First-Aid/CPR/Bloodborne Pathogens (BBP) – A minimum of two people will have this training.

In addition, the SSHO will have completed at least 24 hours of safety training every four years. A copy of applicable training records for project personnel will be available on-site and maintained by the SSHO.

6.4 BUDDY SYSTEM TRAINING

All work will be performed using the buddy system. Team members will keep in visual contact with each other at all times. Team members will be made aware of any slip, trip, and lifting hazards along with any potential exposure to chemical substances, heat or cold stress, and general hazards within their work area.

6.5 OSHA CONSTRUCTION TRAINING

In compliance with USACE Health and Safety Requirements Manual (EM 385-1-1), 30 November 2014, the SSHO, at a minimum, will have completed the 30-hour OSHA construction safety class or equivalent training, and complete a minimum of 24 hours of formal safety coursework every 4 years.

6.6 FIRST-AID AND CPR TRAINING

6.6.1 Training Requirements

The SSHO and at least one additional employee or subcontractor staff for each site will be currently certified in first aid and cardiopulmonary resuscitation (CPR). The training will be equivalent to that provided by the American Red Cross.

6.7 BLOODBORNE PATHOGEN TRAINING

Personnel trained in first aid and expected to administer first aid will receive training in controlling exposures to BBP. This training will address the following topics:

- The BBP standards.
- Requirements of the Exposure Control Plan.
- Description of the risks of exposure and how BBP are transmitted.
- Management and employee responsibilities.
- Protection methods against exposure and decontamination procedures.
- Post-exposure procedures.
- Labeling and color-coding of infectious waste.

6.8 CONFINED SPACE ENTRY TRAINING

All the TEC-Weston JV and subcontractor personnel performing confined space work, including entrants, attendants, supervisors, and rescue personnel, will have completed training in accordance with 29 CFR 1910.146. Documentation of training will be maintained on-site.

6.9 RESPIRATORY PROTECTION TRAINING

In accordance with 29 CFR 1910.134, all site personnel required to use respiratory protection devices will have received equipment-specific training. This training covers the use, limitations, inspection, maintenance, and cleaning of respiratory protection devices. Daily site-specific briefing/training will reinforce knowledge as necessary.

6.10 HEARING CONSERVATION TRAINING

All site personnel exposed to noise levels exceeding 85 A-weighted decibels (dBA), 8-hour time-weighted average (TWA) will be provided with training, which addresses the following topics and will be enrolled in the TEC-Weston JV's hearing conservation program:

- Physical and psychological effects of high noise exposure.
- Noise exposure limits.
- Elements of the Hearing Conservation Program.
- Selection, use, and limitations of hearing protection devices.

6.11 PERSONAL PROTECTIVE EQUIPMENT TRAINING

Personnel will be trained in the use and maintenance of any PPE required to be used. All PPE will be provided, used, and maintained in a sanitary and reliable condition based upon manufacturer's recommendations. All PPE will be of the construction, design, and material to provide employees with protection against known or anticipated hazards. PPE will be selected that properly and appropriately fits the employee. The TEC-Weston JV employees have been provided with training in accordance with the standard. Any concerns regarding the use of appropriate PPE will be brought to the attention of the SSHO, who is directed to contact the Program CIH for assistance in the evaluation of PPE as necessary.

If higher levels of protection (LOPs) are required, an addendum to the APP will be drafted and approved.

6.12 HAZARD COMMUNICATION TRAINING

To comply with 29 CFR 1910.1200 Hazard Communication, a written Hazard Communication Program has been established and is provided in Attachment 1 of the SSHP. All employees will be briefed on this program, and have a written copy of the information for review.

Prior to starting work, employees will attend a health and safety orientation and will receive information and training on the following: (1) an overview of the requirements contained in the

Hazard Communication Standard, 29 CFR 1910.1200; (2) chemicals present in their workplace operations; (3) location and availability of a written hazard program; (4) physical and health effects of the hazardous chemicals; (5) methods and observation techniques used to determine the presence or release of hazardous chemicals; (6) how to lessen or prevent exposure to these hazardous chemicals through usage of control/work practices and PPE; (7) emergency procedures to follow if they are exposed to these chemicals; (8) how to read labels and review Safety Data Sheets (SDSs) to obtain appropriate hazard information; and (9) location of the SDS file and the location of the hazardous chemical list.

6.13 PROJECT SITE-SPECIFIC SAFETY AND HEALTH TRAINING

Project site-specific training will be provided to workers prior to on-site operations. This training will include the following:

- Training specific to other sections of EM 385-1-1 or OSHA standards in 29 CFR 1910 and 29 CFR 1926 that are applicable to site operations as discussed in Subsection 6.1.
- Training covering each element in the APP, including the items listed in the following subsections.

6.13.1 Site-Specific Chemical and Physical Hazards

Site-specific health and safety training will be conducted prior to field activities at each site. In particular, the training will stress emergency response procedures and will cover the chemical and physical hazards of the site and site operations.

6.13.2 Periodic Safety and Health Training

The SSHO will present daily site safety briefings (i.e., tailgate meetings) to on-site personnel prior to the start of the work shift. The purpose of the briefings is to assist personnel in safely conducting the scheduled work activities. The briefings will include the following:

- Tasks to be performed and work method and general description of job scope.
- Work location.
- Equipment usage.
- Control of hazards.
- Weather conditions.
- Chemical hazards.

- Contingency plans [Emergency Response Plan, 29 CFR 1910.120(l)].
- Engineering controls and work practices.
- PPE.
- Physical hazards.
- Respiratory protection.
- Sanitation [29 CFR 1910.120(n)].
- Site characterization and analysis.
- Site control [29 CFR 1910.120(d)].
- Symptoms of overexposure to hazards.

The briefings will provide an opportunity for individuals to share observed safety deficiencies and recognitions. Documented attendance at these daily safety briefings will be maintained by the SSHO.

In addition to the daily site safety briefings, a formal safety meeting will be conducted at least monthly for SSHOs within their respective divisions. A safety manager or designee will be invited to attend this monthly meeting.

6.13.3 Visitor Training

All visitors will receive site-specific training to ensure that potential hazards and risks are identified. This training will consist of a safety briefing by the SSHO that will include the following:

- Location and description of potential hazards and risks.
- Required PPE.
- Smoking area.
- Base regulations on cell phone and texting while driving.
- Areas of the site that are closed to visitors.
- The site evacuation plan and emergency procedures.
- Other topics as deemed appropriate.

Documentation of site-specific training will be provided in the field logbook.

6.14 REQUIREMENTS FOR EMERGENCY RESPONSE TRAINING

The TEC-Weston JV provides training by the American Red Cross or an equivalent organization in Standard First Aid, Adult CPR, and BBP for the field staff. At least two personnel with such training and also trained in the use of fire extinguishers will be on-site to provide emergency response. In the event specialized/elevated care is necessary, either the TEC-Weston JV personnel or the on-call emergency medical technician (EMT)/ambulance service will transport the injured person to the appropriate medical facility.

The TEC-Weston JV personnel involved with responding to an on-site emergency will be briefed in their roles and responsibilities as part of the initial indoctrination training discussed above. During this training, personnel will be briefed on the Hazard Communication (HAZCOM) Program, emergency equipment, and first-aid procedures. Personnel will also be briefed on the emergency response and contingency procedures, which include:

- Procedures and tests.
- Spill prevention.
- Firefighting.
- Posting of emergency telephone numbers.
- Medical support.

This training will be documented and will also involve a drill of the emergency response procedures prior to the start of site activities. During this training, the route to and the location of the evacuation point and the location of medical support will be discussed with each staff member.

7. SAFETY AND HEALTH INSPECTIONS

A competent person(s) will conduct and document all safety inspections.

- Daily and weekly safety and health inspections will be conducted and documented by the SSHO.
- The Program Health & Safety Officer or his/her designee will audit all project sites at least quarterly.

7.1 LOGS, REPORTS, AUDITS, INSPECTIONS, AND RECORDKEEPING

7.1.1 Safety Log

The SSHO will maintain a safety log of all safety-related activities. The SSHO is responsible for ensuring that health and safety activities for the day, as well as safety meeting minutes, are included within the log or filed appropriately.

7.1.2 Training Log

The SSHO is responsible for ensuring that all training conducted relative to job site activities is documented appropriately and maintained on-site.

7.1.3 Site Control Log

A log of all personnel visiting, entering, or working on the site will be maintained. The log will include the following: date, name, agency or company, and the time entering and exiting the site. This information, including dates, will be recorded in the site control log.

7.1.4 Safety Inspection Forms

Daily safety and health inspections will be conducted by the SSHO with the results recorded in the safety log. The Program Health & Safety Officer will conduct periodic safety and health audits to ensure site personnel are performing the tasks in accordance with the Work Plan and this APP. A weekly inspection form is provided in **Attachment C**.

7.2 DEFICIENCY TRACKING

A deficiency tracking form, presented in **Attachment D**, will be used to document unacceptable work practices. The deficiency tracking form lists the status of safety and health deficiencies in chronological order; displays the type and description of the deficiency; the risk rating; code reference; the corrective action taken and the projected resolution date; date resolved; and the person responsible for the corrective action. The deficiency tracking system will be posted on the safety bulletin board and will be updated daily. In most cases, discrepancies of greater severity are corrected immediately, or within 24 hours if they are of lower severity.

When a deficiency is identified, the SSHO will update the deficiency tracking form to indicate the specific corrective action, the person(s) responsible for the corrections, and the date by which the action needs to be accomplished. The SSHO will also ensure that the corrective action is accomplished in the timeframe indicated. During health and safety audits, the deficiency log is reviewed to ensure that the corrective action process has been implemented. The information from the deficiency tracking form is presented in daily safety meetings and monthly supervisor meetings so that lessons learned are disseminated.

7.3 EXTERNAL INSPECTIONS

Although no external inspection is expected, regulatory agencies do conduct inspections from time to time. An inspector should be treated as a professional and with courtesy. The regulatory agency inspector should introduce himself/herself to the manager in charge of the operation and present credentials to verify that he/she is representing a recognized regulatory agency such as OSHA, Federal Aviation Administration (FAA), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA), or other regulatory agencies.

Any pre-inspection conference will be attended by the SSHO and the National Guard Bureau (NGB) Program Manager at a minimum. At that time, the scope of the inspection should clearly be described by the inspector. If the inspector has not described the scope of the inspection during the pre-inspection conference, ask the inspector to provide such a description.

Prior to taking the inspector on-site, it is necessary to contact the PM and the Program Health & Safety Officer. The inspector will perform the inspection, which may include a walk-through inspection of the work-site or a targeted file/records review. The site or office inspection typically ends with a close-out conference during which the inspector may provide tentative findings. In some cases the inspector may forego the close-out conference and issue a written citation after leaving the site. On occasion, inspections may require more than one day.

Most regulatory agency inspectors seldom issue citations during the inspection; however, if an OSHA or EPA inspector observes an imminent hazard, he/she can order a work stoppage.

It is the TEC-Weston JV’s practice to cooperate with investigations. Information that is requested should be provided; however, requests for copies of documents, health and safety plans, and training records should not be provided without first obtaining approval. Under no circumstances should any attempt be made to mislead the inspector.

Coordination of any regulatory agency inspection is the responsibility of the SSHO.

8. MISHAP REPORTING

8.1 EXPOSURE DATA (MAN-HOURS WORKED)

The SSHO and PM will track exposure hours. The hours will be presented as a spreadsheet compilation of hours worked, any reportable mishaps that occurred during the month, and accidents that have occurred since the start of the project.

8.1.1 Mishap Investigations, Reports, and Logs

All incidents, near incidents, spills, thefts, or other site issues will be reported to the East EHS Leader within 1 hour of the occurrence, or as soon as physically possible. Mishaps occurring on ANG facilities must be reported to the NGB Program Manager and the PM. The Preliminary Accident Notification (PAN) Report (see **Attachment E**) and the electronic incident reporting and notification process (Notice of Incident [NOI] Track) must be submitted to the Program Health & Safety Officer and East EHS Leader within 24 hours of the incident. Incidents will be reported to the Contracting Officer (KO)/Contracting Officer’s Representative (COR) within 24 hours, with written follow-up using USACE ENG Form 3394 within 5 days after the incident.

NOITrack is used to document incidents, corrective action plans, and investigations involving the TEC-Weston JV-managed work. Incidents meeting the OSHA definitions of recordable incidents are documented on the 300 logs, and the SSHO also records these incidents on the site OSHA 300 log.

All incidents, including near incidents or “near misses,” will be investigated. Corrective actions will be implemented as soon as reasonably possible.

8.2 IMMEDIATE ACCIDENT NOTIFICATION

The following incidents require immediate notification, no later than 1 hour, to the CO/COR, or designee. The Government Designated Authority (GDA) shall immediately notify the Safety and Occupational Health Office (SOHO) when any of these occurs and subsequently follow-up with official accident reports as prescribed by regulation.

- Fatal injury/illness

- Permanent total disabling injury/illness
- Permanent partial disabling injury/illness
- Hospitalization of one or more people resulting from a single occurrence
- Property damage greater than or equal to $500,000
- Three or more individuals become ill or have a medical condition which is suspected to be related to site condition, or a hazardous or toxic agent on the site.

The written follow-up will use the USACE ENG Form 3394 Accident Investigation Report (see **Attachment E)**.

OSHA will be notified under the following circumstances:

- Within 8 hours of any fatality as a result of a work-related incident.
- Within 24 hours after a work-related inpatient hospitalizations of one or more employees.
- All work-related amputations.
- All work-related losses of an eye.

8.3 NOITRACK PROCEDURE

The NOITrack information must be completed within 24 hours of the incident, mishap, or near mishap. Anyone involved in the incident can complete an NOI.

The NOI must be used to report ALL incidents and near-incidents. Incidents include the following: employee accidents, injuries, auto accidents, property damage/loss, utility damage, information/data breaches, security concerns/breaches, break-ins, subcontractor injuries, accidents, or events, or any other liability situation or circumstance that could give rise to a claim. For example, spills/discharges resulting from the installation of equipment or systems by the TEC-Weston JV or the TEC-Weston JV subcontractors should be reported using the NOITrack system. An NOI must be submitted if something happens on a project that was not intended and could result in liability for the TEC-Weston JV.

8.4 MISHAP REVIEW

Any mishap that occurs while an employee is driving on company business, or operating a company-owned, leased, rental, or allowance vehicle at any time will be reviewed and investigated. Drug and/or alcohol testing will be conducted in a timely manner in accordance with the Drug and Alcohol Operating Practice. The mishap review is intended to determine whether the mishap was “preventable” as defined by the National Safety Council. The investigation will also include consideration of citations issued, if any, and the specifics of the mishap to determine appropriate consequences, if any. Investigation may result in outcomes such as recommendation for driver training programs, changes or modifications to vehicle/equipment, suspension of driving privileges, or employee termination. The Risk Management Department will provide input and guidance and will serve as a liaison with insurance carriers, as needed.

9. MEDICAL SUPPORT

9.1 ON-SITE MEDICAL SUPPORT

In the event that specialized/elevated care is necessary, either the TEC-Weston JV or the on-call EMT/ambulance service will transport the injured person to the regional hospital closest to the ANG facility. Local fire and emergency services can be notified of emergency situations by using the telephone numbers listed in Tables 15-1 through 15-3 of each SSHP.

A first-aid kit will be provided on-site and will be in compliance with the criteria contained in American National Standards Institute Z308.1-2009 and EM 385-1-1. BBP kits containing PPE barriers and appropriate decontamination solutions will be maintained on-site.

In case of injury, the following procedures apply:

- For minor injuries, routine first-aid procedures will be used.
- For major injuries, an ambulance will be called immediately, and the appropriate first aid will be administered until the ambulance arrives.
- Trained personnel will use approved measures for treatment based on the training they have received.

9.2 OFF-SITE MEDICAL SUPPORT

Emergency contact numbers are provided in Tables 15-1 through 15-3 of each ANG SSHP**.**

9.3 DIRECTIONS AND MAP TO NEAREST HOSPITAL

Hospitals close to each ANG facility have been identified and are provided as Figure 15-1 in each SSHP. The hospitals offer primary and 24-hour emergency services, including emergency surgery.

9.4 FIRST AID AND CPR TRAINING

Table 9-1 presents first aid and CPR training for key personnel.

Table 9-1
First Aid and CPR Training for Key Personnel

Personnel Name	First Aid (expires)	CPR (expires)	Bloodborne Pathogens Refresher (expires)
Louise Kritzberger	2/18/2017	2/18/2017	8/3/2016
Dan Locurcio	6/8/2017	6/8/2017	12/10/2016
Tom Dakin	12/1/2016	12/1/2016	10/7/2016
Robert Wagner	1/19/2018	1/19/2018	10/7/2016
Michael Argue	2/17/2018	2/17/2017	1/27/2017
Brenden Beaumont	11/11/2017	11/11/2017	3/27/2017
Paul Landry	1/19/2018	1/19/2018	10/7/2016
Robin Dermigny	1/26/2017	1/26/2017	3/27/2017
Dane Kormos	12/01/2017	12/01/2017	2/28/2017
Dave Sena	1/19/2018	1/19/2018	4/13/2017
Dave Chapman	2/17/2018	2/17/2017	1/27/2017
Allie Balter	6/1/2017	6/1/2017	1/27/2017
Jeff Broudy	12/22/2016	12/22/2016	12/10/2016
Craig Anderman	12/01/2017	12/01/2017	4/13/2017
Mary Boggs	7/24/2016	7/24/2016	8/20/2016
Brian Tolton	1/19/2018	1/19/2018	2/10/2017
Zachary Taylor	3/28/2018	3/28/2018	NA

CPR = cardiopulmonary resuscitation.

Note: PM will ensure all field personnel are current with their certifications prior to the start of field work.

9.6 MEDICAL SURVEILLANCE

Site personnel and subcontractors who enter the site during operations must comply with an Occupational Health Program (OHP). Personnel will be required to provide their certifications to the SSHO for review and approval prior to being granted authorization to work. Certifications will be maintained at the project site.

9.6.1 Occupational Health Program

To comply with OSHA requirements, Dr. Peter Greaney of WorkCare® will oversee the site-specific medical surveillance and the OHP. Dr. Greaney is a board-certified physician in internal and occupational medicine**. Dr. Greaney can be reached during regular business hours at 800-455-6155.**

The purpose of the OHP is to ensure suitable job placement of employees, to monitor the health effects of hazards encountered in the workplace, and to maintain and promote good health through preventive measures. Medical examination criteria are established by WorkCare in compliance with 29 CFR 1910.120.

10. PERSONAL PROTECTIVE EQUIPMENT

10.1 HAZARD ASSESSMENTS

For the ANG projects, the Program Health & Safety Officer, East EHS Leader, and the SSHO are responsible for overseeing the development and implementation of the PPE Program. Once on-site, the SSHO is responsible for ensuring that the level of protection is correct for the activities. If field conditions change, an amendment will be made to the AHA to reflect the necessary PPE.

10.2 IDENTIFYING WHEN HAZARD ASSESSMENTS WILL BE CONDUCTED

Hazard assessments are conducted during the site walk and document review. During the initial PPE decision-making process, the APP preparer reviews available site information and establishes the level of protection to be worn by site personnel for each task. This process is then approved by the Program Health & Safety Officer and East EHS Leader. Additional hazard assessments will be conducted periodically and when field activities or site conditions change.

10.3 IDENTIFYING HOW HAZARD ASSESSMENTS WILL BE CONDUCTED

The selection of the most appropriate level of protection depends on the following:

- Hazards, known or potential:
  - Physical hazards.
  - Biological hazards.
  - Chemical hazards.
- Properties such as toxicity, radioactivity, route of exposure, and matrix (i.e., air, soil, water) in which the contaminants are known or suspected.
- Type and measured concentrations of contaminants.
- Potential for exposure based upon task.
- Route of exposure.

PPE for the specific tasks will be identified in the AHAs, based upon activities identified by the APP preparer, in consultation with the appropriate safety professionals. The SSHO will develop the AHAs and the identified PPE to determine its suitability based on the site activities and conditions. New or additional PPE will be selected as conditions change to ensure that employees are protected from hazards. Care will be taken to recognize the possibility of multiple and simultaneous exposures to a variety of hazards.

The levels of personal protection and the procedures specified in this plan are based on the best information available from reference documents and current site data; therefore, these recommendations represent the minimum safety and health requirements to be observed by personnel engaged in this project. Unforeseeable site conditions or changes may warrant a reassessment of protection levels and controls stated. Adjustments to the APP must have prior approval by the Program Health & Safety Officer, East EHS Leader, and NGB Program Manager.

Work at the ANG bases will be completed in Level D PPE. If other levels of protection are required, an addendum to the APP will be prepared and approved.

10.4 PERSONAL PROTECTIVE EQUIPMENT TRAINING

In accordance with OSHA 29 CFR 1910, Subpart I (Personal Protective Equipment), PPE will be provided, used, and maintained in a sanitary and a reliable condition. The construction, design, and material of PPE will provide employees with protection against known or anticipated hazards. PPE that properly and appropriately fits the employee will be selected. Any concerns regarding the use of appropriate PPE will be brought to the attention of the SSHO, who will contact the Program Health & Safety Officer or East EHS Leader for assistance.

In accordance with OSHA, any worker required to wear PPE shall receive training in the proper use and care of PPE. Periodic retraining shall be offered by the Program Health & Safety Officer, East EHS Leader, or designees to both the employees and the supervisors. The training shall include, but not necessarily be limited to, the following subjects:

- Proper selection of PPE.
- When PPE is anticipated for use.
- Proper uses and limitations of equipment during temperature extremes, heat/cold stress, and in relation to employee medical conditions.
- Proper donning and doffing, and adjusting of PPE.

- Maintenance, cleaning, and storage of PPE.
- Inspection procedures for PPE.

Training is typically delivered through formal programs such as HAZWOPER training, refresher training, or specific hazard training. Additional training is offered through routine site training and site-specific training. After the training, the employees will demonstrate that they understand the components of the PPE Program and how to use PPE properly, or they will be retrained.

10.5 PERSONAL PROTECTIVE EQUIPMENT RETRAINING

Retraining is typically delivered through formal programs such as HAZWOPER annual refresher training or specific hazard training. Additional retraining is offered through routine site training and site-specific training.

The SSHO will identify personnel that have received PPE training but do not have the understanding and skill required to use the PPE. Those personnel will be re-trained to acquire the appropriate skills. The re-training will be documented in a database and available for review on-site.

10.6 MONITORING EQUIPMENT TRAINING

Personnel are initially trained on instrument use and calibration during their 40-hour OSHA training. Instrument use and calibration is reviewed annually during the 8-hour refresher training. Site personnel will review the manufacturer’s instructions accompanying the instrument prior to use. Personnel will receive a site-specific briefing covering the hazards, testing, and monitoring procedures prior to start of monitoring for site-specific chemicals of concern.

10.7 WRITTEN CERTIFICATION OF EMPLOYEE PPE TRAINING

Project personnel will have appropriate training as determined by the Program Health & Safety Officer and the East EHS Leader. Required training and certifications are reviewed internally as part of the APP development prior to project commencement. An on-line system allows rapid access to personnel training records to facilitate tracking the current certification status of project personnel. Information documented includes the name of individual, date of training or certification, name and description of training course or certificate, and training or certificate provider. The SSHO will use this online system to update contact information, view EHS personnel training certifications, and view medical clearances. The SSHO will verify each person's training certification and medical clearance status prior to the start of work and will periodically perform reviews for updates. Copies of all training and certifications will be available on-site. Key site personnel training/certifications are provided in **Table 10-1**.

Table 10-1
Current Key Site Personnel Training/Certifications

Personnel Name	Position	Medical Clearance (expires)	40-Hour HAZWOPER	8-Hour HAZWOPER Refresher (expires)	First Aid (expires)	CPR (expires)	30-Hour Construction Safety	Supervisors Health and Safety	Bloodborne Pathogens Refresher (expires)
Louise Kritzberger	SSHO	7/9/2016	5/3/1991	8/3/2016	2/18/2017	2/18/2017	2/22/2008	8/10/1993	8/3/2016
Dan Locurcio	SSHO	7/31/2016	3/22/2002	12/10/2016	6/8/2017	6/8/2017	8/17/2007	2/10/2005	12/10/2016
Tom Dakin	SSHO	12/18/2016	4/1/2004	10/7/2016	12/1/2016	12/1/2016	6/12/2009	4/2/2009	10/07/2016
Robert Wagner	SSHO	7/9/2016	1/11/1999	10/7/2016	1/19/2018	1/19/2018	3/17/2005	2/3/1999	10/7/2016
Michael Argue	SSHO	2/2/2018	10/23/1998	1/27/2017	2/17/2018	2/17/2017	2/23/2007	01/21/1999	1/27/2017
Brenden Beaumont	SSHO	1/22/2017	10/25/2002	3/27/2017	11/11/2017	11/11/2017	7/14/2006	4/2/2009	3/27/2017
Paul Landry	Geologist	1/28/2017	4/17/1987	10/7/2016	1/19/2018	1/19/2018	3/11/2011	3/19/1988	10/7/2016
Robin Dermigny	Geologist	3/10/2018	10/21/2004	3/27/2017	1/26/2017	1/26/2017	3/11/2011	5/18/2009	3/27/2017
Dane Kormos	Geologist	10/31/2016	5/15/2009	2/28/2017	12/01/2017	12/01/2017	3/22/2012	11/10/2011	2/28/2017
Dave Sena	Project Scientist	5/19/2016	5/10/2010	4/13/2017	1/19/2018	1/19/2018	NA	5/21/2010	4/13/2017
Dave Chapman	Geoscientist	8/7/2016	5/22/2005	1/27/2017	2/17/2018	2/17/2017	NA	4/13/2006	1/27/2017
Allie Balter	Geoscientist	8/12/2017	8/21/2016	1/27/2017	6/1/2017	6/1/2017	NA	NA	1/27/2017
Jeff Broudy	Scientist	4/5/2017	5/25/2007	12/10/2016	12/22/2016	12/22/2016	NA	10/16/2014	12/10/2016
Craig Anderman	Project Scientist	11/24/2016	5/25/2007	4/13/2017	12/01/2017	12/01/2017	NA	10/16/2014	4/13/2017
Mary Boggs	Engineer	5/28/2016	9/19/2008	8/20/2016	7/24/2016	7/24/2016	NA	4/5/2013	8/20/2016
Brian Tolton	Scientist	8/28/2016	5/1/2015	2/10/2017	1/19/2018	1/19/2018	NA	NA	2/10/2017
Zachary Taylor	Geologist	3/23/2017	1/31/2014	7/7/2016	3/28/2018	3/28/2018	NA	NA	NA

Note: PM will ensure all field personnel are current with their certifications prior to the start of field work.

11. PLANS REQUIRED BY EM 385-1-1

Plans, programs, and procedures required by EM 385-1-1 and their disposition in the APP are shown in **Table 11-1**.

Table 11-1 Plans Required by EM 385-1-1

Plan, Program or Procedure	Document Location
a. Fatigue Management plans (01.A.20)	Section 11.1
b. Emergency Response Plans	
(1) Procedures and tests (01.E.01)	Section 11.2
(2) Spill plans (01.E.01, 06.A.02)	Section 11.3
(3) Fire-fighting Plan (01.E.01, 19.A.04)	Section 11.4
(4) Posting of emergency telephone numbers (01.E.05)	Section 9
(5) Man overboard/abandon ship (19.A.04)	This plan is not required.
(6) Medical support (Section 03.A.02; 03.D)	Section 9 of APP and Section 15 of SSHP
c. Plan for prevention of alcohol and drug abuse (01.C.02)	Section 10.6 of SSHP
d. Site Sanitation Plan (Section 02.B)	Section 11.6
e. Medical Support Plan (Section 03.A.01; 03.A.06; 03.D)	Section 9
f. Bloodborne Pathogen Plan (Section 03.A.05)	Section 11.7
g. Exposure Control Plan (Section 03.A.05)	Section 11.7
h. Hazard Communication Program (01.B.01) Provide the location of the Safety Data Sheet (SDS), records of contractor employee training, and inventory of hazardous materials (including approximate quantities and a site map) that will be brought onto government project by the contractor and subcontractor.	Will be maintained at the site by the SSHO. Attachment 1 of the SSHP**.**
i. Access and Haul Road Plan (04.B)	This plan is not required.
j. Hearing Conservation Program (Section 05.C)	Section 11.8
k. Respiratory Protection Plan (05.G)	Section 11.9
l. Health Hazard Control Program (06.A)	Health Hazard Control will be addressed in the AHAs.
m. Process Safety Management Plan (06.B.04)	This plan is not required
n. Lead Abatement Plan (06.C and specifications)	This plan is not required.
o. Asbestos Abatement Plan (06.C and specifications)	This plan is not required.

Table 11-1 Plans Required by EM 385-1-1 (Continued)

Plan, Program or Procedure	Document Location
p. Radiation Safety Program (06.F)	Encountering ionizing radiation above background or use of radiation producing devices is not anticipated. A Radiation Safety Program is not required.
q. Abrasive blasting (06.I)	This plan is not required.
r. Heat/Cold Stress Monitoring Plan (06.I)	Section 11.10
s. Indoor Air Quality Management Plan (Section 06.L)	This plan is not required.
t. Mold Remediation Plan (Section 06.L.04)	This plan is not required.
u. Chromium (VI) Exposure Plan (Section 06.M)	This plan is not required.
v. Crystalline Silica Monitoring Plan (Assessment) (06.N)	This plan is not required.
w. Lighting Evaluation Plan (Section 07.A)	This plan is not required.
x. Night Operations Lighting Plan (07.A.09)	This plan is not required.
y. Traffic Control Plan (Section 08.C.05)	This plan is not required.
z. Fire Prevention Plan (09.A.01)	Section 11.4
aa. Wild Land Fire Management Plan (09.L)	Section 11.5
bb. Arc Flash Hazard Plan (Section 11.B)	This plan is not required.
cc. Assured Equipment Grounding Control Plan (AEGCP) (Section 11.D.05, App D)	This plan is not required.
dd. Hazardous Energy Control Plan (12.A.01)	This plan is not required because no stored hazardous energy activities are anticipated.
ee. Standard Pre-Lift Plan (LHE) (Section 02)	This plan is not required.
ff. Critical lift procedures (16.H)	This plan is not required.
gg. Naval Architectural Analysis Plan (Section 16.L)	This plan is not required.
hh. Contingency plan for severe weather (19.A.03)	Section 11.10
ii. Man Overboard/Abandon Ship Plan (Section 19.A.04)	This plan is not required.
jj. Float Plan (19.F.04)	This plan is not required
kk. Fall Protection Plan (Section 21.D)	This plan is not required
ll. Demolition Plan (engineering surveys) (23.A.01)	This plan is not required.
mm. Rope Access Program (Section 24.H.02)	This plan is not required.
nn. Excavation/Trenching Plan (25.A.01)	This plan is not required.
oo. Underground Construction Fire Prevention and Protection Plan (26.D.01)	This plan is not required
pp. Compressed Air Plan (26.I.01)	This plan is not required

Table 11-1 Plans Required by EM 385-1-1 (Continued)

Plan, Program or Procedure	Document Location
qq. Formwork and Shoring Erection and Removal Plans (27.C)	This plan is not required.
rr. Pre-Cast Concrete Plan (27.D)	This plan is not required
ss. Lift Slab Plans (27.E)	This plan is not required
tt. Masonry Bracing Plan (Section 27.F.01)	This plan is not required.
uu. Steel Erection Plan (27.F.01)	This plan is not required
vv. Explosives Safety Site Plan (ESSP) (Section 29.A)	This plan is not required.
ww. Blasting Plan (29.A.01)	This plan is not required
xx. Underwater Diving Operations Plan (30.A.14, 16)	This plan is not required.
yy. Tree Felling/Maintenance Plan (Section 31.A)	This plan is not required.
zz. Aircraft/Airfield Construction Safety & Phasing Plan (Section 32.A.02)	This plan is not required.
aaa. SSHP (HTRW) (33.B)	This plan is not required.
bbb. Confined space (34.A)	This plan is not required.

11.1 FATIGUE MANAGEMENT PLANS

Personnel will follow the TEC-Weston JV’s Employee Work Schedule. If extended periods of working long hours are required, the SSHO will monitor employees for outward signs of fatigue. Employee rotations may need to be adjusted to allow for individual differences in how fatigue-related stress is handled and for employee-specific roles on the project. When employees are working extended hours, employee travel time to and from work will be minimized to allow sufficient rest and should be taken into account in determining hours per day and per week limits. Group transportation to and from the work location and lodging will be used to address this situation. Consideration should be given to “awake” time and not just the hours logged on a time sheet.

11.1.1 Intrinsic Fatigue Symptoms

1. **Physical** – Frequent, unexplainable headaches; muscle aches and pains; breathing difficulties; blurred/double vision; burning urination.
2. **Mental –** Difficulty focusing attention, distracted easily, depression, impaired judgment, and/or poor visual perception.

11.1.2 Extrinsic Fatigue Symptoms

1. **Physical –** Degraded motor skills, tenseness and tremors, intolerant/irritable, increased reaction time, social withdrawal.
2. **Mental –** Absentmindedness, poor short-term memory, lack of interest and drive, confusion and fearfulness, slow startle response, worry, and anxiety.

11.2 EMERGENCY PROCEDURES

The site evacuation route and predetermined meeting location map will be developed and posted prior to mobilization. The evacuation route and predetermined meeting location map will be reviewed with all employees prior to the start of work and prior to the start of each new task.

Within a few days of the startup of work, a drill will be run for the emergency response plan. The TEC-Weston JV has evaluated the emergency medical services. The SSHO will have a roster of individuals on-site so that they can be accounted for in the event of an emergency.

11.3 SPILLS

The procedures described in the following subsections comprise the spill containment program in place for activities at ANG facilities. Spill procedures will be reviewed with team members by the SSHO.

11.3.1 Spill Control and Prevention

The TEC-Weston JV anticipates that unleaded gasoline, diesel fuel No. 2, and motor oil will be the only substances with hazardous constituents that may be stored on-site and will be in quantities of less than 5 gallons. To decrease the amount of pollutants to be stored on-site, the TEC-Weston JV plans, to the greatest extent possible, to conduct all fueling and repair of vehicles off-site. Hazardous liquids that are necessary to conduct the tank inspection and repair activities will be stored in the smallest quantities possible. Should the storage of hazardous waste or materials with hazardous constituents be necessary, a storage tank constructed primarily of non-earthen materials, or a stationary device designed to contain an accumulation of hazardous waste would be placed within an approved secondary containment of adequate size to contain a spill (110% of storage tank size). The tank would be managed in accordance with the APP and 40 CFR Subpart I.

11.3.1.1 Spill Response

Because of the nature of the operations, the potential for a spill of pollutants during operations is low. The highest probability for a spill will occur during re-fueling operations of equipment (e.g., filling a chainsaw's gas and oil tanks). In the event of a spill, the TEC-Weston JV will notify appropriate emergency responders and federal and state reporting agencies. Additionally, the TEC-Weston JV will be equipped with spill kits on-site as needed for immediate cleanup if a petroleum product is inadvertently spilled. Any spills originating from small containers (e.g., gasoline cans) would be contained using absorbent materials.

If fuel or oil is spilled, the following measures will be taken:

- The spill area will be isolated and contained.
- Proper notifications will be made.
- The liquid and affected soil will be shoveled into a plastic bag and subsequently placed into a U.S. Department of Transportation-approved shipping container.
- Each container will be labeled to identify its contents.
- The container(s) will be shipped off-site and disposed of at a permitted facility in accordance with the CFR 260 to 270.
- Fire-extinguishing equipment meeting 29 CFR Part 1926, Subpart F, shall be on hand and ready for use to control fires.

11.3.2 Notification

In the event of a spill or release, the TEC-Weston JV personnel will immediately dial 911 and will then notify the SSHO or his designee. The SSHO or designee will respond in accordance with the seriousness of the spill or release. The TEC-Weston JV Project Manager and Program Health & Safety Officer and EHS Leader will be informed of any spills or releases, minor or serious. The SSHO will file an incident report within 24 hours of the accident.

11.4 FIREFIGHTING PLAN

Potential sources of fuel include grass and leaves. Types of fire suppression systems include multipurpose ABC portable fire extinguishers. In case of fire, evacuate the area immediately. Activate 911 or the established Fire Emergency Number from a safe location. Indicate what is happening, the location of the fire, and whether there are injuries. Comply with requests from the 911 operator for information. Do not hang up until told to do so by the operator, or allow the operator to hang up first. Upon completion of the emergency phase, comply with incident notification procedures.

If the fire is small and manageable with fire-extinguishing equipment at hand, and you are trained in the use of this equipment, you may make the decision to use this equipment while waiting for advanced assistance. Never place yourself in danger, always have a plan for escape, and never attempt to fight a fire if there are any doubts about the type of fire or your ability to successfully fight the fire. Never allow the fire to get between you and your escape route.

11.4.1 Fire Extinguishing Equipment

Fire extinguishing equipment that meets 29 CFR Part 1926, Subpart F, will be on hand and ready for use to control fires. The following procedures will be followed:

1. Flammable and Combustible Materials (liquids, gases):
    - Flammable materials must be properly labeled, stored, handled, and used.
    - No smoking or use of open flame-producing devices within 50 feet of flammable and combustible materials.
    - Obtain SDSs for all flammable materials in use and ensure all personnel are aware of hazards.
    - Label all containers with contents, the word “Flammable”, and in accordance with hazard communication requirements.
    - Store materials in well-ventilated areas that are free of ignition sources and flame or sparks.
    - Ensure that incompatible materials are stored in remote locations from each other (e.g., keep flammables from oxidizers).
    - Limit quantities to minimum required.
    - Store cylinders in upright and secure positions.
    - Bond and ground containers as (and where) necessary.
    - Use proper storage cabinets for flammable and combustible materials. Contact EHS Staff for assistance.
    - Use only approved containers.
    - Use and dispense only in well-ventilated areas.

2. Combustible Materials (solids):
    - Solid combustible materials include wood, paper, and cloth. Proper housekeeping reduces concerns for combustion of these materials. Use proper receptacles for disposal, and dispose of solid combustible materials routinely.
3. Oxidizers:
    - An oxidizer is a substance that increases the flammability of materials, allowing them to burn more easily. Examples include pure oxygen, chlorine, and ammonium nitrate. Store oxidizers in a remote location from flammable and combustible materials.
4. Electric Appliances:
    - Do not use electric appliances near flammable or combustible materials. Never place an appliance on an unstable surface. Use only Underwriters Laboratories, Inc. (UL) - or Factory Mutual Research Corp. (FM)-approved appliances. Follow the manufacturer's recommendations or requirements for use and maintenance.
5. Smoking:
    - Smoking is prohibited indoors. Smoking is allowed only in outdoor, designated areas. Smokers are to maintain smoking areas in a clean and safe condition. Ensure that receptacles for disposal of cigarettes and other smoking materials are appropriately constructed, free of combustible debris, and, when necessary, are cool before emptying into waste receptacles.
6. Housekeeping:
    - Personnel are responsible for keeping work areas free of combustible materials and debris.
    - Weeds and grass must be properly maintained to limit potential fire hazard.
    - The SSHO will document and inspect all project fire extinguishers on a monthly basis.

11.5 WILD FIRES

11.5.1 Prevention

Site personnel should practice smart fire safety habits and watch for hazardous conditions. If conditions are dry, wild fires can pose a threat—not only because there is plenty of fuel to burn, but also because rural areas and remote locations often do not have easy access for firefighters. There also is a chance that embers from a fire a mile or more away may fall onto nearby vegetation and cause them to catch fire. The following preventive measures will be observed:

- Smoke only in designated areas.
- Avoid driving through high grass or areas where vehicle exhaust or hot engine surfaces could cause fires.

- Keep a fire extinguisher handy.
- Be extra cautious during the dry season and observe warnings and prohibitions established by the Forestry Service or other agencies.
- Be aware of wild fires in neighboring areas.

11.5.2 Awareness and Response

Wild fires can spread quickly and without warning. A subtle shift in the wind could send the flames in your direction even though authorities may have deemed your area safe. Make sure you have a plan in place:

- Be aware of wild fires in neighboring areas.
- Do not attempt to fight forest fires. If fire or smoke is observed, notify all site personnel, initiate evacuation, and report the fire to the designated emergency agencies.
- Designate a place to meet if there is a fire.
- Identify multiple places you could evacuate to, such as a motel outside the danger zone.

If you are driving:

- Roll up your windows and close your air vents.
- Drive slowly and turn on your headlights.
- Do not drive through heavy smoke.

11.6 SANITATION

Employers will establish and maintain hygienic sanitation provisions for all employees in all places of employment. General housekeeping activities will occur daily.

11.6.1 Drinking Water

An adequate supply of potable water will be provided in all places of employment, for both drinking and personal cleansing. Cool drinking water (bottled water) will be provided.

11.6.2 Toilets

Toilets are required in all places of employment. Toilet facilities are available for use throughout ANG facilities. Hand soap or similar cleansing agents are available.

11.6.3 Procedures for Vermin Control

The work areas will be kept clean and organized. Organics such as foods will be wrapped and then properly discarded to avoid attracting pests.

11.6.4 Waste Disposal

A dumpster for garbage will be made available.

11.7 BLOODBORNE PATHOGENS EXPOSURE CONTROL PLAN – FIRST AID PROVIDERS

11.7.1 Scope

The TEC-Weston JV personnel do not provide medical assistance as a primary job duty; however, this Bloodborne Pathogen Exposure Control Plan (ECP) is applicable to designated first aid providers. The TEC-Weston JV workers expected to administer first aid must have a basic understanding of bloodborne pathogens in order to protect themselves effectively from any hazards. At a minimum, this Bloodborne Pathogen ECP for First Aid Providers will be on-site.

The TEC-Weston JV personnel may deliver First Aid and CPR in a nonclinical setting. First Aid and CPR duties are often performed in uncontrolled environments, which, due to a lack of time and other factors, do not allow for application of a complex decision-making process to the emergency at hand.

This ECP is intended to assist personnel in making decisions concerning the use of PPE and resuscitation equipment, as well as for decontamination, labeling, containerizing and disposal procedures.

11.7.2 Information Program

Identification and assessment of the risk from exposure to biological hazards is conducted as part of the development of the APP. This ECP deals with forms of infection that are of concern to workers who can come in contact with bodily fluids associated with blood.

Training programs provide information on bloodborne pathogens and the Occupational Exposure to Bloodborne Pathogens Standard to all field personnel with special emphasis on those employees who are certified and called upon to perform First Aid.

11.7.3 Exposure Control

This ECP is designed to eliminate or minimize employee exposure to bloodborne pathogens through information and training, use of PPE, safe handling procedures, decontamination, and proper disposal methods.

11.7.3.1 Exposure Determination

Employees certified in First Aid and CPR may be at risk from bloodborne pathogens when these services are rendered. **Attachment 11-1**, presented at the end of this subsection, identifies tasks in which occupational exposure may occur, the potential contact, and the required protective measures for First Aid providers.

11.7.4 Methods of Compliance

11.7.4.1 Universal Precautions

When treating a victim for an injury, conducting CPR, or handling potentially infectious waste, the use of universal precautions is the recommended approach to infection control. Universal precautions assume all human blood and certain human body fluids are infectious for HIV, HBV, and other bloodborne pathogens. Other body substances, including feces, urine, or vomit are not included, unless they contain visible blood. Under circumstances in which differentiation between body fluid types is difficult or impossible, all body fluids shall be considered potentially infectious materials.

11.7.4.2 Work Practice Controls

Work practice controls reduce the likelihood of exposure by formalizing the manner in which a task is performed.

- All first aid procedures involving blood or other potentially infectious materials shall be performed in a manner that minimizes splashing, spraying, spattering, and generation of droplets of these substances.

- Mouth suctioning of blood or other infectious materials is prohibited.
- When handling sharps such as needles used for bee stings or diabetes, do not recap, purposely bend, break by hand, remove from disposable syringes, or otherwise manipulate by hand.
- As soon as possible after use, contaminated sharps are to be placed in puncture-proof/leak-proof containers until they can be disposed.
- Broken glassware that may be contaminated shall not be picked up directly with the hands unless gloves are used to protect the hands against cuts. It is best to use mechanical means, such as a brush and dust pan, and then place the contaminated broken glass in a puncture-proof/leak-proof container.
- When handling red bag waste, hold the top end of the bag rather than the bottom.
- Containers of potentially infectious waste should be labeled with a biohazard label.
- All PPE should be inspected prior to use. PPE should not be worn if the PPE barrier is compromised.
- Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood, other body fluids to which universal precautions apply, or their potentially contaminated articles. Hands should always be washed after gloves are removed even if the gloves appear intact.
- Where hand washing facilities are not readily accessible, an antiseptic hand cleaner along with clean cloth/paper towels or antiseptic towelettes should be used. When antiseptic hand cleaners or towelettes are used hands shall be washed with soap and running water as soon as feasible.

11.7.4.3 Engineering Controls

Engineering controls isolate or remove the bloodborne pathogen hazard from the workplace.

- Proper containerizing, labeling, and disposal of contaminated items are required for all potentially infectious waste.
- Minimizing needle sticks by placing them in a puncture-proof container.
- Limiting access or closing off areas that contain potentially infectious materials.

11.7.4.4 Administrative Controls

Administrative controls reduce or eliminate bloodborne pathogen hazards from the workplace by program development (i.e., ECP), auditing to ensure these programs are in place and implemented, and providing information and training.

11.7.4.5 Personal Protective Equipment (PPE)

PPE is specialized clothing or equipment worn by an employee for protection against a hazard. **Attachment 11-1** provides examples of recommendations for PPE in the nonclinical setting; the list is not intended to be all-inclusive.

First-aid kits will be supplemented with bloodborne pathogen kits or supplies and will be readily accessible at all times.

If the chance of being exposed to blood is high, the caregiver should put on protective attire before beginning CPR or First Aid. Protective barriers should be used in accordance with the level of exposure encountered.

Under rare or extraordinary circumstances, a responding employee may decide, based on his or her judgment, that use of PPE would prevent delivery of care or pose an increased hazard to safety of the employee or co-worker. When this judgment has been made, an investigation of the event will be initiated and documented in order to determine what changes in procedures or protective equipment is needed.

11.7.4.6 Resuscitation Equipment

No transmission of HBV or HIV infection during mouth to mouth resuscitation has been documented. However, because of the risk of salivary transmission of other infectious diseases and the theoretical risk of HIV and HBV transmission during artificial ventilation of trauma victims, disposable mouth to mouth resuscitation masks (one-way valve type only) should be used. These devices are designed to isolate emergency response personnel from contact with victim's blood and blood-contaminated saliva, respiratory secretions, and vomit. Disposable resuscitation equipment and devices should be disposed of once they have been used.

11.7.4.7 Decontamination and Disposal

All PPE will be removed prior to leaving a contaminated area and secured properly for decontamination or proper disposal.

Decontamination uses physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal. All spills of blood and blood-contaminated fluids should be promptly cleaned up. The area should be decontaminated with a commercial disinfectant solution or a 1:100 solution of household bleach. Soiled cleaning equipment should be cleaned and decontaminated with the disinfectant solution.

If a victim's clothes become soiled with blood during First Aid or CPR, the soiled material (i.e., clothes, resuscitation equipment or disposable towels) should be placed in a red or orange plastic bag. If possible, this bag should accompany the victim to the hospital or ambulance. Where on-site emergency care is given and additional medical treatment is not likely, soiled material should be placed in a red or orange plastic bag and then pick-up should be arranged by a local medical waste disposal company. Containers must be identified prior to transport or pick-up.

Any questions regarding the disposal or management of soiled garments or materials should be directed to Program Health & Safety Officer or EHS Leader.

11.7.4.8 Containerizing

The potentially contaminated materials and sharps container generated from giving First Aid and CPR will be placed in a red or orange container/bag. When PPE is removed, it shall be placed in an appropriate designated area for containerization. If the outside contamination of the primary container occurs, the primary container shall be placed within a second container that prevents leakage during handling, processing, storage, transport or shipping, and is labeled or color coded.

Sharps such as needles used for bee stings or diabetes should be placed in a puncture-proof/leak-proof, color-coded or labeled container. If other contents could puncture the primary container, the primary container shall be placed within a secondary container that is puncture resistant. The liquid generated from the decontamination process should be contained in a leak-proof container until a local medical waste disposal company can provide information on proper disposal based on local, state, and federal regulations.

11.7.4.9 Labeling and Hazard Communication

Biohazard warning labels required by the Standard [29 CFR 1910.1030(g)(1)(i)(B)] must be attached to containers of regulated wastes or other containers of potentially infectious materials during storage and transport or shipment. Red or orange bags may be substituted for labeling requirements; otherwise, a biohazard label with lettering or symbols should be affixed to the outside of each bag or container generated. Consequently, any container so labeled or any red- or orange-bagged waste or materials shall be considered to contain either blood or other infectious material.

11.7.4.10 Incident Reporting

When an employee gives First Aid or CPR, or is potentially exposed to a bloodborne pathogen, an NOI Report must be completed. The report must indicate "Potential Exposure to Bloodborne Pathogens."

11.7.4.10.1 Vaccination and Post-Exposure Evaluation and Follow-up

The pre-work Hepatitis B Vaccination for First Aid providers is not required; therefore, it will be offered post-exposure.

Hepatitis B vaccines are effective in preventing hepatitis B following a documented exposure when given within 1 week after HBV exposure. The vaccine may be more effective when combined with HBIG, a preparation of immune globulin with high levels of antibody to HBV (anti-HBs). The U.S. Public Health Service and Centers for Disease Control and Prevention (CDC) guidelines should be accessed for current information.

Upon suspicion or verification of exposure to blood or infectious materials, hepatitis vaccine will be made available to the exposed individual(s) at no cost to the employee. The employee will immediately be referred to the Occupational Medical Consultant (OMC) for counseling and management.

Upon learning of exposure to a source or source individual found to be positive for HBV or HIV, the OMC will provide direction on case management. The OMC, after discussion of the exposure situation with the medical clinic or hospital where the victim was evaluated and treated for injury, will determine whether the exposed employee should be tested for HBV or HIV prior to the status of the source being known (or in the case where the source is unknown).

HBV and HIV testing of the source individual should be done at the local office’s medical clinic or at the hospital where the victim was treated for injury. Local laws may apply for testing source individuals in situations where consent cannot be obtained because the source refuses testing or cannot be identified (i.e., an unconscious patient). If the job location does not allow access to the local office's medical clinic, then a new OMC will be consulted for guidance. The alternate clinic/hospital must offer pretest counseling, post-test counseling, and referral for treatment.

Consult with the OMC to determine if the exposed employee should be given the HBV post-exposure vaccination.

Collection and testing of blood for HBV and HIV serological status shall be performed as soon as feasible on the exposed employee's blood (after consent) where the source is found to be positive for HIV or HBV. Results of the source individual's testing shall be made available to the exposed employee, and the employee shall be informed by the Medical Safety Officer of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual. When the source individual is already known to be infected with HBV or HIV, testing of the source individual known HBV or HIV status need not be repeated (CDC, 1985).

If the source of the exposure is a needle stick or bloodstained material (i.e., blood-stained material contacted an open wound on a field team member), the source should be placed in an appropriate container (i.e., sharps container for needles and red bag for blood-tainted material). The container should be given to the medical clinic for analysis. If the source is found to be HBV or HIV positive, the incident report must be updated to change the status from suspected to confirmed exposure. At this point, the NOI Report will be placed in a limited control access portion of incident filing system to maintain confidentiality.

11.7.4.11 Human Immunodeficiency Virus Post Exposure Management

For any exposure to a source or source individual who has AIDS, who is found to be positive for HIV infection or who refuses testing, the worker should be counseled regarding the risk of infection and evaluated clinically and serologically for evidence for the HIV infection as soon as possible after the exposure. The OMC will provide direction on the case management.

If the source individual was tested and found to be seronegative, follow-up will be determined by the OMC.

If the source or source individual cannot be identified, decisions regarding appropriate follow-up should be individualized. Serological testing will be made available to all workers who may be concerned they have been infected with HIV through an occupational exposure. The OMC will provide direction on the case management.

11.7.4.12 Communication of Hazards to Employees

11.7.4.12.1 Training Schedule

Employees, who are certified to provide First Aid and CPR, are also trained in all components of the bloodborne pathogen standard upon assignment and at the annual refresher training. All First Aid providers must be aware of task modifications or procedure changes that might affect occupational exposure.

11.7.4.12.2 Training Contents

A training sign-up sheet will be completed to include course title, date, attendees' names, signatures, job classifications, instructor's name, and duration of the class. Training content will include the following information:

- Where an accessible copy of the regulatory text and the ECP can be found.
- An explanation of the ECP and the means by which employees can obtain a copy of the written plan.
- A general explanation of the epidemiology and symptoms of bloodborne diseases.
- An explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood and other potentially infectious materials.
- An explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and PPE.
- Information on the types, proper use, location, removal, handling, decontamination and disposal of PPE.
- An explanation of the basis for selection of PPE.
- Information on the Hepatitis B vaccine (or any new vaccines), including information on its efficacy, safety, method of administration, the benefits of being vaccinated.
- An explanation of the procedure to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available.
- Information on the post-exposure evaluation and follow-up that is required to be provided to the employee following an exposure incident.

- An explanation of the signs and labels and/or color coding for disposal of infectious materials.
- An opportunity for interactive questions and answers with the person conducting the training session.

11.7.4.13 Recordkeeping

When an employee gives First Aid or CPR and in doing so becomes subject to this ECP, he/she will verbally report the incident within 1 hour and complete a NOI Report within 24 hours. As part of a medical record, the circumstances of exposure will be kept confidential. Relevant information includes the activities in which the worker was engaged at the time of exposure, the extent to which appropriate work practices and PPE were used, and a description of the source of exposure (U.S. Department of Health and Human Services (HHS) and National Institute for Occupational Safety and Health (NIOSH), 1989). When the source is tested for HIV or HBV, the incident report is updated and placed in a confidential file.

Attachment 11-1
Task Identification, Potential Contact, and Protection

CPR and First Aid			
Emergency Situation	**Service**	**Potential Contact**	**PPE Suggested**
Victim is lying on the ground	Primary survey of victim and opening victims airway	Skin to skin contact	Gloves
Victims breathing has ceased	Rescue breathing	Skin to skin contact Mouth to mouth contact	Gloves Resuscitation mouthpiece
No pulse	CPR	Skin to skin contact	Gloves Resuscitation mouthpiece
Victim is lying on the ground	Secondary survey of victim	Skin to skin contact	Gloves
Choking without stoppage of breathing	Heimlich maneuver	Skin to skin contact	None required if skin is intact Non-intact skin requires gloves
Heart attack	Comfort victim	Skin to skin contact	Gloves
Bleeding with spurting blood	External control	Skin to skin contact	Gloves Gown or coveralls Apron (option) Mask or face protection Eyewear
Minimal bleeding	External control	Skin to skin contact	Gloves
Compound fractures	External control	Skin to skin contact	Gloves
Burns	External control	Skin to skin contact	Gloves
Poisoning	If induced vomiting is needed	Skin to skin contact	Gloves Eyewear
Diabetic shock	Giving an injection	Sharps from needle could cause direct injection	Gloves Sharps container
Bites and stings	Giving an injection	Sharps from needle could	Gloves

Attachment 11-1
Task Identification, Potential Contact, and Protection (Continued)

CPR and First Aid			
Emergency Situation	**Service**	**Potential Contact**	**PPE Suggested**
		cause direct injection	Sharps container
Seizures	External control	Eyes and skin contact	Gloves Eyewear
Stroke	Provide comfort	None	Gloves
Heat stress/cold stress	External control	Skin to skin contact	Gloves
Victim has fainted	Raise legs for shock	Skin to skin contact	Gloves
Victim falls down in hazardous atmosphere	Rescue victim from area	Skin to skin contact	Gloves
Soiled clothes handling	Place soiled clothing and materials in red/orange bag	Skin contact with bloodborne pathogens in clothing fabrics	Gloves Gown or apron (as needed)
Decontamination	Scrub with disinfectant	Skin contact with bloodborne pathogens in clothing fabrics	Gloves Gown or apron (as needed)
Containerization	Place contaminated clothing into bags	Potential skin contact with residual bloodborne pathogen on bags	Gloves Gown or apron (as needed)

11.8 OCCUPATIONAL NOISE AND HEARING CONSERVATION PROGRAM

Noise can cause sudden traumatic temporary or permanent hearing loss, long-term slowly occurring sensory-neural and irreversible hearing loss, disruption of communication, and masking of warning devices and alarms. Additional concerns include increased stress levels and effects on the cardiovascular and nervous systems. This Occupational Noise and Hearing Conservation Program describes the process for controlling, reducing, and minimizing noise exposure.

The occupational medical provider (OMP) will assist in compliance with this program through evaluation of clinics, verification of baseline exams, and employee audiogram evaluation. The OMP will advise the appropriate Safety Officer and, if necessary, the EHS Director of any problems associated with medical compliance or occupationally related hearing loss in workers.

The need for noise-monitoring equipment, noise dosimeters or hearing protection devices must be addressed in the planning stages of a project. Some of the sources of noise at hazardous materials sites, demolition operations, construction and industrial sites which can cause hearing damage are earth-moving equipment (front end loader, bull dozer), material handling equipment (cranes, industrial trucks), power units (compressors, generators, drill rig engines), impact devices (pile drivers, chipping hammers), and other powered devices (saws, needle guns, drills, vibrating equipment)

11.8.1 Noise Evaluation and Surveillance Procedures

OSHA, in 29 CFR 1910.95, establishes a permissible exposure limit (PEL), time-weighted average (TWA) of 90 dBA for an 8-hour work day and a TWA of 85 dBA as the trigger point (action level or AL) for establishing a Hearing Conservation Program (HCP). The HCP includes baseline and annual hearing tests, and hearing conservation training.

Noise exposure can also be compared to the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). The TLVs for noise are arranged in a scale in dBs related to time periods. For an 8-hour work period, the TWA TLV is 85 dBA, and the AL is 80 dBA. The ACGIH numbers are more conservative and realistically reflect current scientific knowledge on the human effects from noise exposure. Therefore, the TEC-Weston JV will use the ACGIH TLVs and guidance and the 3-dB exchange rate as the basis for the HCP to provide a higher level of protection for our employees than that offered by compliance with the OSHA requirements, which are several dB higher. Noise exposure assessment is performed only by qualified personnel with properly calibrated and functional noise measuring equipment. If the APP or the SSHO indicates that the site or activity requires an instrumentation survey, then the area will be screened with an A-weighted sound level meter (Area Monitoring). If deemed necessary, a more in-depth evaluation utilizing a noise dosimeter may be performed (Personnel Monitoring). Both types of monitoring, if needed, will be accomplished in accordance with requirements established in 29 CFR 1910.95(d).

In the absence of sound level measuring instrumentation, any noise preventing normal vocal discussion between two individuals at arm’s length distance (“arms-length rule”) will dictate the need for hearing protection. The TEC-Weston JV guidelines require the use of hearing protection on an immediate basis under the “arms-length rule.” Exceptions may be granted based upon evaluation of a specific task and duration with consultation with an industrial hygienist.

Long-term work efforts at fixed locations (e.g., water treatment plants, incinerators) require an evaluation of noise levels. Re-monitoring may be necessary when changes in equipment, processes, or activities result in modification of the noise level.

If impact noise is present, the peak noise levels and the frequency of the impacts should be determined. OSHA and AGCIH recommendations and/or qualified personnel should be consulted if questions arise regarding impact or impulse noise.

11.8.2 Noise Control Methods

11.8.2.1 Engineering Controls

The primary means of reducing or eliminating personnel exposure to noise is through engineering controls. Engineering controls are defined as any modification or replacement of equipment, or related physical change at the noise source or along the sound transmission path that will reduce the noise level to the employee's ear. Engineering controls include items such as mufflers on heavy equipment or motors, sound baffles, and enclosures.

11.8.2.2 Administrative Controls

Administrative controls may include changes in the work schedule or operations to reduce noise exposure, increasing worker distance from the noise source, and rotation of jobs to reduce time limits of exposure. Administrative time control is not a preferable method for preventing noise exposure since extreme noise for a short duration can cause severe, permanent hearing loss. Administrative controls may be utilized in accordance with the TLV Table ACGIH TLVs and Biological Exposure Indices (BEIs), 2007 Edition. Administrative controls may not be utilized for exposures greater than 100 dBA, regardless of the exposure time.

11.8.2.3 Hearing Protection

Hearing protection devices are utilized whenever engineering controls prove to be infeasible or cost prohibitive. Various types of ear muffs and ear plugs are available. Hearing protector attenuation is intended to reduce employee exposures to below 80 dBA for employees with standard threshold shifts and to below 85 dBA for all other employees.

The TEC-Weston JV personnel and the TEC-Weston JV subcontractors must wear hearing protection devices (HPDs) when required and where signs are posted requiring their use. Hearing protection devices are strongly recommended in any noisy environment, but are mandatory in the following situations:

- The 8-hour average may equal or exceed 85 dB.
- Any employee exposed to greater than or equal to 85 dB and who has experienced a standard threshold shift in their hearing.
- Any noise equal to greater than 100 dB impact, continuous or intermittent.
- Anywhere a “HEARING PROTECTION REQUIRED” sign is posted. These signs are to be posted in all mandatory situations listed above.

In addition, when noise levels equal or exceed 80 dBA, employees must have:

- Availability of hearing protectors.
- Information and training on effects of noise.
- Availability of audiometric testing where there is a risk to health.

Not all hearing protection devices have the same noise reduction rating (NRR). Verification of all NRR values must be made by referring to the manufacturer’s specifications. The proper hearing protection is selected using results from a properly calibrated sound level meter in accordance with ACGIH TLVs and BEIs, 2007 Edition.

Additional information regarding the selection, use, maintenance, and control of hearing protection devices is provided in the TEC-Weston JV Personal Protective Equipment Program (Section 10). NRR will be adjusted using the information presented in the following subsections to estimate the attenuation afforded to a noise-exposed employee in a work environment by muffs, plugs, or a combination of both:

11.8.2.3.1 Single Protection

A common formula used to estimate exposure for **single protection** (either muffs or plugs) is as follows:

1. Determine the laboratory-based noise attenuation provided by the HPD. This is referred to as the NRR and is listed on the packaging.
2. Subtract the NRR from the C-weighted TWA workplace noise level, as follows:

Estimated Exposure (dBA) = TWA (dBC) - NRR

If C-weighted noise level data are not available, A-weighted data can be used by subtracting a 7 dB correction factor from the NRR, as follows:

Estimated Exposure (dBA) = TWA (dBA) - (NRR - 7)

Example: TWA=100 dBA, muff NRR=19 dB

Estimated Exposure = 100 - (19-7) = 88 dBA

11.8.2.3.2 Dual Protection

A common formula used to estimate exposure for **dual protection** (ear muffs and plugs are used simultaneously) is as follows:

1. Determine the laboratory-based NRR for the **higher** rated protector (NRR_h).
2. Subtract 7 dB from NRR_h if using A-weighted sound level data.
3. Add 5 dB to the field-adjusted NRR to account for the use of the second hearing protector.
4. Subtract the remainder from the TWA as follows:

Estimated Exposure (dBA) = TWA (dBC) - (NRR_h + 5) or

Estimated Exposure (dBA) = TWA (dBA) - [(NRR_h- 7) + 5]

Example: TWA=110 dBA, plug NRR=29, and muff NRR=25 dB

Estimated Exposure = 110 - [(29 - 7) + 5] = 83 dBA

11.8.3 Medical Surveillance

Compliance with the HCP is required when an employee's exposure to noise is in excess of 85 dBA. Employees who work with drill rigs, heavy construction equipment, or noisy client operations are candidates for the HCP and medical surveillance requirements thereof. Supervisors of any employees who do not meet these categories but who work around excessive noise (e.g., treatment plant operations, print shop, maintenance personnel) must perform noise surveys to determine the need for those employees to participate in the HCP, and advise the safety officer, who will notify the OMP.

The OMP will make the final determination of employee involvement in the medical surveillance component of the HCP. Audiometric testing is performed annually to evaluate the hearing of all individuals who are routinely exposed to 8-hour TWA exposures of 85 dBA or greater (including compliance with the "arms-length rule"). The OMP is responsible for assuring local clinic compliance with the audiometric testing component of the standard.

11.8.4 Training

Training is regularly provided during initial and refresher courses under 29 CFR 1910.120 (HAZWOPER). Alternative training will be given to employees who are included in the HCP but are not required to have HAZWOPER training. Initial and annual training shall be given to each employee included in the HCP and will address the following:

- The effects of noise on hearing.
- The purpose of hearing protection, advantages, disadvantages, attenuation of various types, and the selection, fitting, use, and care of protectors.
- The purpose of audiometric tests and explanation of test procedures.
- Recognition of hazardous noise.

11.8.5 Program Evaluation

Periodic program evaluations will be conducted to assess compliance with 29 CFR 1910.95. The OMP is responsible for assisting in this evaluation by providing information relative to employee exposure and medical surveillance data.

11.8.6 Recordkeeping

Employee exposure measurements are retained for a minimum of two years and audiometric test records are retained for the duration of the employee's employment, plus 30 years.

11.8.7 References

29 CFR 1910.95, Occupational Noise Exposure.

American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Value (TLV) for Chemical Substances and Physical Agents, 2007.

11.9 RESPIRATORY PROTECTION PLAN

The following Respiratory Protection Plan (RPP) has been developed based on the site history and characterization data and follows the standards established by OSHA and the RPP.

11.9.1 RPP Notifications

Safety procedures and PPE for the specific field activities to be conducted will be reviewed prior to work being conducted.

Review of the RPP will occur daily. If an upgrade/downgrade of the RPP is required due to environmental or hazardous conditions, the Program Health & Safety Officer or East EHS Leader will be notified. The APP will be amended based upon new site conditions.

11.9.2 Respirator Selection

The respiratory protection selected by the CIH for this project is a full-face, negative-pressure, air-purifying respirator (APR) that will be used when Action Levels (ALs) for airborne contaminant or particulate are exceeded.

Manufacturer’s literature or technical services will be consulted to assist in selecting the appropriate filter media to protect against the known or anticipated contaminants.

11.9.2.1 Cartridge Change Schedule

The respirator cartridges in use will be changed in accordance with the manufacturer’s recommendations and at the end of each work shift.

11.9.2.2 Upgrade in Respirator Selection

An upgrade of respiratory protection requires implementation of the Respiratory Protection Program. Working under the Respiratory Protection Program will include the following:

- Current medical evaluations for respirator users approving their use of respirators.
- Selection of appropriate respirators by the SSHO.
- Fit-testing performed within the last year to determine that an employee’s respirator is adequately tight-fitting and protective.
- Respirators used in accordance with the manufacturer’s instructions and regulatory requirements.
- Cartridge service life/change-out schedules and procedures documented relevant to the work at the site.
- Employees trained within the last year on inspection, care, use, cleaning, disinfecting, storage, and operation of the respirators.

- Fit-checking performed upon donning a respirator.
- Current records of medical surveillance, fit testing, and training kept on file for each respirator user.

11.10 HEAT AND COLD STRESS/WEATHER

Personnel will be provided information about heat and cold stress symptoms. Weather conditions will be discussed during morning safety briefings.

11.10.1 Heat Stress

One of the most common types of stress that can affect field personnel is heat stress. Heat stress can be a serious hazard to workers at project sites because of the PPE required. The SSHO is responsible for evaluating the conditions, work tasks, and requirements for PPE and for implementing the emergency response procedures. The following sections describe the signs and symptoms, monitoring requirements, prevention and treatment procedures for heat rash, heat cramps, heat exhaustion, and heat stroke. These requirements and procedures will be followed at all times.

During hot conditions, cool drinking water will be provided for employees. Employees will be encouraged to drink at least one cup every 20 minutes and to take breaks in a cooler, shady location. Personnel not acclimated to the climate or taking medications that might make them sensitive to heat should be allowed additional breaks. Work should be scheduled during cooler periods of the day, when possible. Personnel working outside should use sun screen with a high sun protection factor (SPF).

11.10.1.1 Heat Stress Symptoms and Treatment

11.10.1.1.1 Heat Rash

Heat rash, also known as prickly heat, may occur in hot and humid environments, when sweat does not evaporate from the surface of the skin, and the skin becomes chafed by clothing. Heat rash, when extensive or complicated by infection, can be uncomfortable and inhibit sleep or impair a worker’s performance.

- **Symptoms**—Mild red rash, especially on areas of the body that come into contact with protective gear.

- **Treatment**—Decrease amount of time spent working in protective gear and provide body powder to help absorb moisture and decrease chafing. Heat rash can be prevented by showering, resting in a cool place, and allowing the skin to dry.

11.10.1.1.2 Heat Cramps

Heat cramps are caused by inadequate electrolyte intake. The individual may be receiving adequate water; however, if not combined with an adequate supply of electrolytes, the blood can thin to the point where it seeps into the active muscle tissue, causing cramping.

- **Symptoms**—Acute painful spasms of voluntary muscles, most notable in the abdomen and extremities.
- **Treatment**—Move the victim to a cool area and loosen clothing. Have the victim drink 1 to 2 cups of cool potable water or diluted commercial electrolyte solution (e.g., Gatorade®, Quench®) immediately, and then every 20 minutes until symptoms subside. Electrolyte supplements can enhance recovery; however, it is best to double the amount of water required by the dry mix package directions or to add supplemental water to the liquid form.

11.10.1.1.3 Heat Exhaustion

Heat exhaustion is a state of weakness or exhaustion caused by the loss of fluids from the body. Heat exhaustion is not as dangerous as heat stroke, but if not properly managed in the field, it may lead to heat stroke.

- **Symptoms**—Pale, clammy, and moist skin, profuse perspiring, and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, may vomit, may feel dizzy, and may be irritable or confused.
- **Treatment**—Move the victim to a cool, air-conditioned or temperature-controlled area. Loosen the victim's clothing, place the victim in a position with his or her head lower than the feet (shock prevention), and allow the victim to rest. Consult a physician. Ensure that the victim is not nauseated or vomiting. If not nauseated or vomiting, the victim may be given small sips of cool water or diluted electrolyte replenishment solution (1 to 1 dilution with water, or if mixing from powder, double the water added). If this is tolerated, have the victim drink 1 to 2 cups of fluid immediately, and every 20 minutes until symptoms subside. Seek medical attention at the advice of the consulting physician.

11.10.1.1.4 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the body's heat regulating mechanisms (i.e., the individual's temperature control system (sweating) stops working correctly). Body temperature rises so high that brain damage and death may result if the person is not cooled quickly.

- **Symptoms**—Red, hot, dry skin (although the person may have been sweating earlier), nausea, dizziness, confusion, extremely high body temperature (i.e., 104 degrees Fahrenheit (°F) or greater as measured with a tympanic thermometer), rapid respiratory and pulse rate, seizures or convulsions, unconsciousness, or coma.
- **Treatment**—Immediately call for emergency medical assistance. Remove the victim from the source of heat and cool the victim quickly. If the body temperature is not brought down quickly, permanent brain damage or death may result. Remove all PPE and as much personal clothing as decency permits. Fan the person while sponging or spraying with cool or tepid water. Apply ice packs (if available) to the back of the neck, armpits, groin area, or behind the knees. Place the victim flat on his or her back with head and shoulders slightly elevated. If conscious, and not nauseated or vomiting, the victim may be provided sips of cool water. Do not give the victim coffee, tea, or alcoholic beverages. Emergency medical personnel will take over treatment upon arrival.

11.10.1.2 Heat Stress Prevention

The following measures should be followed to prevent heat stress:

- The most important measure is to prevent heat-related illness through adequate fluid intake.
- Ensure workers drink 1/2 to 1 quart of liquid per hour in high heat conditions. Most of this liquid should be water.
- Provide a shaded area for rest breaks.
- Ensure that adequate shelter is available to protect personnel against heat and direct sunlight. When possible, shade the work area.
- Discourage the intake of caffeinated drinks during working hours.
- Monitor for signs of heat stress.
- Encourage workers to maintain a good diet during these periods. In most cases, a balanced diet and lightly salted foods should help maintain the body's electrolyte balance. Bananas are especially good for maintaining the body's potassium level.
- If using commercial electrolyte mixes, double the amount of water called for in the package directions. Indications are that "full-strength" preparations taken under high heat stress conditions may actually decrease the body's electrolytes.

- Acclimate workers to site work conditions by slowly increasing workloads (i.e., do not begin work activities with extremely demanding tasks).
- Encourage workers to wear lightweight, light-colored, loose-fitting clothing.
- In extremely hot weather, conduct field activities in the early morning and evening.
- Maintain good hygienic standards through frequent showering and changes of clothing.
- Allow clothing to dry during rest periods.

11.10.1.3 Heat Stress Monitoring and Work Cycle Management

When strenuous field activities are part of ongoing site work conducted in hot weather, the following guidelines should be used to monitor the body's physiological response to heat, and to manage the work cycle, even if workers are not wearing impervious clothing. These procedures should be instituted when the temperature exceeds 70 ºF and the tasks and risk analysis indicate an increased risk of heat stress problems. Consult the safety professional (e.g., East EHS Leader or SSHO) if questions arise as to the need for specific heat stress monitoring. In all cases, the site personnel must be aware of the signs and symptoms of heat stress and be provided adequate rest breaks and proper aid as necessary. The SSHO will conduct heat stress monitoring using the Wet-Bulb Globe Temperature (WBGT)-based heat exposure assessment as described in Section 11.10.2. If the WBGT Action Limits in **Table 11-2** are exceeded, the SSHO will conduct physiological monitoring of all site personnel and will adjust the work/rest regimen as required. Physiological monitoring procedures are presented below.

Measure Heart Rate – Heart rate should be measured by the radial pulse for 30 seconds as early as possible in the rest period. The heart rate at the beginning of the rest period should not exceed 110 beats per minute. If the heart rate is higher, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work cycle should be further shortened by 33%. The procedure is continued until the rate is maintained below 110 beats per minute.

Measure Body Temperature – When ambient temperatures are over 90°F, body temperatures should be measured with a clinical thermometer as early as possible in the rest period. If the oral temperature exceeds 99.6 °F (or a 1 degree change from baseline) at the beginning of the rest period, the following work cycle should be shortened by 33%. The procedure is continued until the body temperature is maintained below 99.6 °F (or a 1 degree change from baseline). Under no circumstances should a worker be allowed to work if their oral temperature exceeds 100.6 °F.

Measure Body Water Loss – Body water loss greater than 1.5% of total body weight is indicative of a heat stress condition. Body weight is measured before PPE is donned and after the PPE is removed following a work cycle. Body water loss can be measured with an ordinary bathroom scale; however, the scale must be sensitive to one-half pounds increments. A worker is required to drink additional fluids and rest if their body water loss is greater than 1.5%.

11.10.2 Screening Threshold Based on Wet-Bulb Globe Temperature (WBGT)

In conditions where heat stress could impact workers, acclimatization and work tasks will be considered in assessing work/rest regimens. Guidance specified in ACGIH “Threshold Limit Values and Biological Exposure Indices” will be used for WBGT along with physiological monitoring of the workers.

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer. The measurement of environmental factors shall be performed as follows:

- The range of the dry and the natural wet-bulb thermometers should be -5 °C to +50 °C, with an accuracy of ±0.5 °C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet bulb thermometer should be kept wet with distilled water for at least one-half hour before the temperature reading is made. It is not enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick must be wetted by direct application of water from a syringe one-half hour before each reading. The wick must cover the bulb of the thermometer, and an equal length of additional wick must cover the stem above the bulb. The wick should always be clean, and new wicks should be washed before using.
- A globe thermometer, consisting of a 15 cm (6-inch) diameter hollow copper sphere painted on the outside with a matte black finish, or equivalent, must be used. The bulb or sensor of a thermometer (range -5 °C to +100 °C with an accuracy of ±0.5 °C) must be fixed in the center of the sphere. The globe thermometer should be exposed at least 25 minutes before it is read.

- A stand should be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs and the wet-bulb and globe thermometer are not shaded.
- It is permissible to use any other type of temperature sensor that gives a reading similar to that of a mercury thermometer under the same conditions.
- The thermometers must be placed so that the readings are representative of the employee's work or rest areas, as appropriate.
- Once the WBGT has been estimated, employers can estimate workers' metabolic heat load (see tables) and use the ACGIH method to determine the appropriate work/rest regimen, clothing, and equipment to use to control the heat exposures of workers in their facilities.

WBGT values are calculated using one of the following equations:

With direct exposure to sunlight:

$$WBGT_{out} = 0.7\ T_{nwb} + 0.2\ T_g + 0.1\ T_{db}$$

Without direct exposure to the sun:

$$WBGT_{in} = 0.7\ T_{nwb} + 0.3\ T_g$$

where:

T_{nwb} = natural web-bulb temperature (sometimes called NWB)
T_g = globe temperature (sometimes called GT)
T_{db} = dry-bulb (air) temperature (sometimes called DB)

Table 11-2 provides correction factors for workplace protective clothing ensembles.

Table 11-2 Clothing Adjustment Factors for Clothing Ensembles

Clothing Type	Addition to WBGT (^oC)
Work clothes (long sleeve shirt and pants)	0
Cloth (woven material) coveralls	0
Double-layer woven clothing	3
SMS polypropylene coveralls	0.5
Polyolefin coveralls	1
Limited-use vapor-barrier coveralls	11

Table 11-3 provides action levels for heat stress exposure.

Table 11-3 Screening Criteria for TLV and Action Limit for Heat Stress Exposure

Allocation of Work in a Cycle of Work and Recovery	TLV (WBGT values in °C)[b]				Action Limit (WBGT values in °C)[b]			
	Light[a]	**Moderate[a]**	**Heavy[a,c]**	**Very Heavy[a,c]**	**Light[a]**	**Moderate[a]**	**Heavy[a,c]**	**Very Heavy[a,c]**
75 to 100%	31.0	28.0	-[c]	-[c]	28.0	25.0	-[c]	-[c]
50 to 75%	31.0	29.0	27.5	-[c]	28.5	26.0	24.0	-[c]
25 to 50%	32.0	30.0	29.0	28.0	29.5	27.0	25.5	24.5
0 to 25%	32.5	31.5	30.5	30.0	30.0	29.0	28.0	27.0

Notes:

[a] See Table 11-4 for work demand categories. The thresholds are computed as a TWA-Metabolic Rate where the metabolic rate for rest is taken as 115 W and work is the representative (mid-range) value of Table 11-4. The time base is taken as the proportion of work at the upper limit of the percent work range (e.g., 50% for the range of 25 to 50%).

[b] WBGT values are expressed to the nearest 0.5 °C.

[c] Because of the physiological strain associated with Heavy and Very Heavy work among less fit workers regardless of WBGT, criteria values are not provided for continuous work and for up to 25% rest in an hour for Very Heavy. The screening criteria are not recommended, and a detailed analysis and/or physiological monitoring should be used.

If work and rest environments are different, hourly time-weighted averages (TWA) WBGT should be calculated and used. TWAs for work rates should also be used when the work demands vary within the hour, but note that the metabolic rate for rest is already factored into the screening limit.

Table 11-3 is intended as an initial screening tool to evaluate whether a heat stress situation may exist; therefore, the table is more protective than the TLV or Action Limit. Because the values are more protective, they are not intended to prescribe work and recovery periods.

Table 11-4 provides metabolic rate categories and representative metabolic rates with example activities.

Table 11-4 Metabolic Rate Categories and the Representative Metabolic Rate with Example Activities

Category	Metabolic Rate (W)*	Examples
Rest	115	Sitting
Light	180	Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional walking.
Moderate	300	Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal walking
Heavy	415	Intense arm and trunk work, carrying, shoveling, manual sawing; pushing and pulling heavy loads; and walking at a fast pace.
Very Heavy	520	Very intense activity at fast to maximum pace.

*The effect of body weight on the estimated metabolic rate can be accounted for by multiplying the estimated rate by the ratio of actual body weight divided by 70 kg (154 lb).

11.10.3 Cold Stress

The potential for cold-related hazards are considered during risk assessment in the planning stages of a project. The SSHO must make decisions on the proper safety procedures. The SSHO will be responsible for implementing the program as well as attaining data on cold stress monitoring using a kestrel or other similar device, which measures wind speed, humidity, and ambient temperature. Each worker must evaluate the risk associated with his or her work and be actively alert to these hazards. Any site worker may stop work if safety procedures are not followed or if the risk is too great.

Personnel working outdoors are subject to cold stress at temperatures below 40 °F. Exposure to extreme cold can cause skin injury or death if the core body temperature is unchecked and permitted to drop. Chemical-protective clothing does not provide protection against cold stress and may increase susceptibility. The following sections describe the signs and symptoms, monitoring requirements, prevention, and treatment procedures for cold stress. These requirements and procedures will be followed at all times.

During cold conditions, employees will be encouraged to take rewarming breaks. Any employee whose clothes become wet will immediately be wrapped in a blanket and will change into dry clothes as soon as possible. Thermally protective gloves should be worn and extremities will be covered by appropriate clothing. Clothing should allow sufficient ventilation or wick moisture away from the skin. Metal hand-held equipment should have a barrier between the equipment and skin.

11.10.3.1 Cold Stress Symptoms and Treatment

11.10.3.1.1 Frostbite

Frostbite is the freezing of tissue and most commonly affects the toes, ears, fingers, and face. Frostbite occurs when an extremity loses heat faster than it can be replaced by the circulating blood. Frostbite may result from direct exposure to extreme cold or to cool, high wind. Damp socks or shoes may contribute to frostbite of the toes.

- **Symptoms—**Cold, tingling, aching, or stinging feeling followed by numbness; skin color is red, purple, white, or very pale and is cold to the touch; blisters may be present (in severe cases).
- **Treatment—**Call for emergency medical assistance. Move the victim indoors and/or away from additional exposure to cold, wet, and wind. Wrap the affected area in a soft, clean cloth (sterile, if available). Give a warm drink (water or juices, not coffee, tea or alcohol). Do not allow the victim to smoke. Do not rub the frostbitten part (this may cause gangrene). Do not use ice, snow, gasoline, or anything cold on the frostbitten area. Do not use heat lamps or hot water bottles to rewarm the frostbitten area. Do not place the frostbitten area near a hot stove. Do not break blisters. After rewarming, elevate the area and protect it from further injury.

11.10.3.1.2 Hypothermia

Hypothermia means “low heat” and is a potentially serious condition. Systemic hypothermia occurs when body heat loss exceeds body heat gain and the body core temperature falls below the normal 98.6 ºF. Although some hypothermia cases are caused by extremely cold temperatures, most cases develop in air temperatures between 30 ^{O}F and 50 ^{O}F, especially when compounded with water immersion and/or windy conditions. The victim of hypothermia may not know, or may refuse to admit, that he or she is experiencing hypothermia. All personnel must be observant for these signs for themselves and for other team members.

- **Symptoms**—Cool bluish skin; uncontrollable shivering; vague, slow, slurred speech; irritable, irrational, or confused behavior; memory lapses; clumsy movements, fumbling hands; fatigue or drowsiness. Below the critical body core temperature of 95 ºF, the body cannot produce enough heat by itself to recover. At this point, emergency measures must be taken to reverse the drop in core temperature. The victim may slip into unconsciousness and can die in less than 2 hours after the first signs of hypothermia are detected. Treatment and medical assistance are critical.
- **Treatment**—Call for emergency medical assistance. Do not leave the victim alone. Prevent further heat loss by moving the person to a warmer location out of wind, wet, and cold. Remove cold, wet clothing, and replace with warm, dry clothing or wrap the victim in blankets. If the victim is conscious, provide warm liquids, candy, or sweetened foods. Carbohydrates are the food most quickly transformed into heat and energy. Do not give the victim alcohol or caffeine. Have the person move his or her arms and legs to create muscle heat. If he or she is unable to move, place warm bottles or hot packs on the arm pits, groin, neck, and head. Do not rub the arms and legs or place the person in warm water.

11.10.3.2 Prevention and Protection

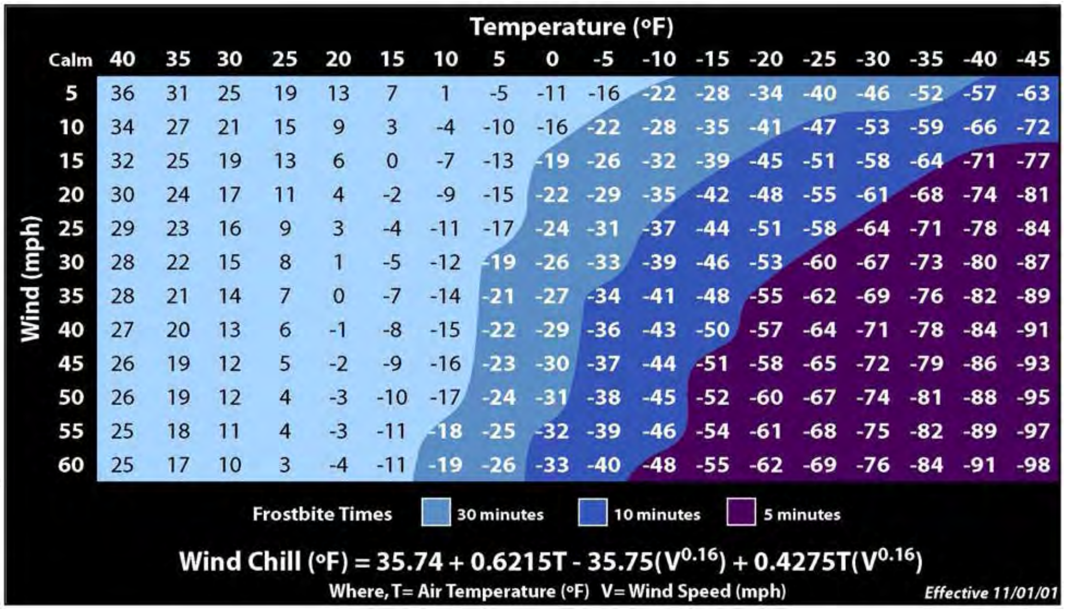
The following general guidelines are recommended for preventing or minimizing cold stress:

- Wear loose, layered clothing, masks, woolen scarves and hats. Wear liners under hard hats.
- Protect hands with gloves or mittens.
- Never touch cold metal with bare hands.
- Wear waterproof, slip-resistant, insulated boots.
- Use chemical foot and hand warmers (commercially available) inside boots and gloves.
- In extreme cold, cover the mouth and nose with wool or fur to “pre-warm” the air you breathe.
- If wearing a face protector, remove it periodically to check for frostbite.
- Ensure that clothing remains secure around the body, especially at the neck and waist.
- If required to wear chemical protective clothing, remember that it generally does not provide protection against cold stress. In many instances, chemical protective clothing increases susceptibility. Dress carefully if both chemical protection and thermal insulation are required.
- Remove outer layers to avoid overheating, and remove clothing soaked with perspiration; replace layers to avoid becoming chilled.

- Keep clothes dry by wearing water-resistant and wind-resistant clothing and outerwear.
- Wear clothing that will “breathe” or allow water vapor to escape.
- Eat well-balanced meals, ensure adequate intake of liquids and avoid alcoholic beverages. Drink warm, sweet beverages and soups. Limit the intake of caffeinated drinks due to the diuretic and circulatory effects.
- Use available warm shelters and implement work-rest schedules.
- If warm shelters are not available, use cars/vehicles as shelters from the cold. (Ensure that tailpipes are not covered by heavy snowfall).
- Use radiant heaters to provide warmth (if using propane heaters ensure adequate ventilation to avoid carbon monoxide poisoning).
- Monitor yourself and others for changes in physical and mental condition.
- Use the buddy system or supervision to ensure constant protective observation.
- If heavy work must be done, resulting in sweating/wet clothing, take rest periods in heated shelters and change into dry clothing as necessary.
- New employees should not work full-time in the cold during the first days of employment until they become accustomed to the working conditions and the use of required protective clothing.
- Include the weight and bulkiness of clothing in estimating the required work performance and weights to be lifted by the worker.
- Arrange the work in such a way that sitting or standing still for long periods is minimized.
- Perform work protected from drafts to the greatest extent possible. If possible, shield the work area from wind.

Table 11-5 and **Table 11-6** should be consulted to adjust working schedules for wind chill conditions based on equivalent chill temperature (ECT). These tables are guidelines only. Ambient temperatures and wind conditions should be monitored frequently, and work schedules adjusted as required. If workers show signs or symptoms of cold stress, the work schedule must be adjusted, as required.

Table 11-5 Wind Chill Chart



Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm																		
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times ☐ 30 minutes ☐ 10 minutes ☐ 5 minutes

$$\text{Wind Chill } (^\circ F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Table 11-6 Cold Work/Warm-up Schedule for 4-Hour Shifts

Equivalent Chill Temperature	Maximum Work Period	Number of Breaks
≥ –24 °F	Normal	1
-25 °F to –29 °F	75 minutes	2
-30 °F to –34 °F	55 minutes	3
-35 °F to –39 °F	40 minutes	4
-40 °F to -44 °F	30 minutes	5
≤ –45 °F	Stop work	Stop work

11.10.3.3 Work/Warming Regimen

Work should be performed during the warmest part of the day. If work is performed continuously in cold or winter conditions or where rain or cool winds are expected, provide heated warming shelters, tents, cabins, or break rooms nearby. Encourage workers to use the shelter at regular intervals, depending on the severity of the cold exposure. **Table 11-5** provides guidance for working in severe cold weather. The onset of heavy shivering and/or the feeling of excessive fatigue, drowsiness, irritability, or euphoria indicate the need to immediately return to the shelter. Pain, numbness, or tingling in the extremities is indication of the need to immediately return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation, or the worker should change into dry clothing. Never return to work in wet clothing.

11.10.4 Weather Hazards

It is possible that severe weather will occur during this project. In the event that a storm threatens the area through observation of a storm system (lightning observation and thunder), all field work will be halted and weather service bulletins and civil defense messages will be monitored on local radio or through cell phone applications. The SSHO will determine through visual observations and weather updates (gathered through the radio or cell phone) when it is necessary to halt work and when to re-start field activities, which include observing the “30-30” rule that states:

- If you see lightning and thunder is heard within 30 seconds (approximately 6 miles), seek shelter.
- If you hear thunder, but did not see the lightning, assume that lightning is within 6 miles and seek shelter.
- Remain in the shelter for 30 minutes following the last lightning strike.

When a tornado warning goes into effect, the following actions will be taken:

- **In vehicles**: Leave your vehicle and seek shelter in a sturdy building. As a last resort, seek shelter in a ditch or culvert.
- **In buildings**: Take shelter in an interior hallway on a lower floor. A closet, bathroom, or other small room with short, stout walls will give some protection from collapse and flying debris. Otherwise, get under heavy furniture and stay away from the windows.
- **In open country**: Seek inside shelter immediately. If a tornado approaches, lie flat in the nearest depression, such as a ditch or culvert, and cover your head with your arms.

When wind speed exceeds 40 mph, the following actions will be taken:

- Follow manufacturer instructions in assessing the limitations associated with field equipment.
- Shut down outdoor activities involving work at elevation.
- Move mobile items stored outside to indoor locations.
- Secure any items that cannot be moved inside.
- Be careful opening exterior doors.

- Stay away from power lines.
- Be cautious about downed power lines, tree limbs, and debris on roads.

If weather remains unstable for more than 1 hour, the SSHO will monitor weather bulletins to further assess changing conditions.

12. RISK MANAGEMENT PROCESSES

The activity hazard analysis is an ongoing process from the initial project preparation through the implementation and completion of the project. AHAs for all field operations will be developed to comply with EM 385-1-1 and will be completed immediately prior to field work activities by the competent person for that task. Modifications to the AHAs may be completed at any time during the project to account for changes in site conditions, work methods, equipment, or other appropriate work changes. The project-specific AHAs are submitted to the NGB Program Manager for review and approval. In the event conditions change such that the Overall Risk Assessment Code (RAC) increases, work must stop or cannot begin until the Program Health & Safety Officer, EHS Leader, and NGB Program Manager have reviewed and approved the change.

AHAs are to be considered living documents and are intended to be updated by the workers in the field as needed with the assistance of, but not limited to, the SSHO, CSP, CIH, or other EHS officer.

Subcontractors are required to develop their own means and methods for their scope of work.

AHAs will be developed for the following project field activities:

- Activity 1: Mobilization/Demobilization
- Activity 2: Soil Borings
- Activity 3: Monitoring Well Installation
- Activity 4: Well Development and Groundwater Sampling
- Activity 5: Surface Water and Sediment Sampling
- Activity 6: Soil Sampling
- Activity 7: Surveying
- Activity 8: Temporary Well Abandonment

All activities may not be performed at every base. Tasks specific to the individual bases will be noted in the SSHP Table 2-1 for that base.

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ATTACHMENT A

SITE SAFETY AND HEALTH PLAN

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Site Safety and Health Plan
Attachment A to the Accident Prevention Plan

Remedial Investigation
at
Schenectady Air National Guard Base
Scotia, New York

Newly Eligible Restoration Sites (NERS)
Remedial Investigations/Feasibility Studies (RI/FS)

May 2016

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SITE SAFETY AND HEALTH PLAN CONCURRENCE/SIGNOFF

Project Name:	Newly Eligible Restoration Sites (NERS) Remedial Investigations/Feasibility Studies (RI/FS) at Multiple Air National Guard Installations – New England Region
Work Location:	Schenectady Air National Guard Base, Scotia, NY

WORKER'S STATEMENT

I have read, understood, and agree to abide by the information set forth in the Accident Prevention Plan (APP), Site Safety and Health Plan (SSHP), and any discussions presented in the personnel health and safety briefing. I have received adequate training to perform the procedures addressed in these plans. If I identify a hazard not addressed in the APP or SSHP, or encounter an operation I cannot perform in accordance with the APP or SSHP, I will stop the process and notify my immediate supervisor.

Name	**Signature**	**Date**
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LIST OF ACRONYMS

°F	degrees Fahrenheit
AHA	activity hazard analysis
ANGB	Air National Guard Base
ANSI	American National Standards Institute
APP	Accident Prevention Plan
APR	air-purifying respirator
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials International
BBP	bloodborne pathogens
bgs	below ground surface
CDC	Centers for Disease Control and Prevention
CDL	Commercial Driver’s License
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CGI/O_2	combustible gas indicator/oxygen meter
CHST	Construction Health and Safety Technician
CIH	Certified Industrial Hygienist
COC	chemical of concern
CPR	cardiopulmonary resuscitation
DCE	dichloroethene
DGM	digital geophysical mapping
EC	Emergency Coordinator
ECT	equivalent chill temperature
EHS	Environmental Health and Safety
EM	Engineering Manual
EMS	Emergency Medical Services
eV	electron volt
EZ	exclusion zone
FAR	Federal Acquisition Regulation
FID	flame ionization detector
FM	Factory Mutual Research Corp.
FS	feasibility study
ft	feet
HAZWOPER	Hazardous Waste Operations and Emergency Response

LIST OF ACRONYMS (CONTINUED)

HSA	hollow stem auger
IDLH	immediately dangerous to life or health
IDW	investigation-derived waste
LEL	lower explosive limit
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
mph	miles per hour
NERS	Newly Eligible Restoration Sites
NFRAP	No Further Response Action Planned
NGB	National Guard Bureau
NIOSH	National Institute for Occupational Safety and Health
NOI	Notice of Incident
NYANG	New York Air National Guard
NYSDEC	New York State Department of Environmental Conservation
OHP	Occupational Health Program
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
P.E.	Professional Engineer
PAL	project action limit
PDR	personal dataRAM
PEL	permissible exposure limit
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
QC	quality control
RI	remedial investigation
SCBA	self-contained breathing apparatus
SDS	Safety Data Sheet
SI	site inspection
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
TAGM	Technical and Administrative Guidance Memorandum

LIST OF ACRONYMS (CONTINUED)

TEC-Weston JV	TEC-Weston Joint Venture
TWA	time-weighted average
UL	Underwriters Laboratories, Inc.
USACE	United States Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound
WWTP	wastewater treatment plant

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1. INTRODUCTION

The Site Safety and Health Plan (SSHP) provides detailed project-specific health and safety information for conducting the remedial investigation (RI) at the Schenectady Air National Guard Base (ANGB). The RI is being conducted to determine the nature and extent of contamination and the threat to human health and the environment. If risks are acceptable, the RI will recommend a No Further Response Action Planned (NFRAP) decision. If the risks are not acceptable, the RI will recommend the development of remedial alternatives in a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) feasibility study (FS).

The SSHP is written in accordance with applicable United States Army Corps of Engineers (USACE), Occupational Safety and Health Administration (OSHA), federal, state, and local health and safety requirements and presents the minimum requirements for safety and health that must be met by personnel engaged in site operations. The TEC-Weston Joint Venture (TEC-Weston JV) is the contracting entity, with WESTON and Cardno as the JV team partners. The SSHP does not in any way relieve the TEC-Weston JV site personnel or subcontractors from responsibility for the safety and health of their personnel. Visitors to the Schenectady ANGB will receive a safety briefing by the Site Safety and Health Officer (SSHO) prior to gaining entry to the work area. The SSHO will provide visitors with appropriate personal protective equipment (PPE) and an escort while on-site and will maintain an on-site visitor log.

Changes and modifications to the SSHP are permitted and will be made in writing with the knowledge and concurrence of the Environmental Health and Safety (EHS) Leader and the Program Health & Safety Officer and accepted by the National Guard Bureau (NGB) Program Manager.

2. SITE DESCRIPTION AND CONTAMINANT CHARACTERIZATION

2.1 SITE DESCRIPTION

Schenectady ANGB is located at the Schenectady County Airport in Scotia, New York, approximately 2 miles northeast of Scotia (**Figure 2-1**) and 3 miles north of Schenectady, New York. Schenectady ANGB is located north of the Mohawk River in the Mohawk River Valley.

Schenectady ANGB occupies 124 acres in the southeast portion of Schenectady County Airport and is separated into two sections: New York Air National Guard (NYANG) Main Parcel and NYANG South Parcel (ANG, 2006). The ANG is a tenant (by lease agreement) of the Schenectady County Airport Authority and is responsible only for the operation and maintenance of the ANGB.

Schenectady ANGB began operating at the Schenectady County Airport in 1948 as the 109th Fighter Squadron. The organization was converted to a transport group during 1958 and was activated to full-time status in 1961, flying regular missions to Southeast Asia in support of active duty forces in Vietnam. The 109th Airlift Group received its first C-130s during 1971 and began supporting scientific research programs in 1975. In 1988, they began augmenting the U.S. Navy’s support of the U.S. Antarctic Program by supporting operations at the McMurdo and Palmer stations, Antarctica, as well as at other research stations located in Antarctica and Greenland (ECATS, 2003; Hueber et al., 1997, as cited in AECOM, 2015). In 1996, the 109th Airlift Group was re-assigned as an Airlift Wing (ECATS, 2003, as cited in AECOM, 2015).

The main purpose of Schenectady ANGB is to provide organizational and maintenance support to the 109th Airlift Wing, which flies C-130H and ski-equipped LC-130H aircraft to support the Air Mobility Command and polar airlift missions. The major support operations include aircraft fueling, aircraft deicing, aircraft maintenance, aerospace ground equipment maintenance, ground vehicle maintenance, fueling of ground vehicles, and facilities maintenance (ANG, 2006).

The facility also provides general airlift support throughout the ANGB and Air Mobility Command passenger/cargo systems. The unit services other polar customers, such as the North American Aerospace Defense and the Navy, in addition to polar rescue operations. The unit also has a mission to assist New York State in the event of disaster emergencies and civil disturbances.

Currently, there are approximately 468 full-time personnel at Schenectady ANGB and approximately 703 part-time personnel (ANG, 2014).

2.1.1 ZZ007

ZZ007 includes the area of former Building 13 where hazardous materials were used and hazardous waste was generated. Drum storage was also a former use of the AOC. Building 13 has been demolished, and no building is currently in its place (AECOM, 2015). Preliminary plans to construct a building within the former Building 13 footprint are in progress.

2.1.2 TU008

TU008 includes former Building 4, which was a vehicle maintenance facility, and the associated underground storage tank (UST) #41, which was a 6,000-gallon heating oil tank. Building 4 was demolished in 1995. UST #41 was likely removed at the time of building demolition; however, records of removal and/or sampling of the tank pit during removal are not available (AECOM, 2015).

2.1.3 TU009

TU009 includes a 7,000-gallon UST used by the wastewater treatment plant (WWTP) as a bypass during 1982 and 1983. The WWTP was demolished in 2002, but the UST remains in place and is reported to be partially filled with sand.

2.2 PROJECT DESCRIPTION

The project will include activities at the Schenectady ANGB at ZZ007, TU008, and TU009 (see **Figures 2-2, 2-3,** and **2-4**), as presented in **Table 2-1**.

Table 2-1 Anticipated Phases of Work

Work Phase	Work Description
Activity 1 – Mobilization/Demobilization	Manpower mobilization, setup of site support areas, and demobilization
Activity 2 - Soil Borings	Hollow stem auger (HSA) to advance borings to collect soil samples
Activity 3 – Monitoring Well Installation	Drilling and well installation using air rotary rig

Table 2-1 Anticipated Phases of Work (Continued)

Work Phase	Work Description
Activity 4 – Well Development and Groundwater Sampling	Groundwater sampling using Grundfos or peristaltic pumps and bailers
Activity 5 - Surface Water and Sediment Sampling*	
Activity 6 – Soil Sampling	Collection of soil samples
Activity 7 - Surveying	Surveying of sample and monitoring locations
Activity 8 – Temporary Well Abandonment*	

*Not applicable to this installation.

Under each phase of work, inherently hazardous activities will be analyzed to identify the controls that will protect the safety and health of personnel working at and entering the Schenectady ANGB. Activity hazard analyses (AHAs) for all field operations will be developed to comply with Engineering Manual (EM) 385-1-1 and will be completed immediately prior to field work activities by the competent person for that task.

2.3 CONTAMINATION AND EXPOSURE POTENTIAL

The TEC-Weston JV will ensure compliance with the requirements of EM 385-1-1 and OSHA (29 Code of Federal Regulations [CFR] 1910 and 1926) through formal and site-specific training programs, as well as routine inspections with follow-up compliance. Specific information pertaining to suspected physical, chemical, biological, and radiological hazards associated with the work areas, tasks, and operations is presented in the following subsections. As new data become available, the Accident Prevention Plan (APP) and SSHP may need to be modified.

2.3.1 Chemical Hazards

2.3.1.1 Site ZZ007

A site investigation (SI) was conducted in November 2014. During the SI, five soil borings (ZZ07SB01 through ZZ07SB05) were advanced at Site ZZ007 in the area of former Building 13. The borings were advanced to refusal, which occurred 7.5 to 9 feet (ft) below ground surface (bgs). One soil sample was collected from the dry soils above the water table interface in borings

(ZZ07SB02 and ZZ07SB05) where groundwater samples were also collected. Two soil samples were collected from the remaining three borings; one from the upper portion of the borehole and one from the bottom of each boring. No visual or olfactory or photoionization detector (PID) evidence of contamination was identified in any of the borings. All soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals. Twenty-three metals, 20 VOCs, and two SVOCs were detected in the samples. Detected VOCs and SVOCs did not exceed New York State Department of Environmental Conservation (NYSDEC) unrestricted soil cleanup goals. Arsenic, nickel, and zinc were detected in at least one soil sample at concentrations slightly exceeding NYSDEC unrestricted soil cleanup goals. The detected concentrations did not exceed residential soil cleanup goals. Iron was detected in soil at 31,000 to 47,000 milligrams per kilogram (mg/kg), which exceeded the CP-51 secondary soil cleanup goal. Appendix A of the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (NYSDEC, 1994; 2000) includes eastern United States background levels for iron of 2,000 to 550,000 mg/kg. Metals may be naturally occurring in the soils since there is no evidence of a source area or release.

Groundwater was encountered at 2 to 3 ft bgs in two of the borings (ZZSB02 and ZZSB05) and was not encountered in the other three borings or the two additional offset borings. The site groundwater appeared to be perched and intermittent. Fourteen metals in both total and dissolved forms (arsenic, barium, beryllium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, thallium, and zinc), one metal in total form only (cadmium), and one metal in dissolved form only (selenium) exceeded project action limits (PALs) in one or more samples. Groundwater samples collected were turbid. It was concluded that groundwater samples from permanent wells may have lower concentrations of metals (AECOM, 2015).

Potential Chemical Hazard Summary for ZZ007

- Metals (arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, sodium, thallium, and zinc)
- VOCs, SVOCs

2.3.1.2 Site TU008

The SI was conducted in November 2014. Digital geophysical mapping (DGM) was used to confirm the absence of the former fuel oil UST prior to field sampling. Five borings were advanced until refusal, which occurred between 7 to 9 ft bgs in each boring. One soil sample was collected from each boring in the dry soils above the water table interface. There was no visual, olfactory, or PID evidence of contamination in three of the borings. Odors and elevated PID measurements were detected in borings TU08SB08 [peak of 178 parts per million (ppm) at 5 ft bgs] and TU08SB09 (peak of 97.1 ppm at 4 ft bgs). Measurements decreased with depth in each boring. Samples were analyzed for VOCs and SVOCs. Twenty-one VOCs and 17 SVOCs were detected in the samples. Detected chemicals did not exceed PALs.

One groundwater sample was collected from each boring from 5 to 10 ft bgs. Groundwater samples were analyzed for VOCs and SVOCs with the exception of TU08GW10. SVOCs were not collected at TU08GW10 due to the lack of sufficient groundwater volume. Eleven VOCs and 15 SVOCs were detected in the samples. Four VOCs (naphthalene, n-butylbenzene, sec-butylbenzene, and tert-butylbenzene) and two SVOCs [bis(2-ethylhexyl) phthalate and naphthalene] exceeded PALs in one or more samples.

Potential Chemical Hazard Summary for TU008

- VOCs, SVOCs

2.3.1.3 Site TU009

The SI was conducted in November 2014. DGM was used to locate the outline of the WWTP bypass UST at TU009 prior to field sampling. The geophysical survey concluded that a single location of a large metal object of representative size of the WWPT Bypass UST was identified, along with two manholes associated with the structure (Appendix C of AECOM, 2015). Four borings (TU09SB11 through TU09SB14) were advanced until refusal was met, which occurred between 7.5 and 8.5 ft bgs. The groundwater table was encountered between 5 to 5.5 ft bgs in two borings only (TU09SB12 and TU09SB13). One soil sample was collected from the dry soils above the water table interface in borings where groundwater was encountered. Two soil samples were collected from the remaining two dry borings (TU09SB11 and TU09SB14); one from the upper portion of the borehole and one from the bottom of each boring. There was no visual, olfactory, or

PID evidence of contamination in any of the borings. Soil samples were analyzed for VOCs, SVOCs, and metals. Fifteen VOCs, 12 SVOCs, and 23 metals were detected in the samples. Detected VOCs and SVOCs did not exceed NYSDEC unrestricted soil cleanup goals. Arsenic, copper, and zinc concentrations exceeded PALs in at least one soil sample. The detected concentrations did not exceed residential soil cleanup goals. Iron was detected at 24,000 to 55,000 mg/kg in soil exceeding the CP-51 secondary soil cleanup goal. Appendix A of the NYSDEC TAGM 4046 (NYSDEC, 1994; 2000) includes eastern United States background levels for iron of 2,000 to 550,000 mg/kg. Metals may be naturally occurring in the soils since there is no evidence of a source area or release.

Groundwater samples were collected from the two boring where water was encountered. Samples were analyzed for VOCs, SVOCs, and metals. Four SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and bis(2-ethylhexyl) phthalate], four metals in both total and dissolved forms (iron, magnesium, manganese, and sodium), and nine metals in total form only (arsenic, barium, beryllium, chromium, copper, lead, nickel, thallium, and mercury) exceeded PALs in one or more samples.

Potential Chemical Hazard Summary for TU009

- Metals (arsenic, barium, beryllium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, sodium, and thallium)
- VOCs, SVOCs

A site-specific Hazard Communication Plan is presented in **Attachment 1**. Safety Data Sheets (SDSs) for chemicals brought to the Schenectady ANGB will be added by the SSHO to **Attachment 2.**

2.3.2 Physical Hazards

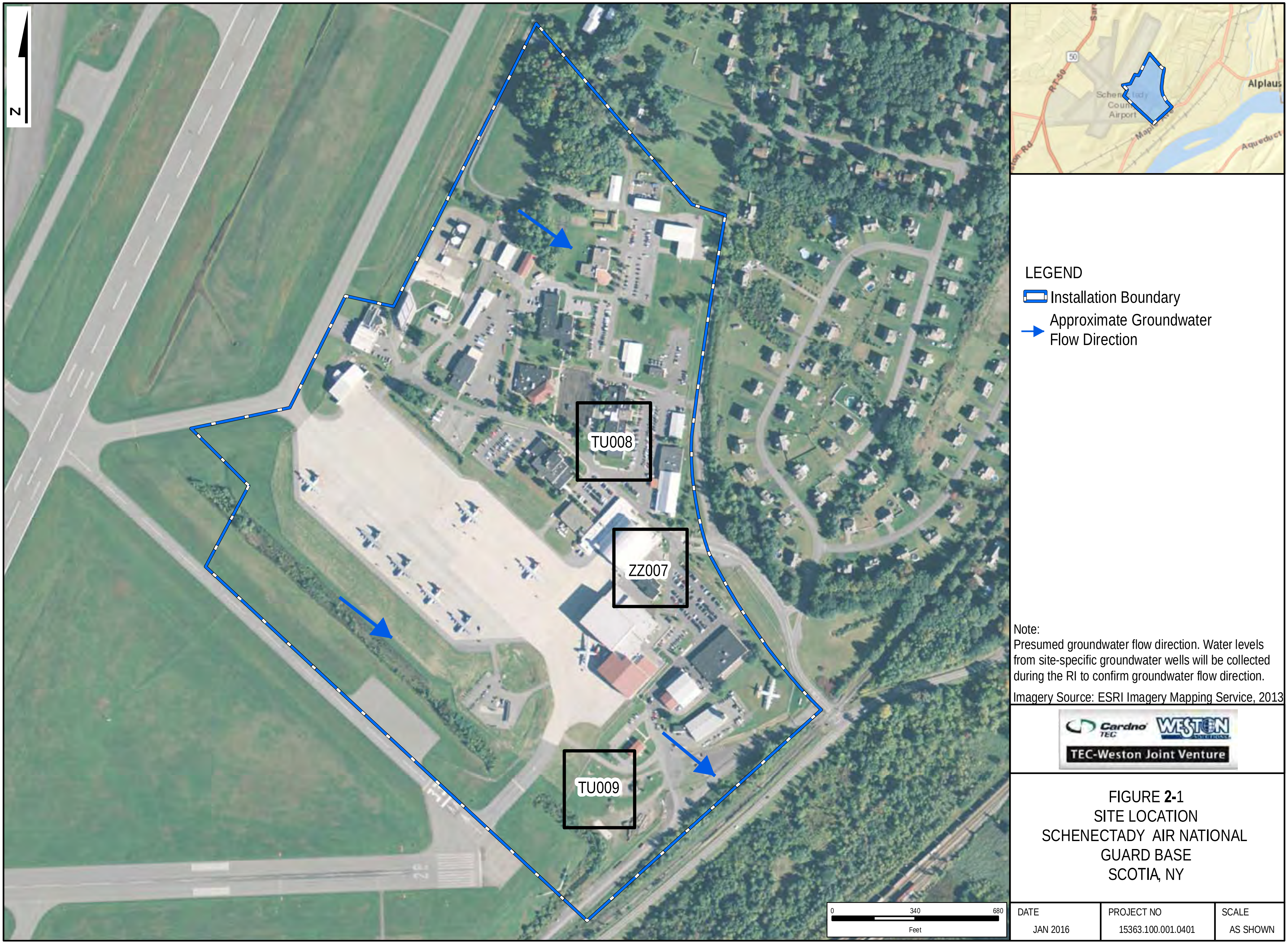
Exposure to physical hazards may include manual lifting; slips, trips, falls; heat/cold stress; hand tools (manual and power); terrain or vegetation; uneven walking surfaces; and weather hazards. Additional common physical hazards include hands or fingers caught between objects, being caught in between/against or struck by an object, and traffic.

2.3.3 Biological Hazards

Biological hazards include wild animals (raccoons, foxes, snakes, rats, and mice); insect bites and stings (ticks, bees, mosquitoes); and poisonous plants. A poster indicating the various types of hazardous plants and reptiles to avoid will be displayed at the site. Site personnel will be instructed to be alert for and to avoid wild animals, to wear long pants and shirts while working in brush, and to use insect repellent as well as poison-ivy block and cleanser. Any site worker who is known to be allergic to insect bites will be required to inform the SSHO and to carry an allergy response kit. First-aid providers will also be trained in the proper first aid procedures for bites. Personnel will receive instruction in the recognition of biological hazards and in using appropriate PPE and/or the procedures to follow in the event that biological hazards create a concern and first aid treatment is required.

2.3.3.1 Nonionizing Radiation

The most likely exposure to nonionizing radiation is the sun. Personnel will receive instruction in using appropriate PPE and/or procedures to follow in the event that nonionizing radiation creates a concern and the use of sunscreen and hats is required.



LEGEND

▭ Installation Boundary

→ Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

TEC-Weston Joint Venture

FIGURE **2-**1
SITE LOCATION
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
JAN 2016	15363.100.001.0401	AS SHOWN

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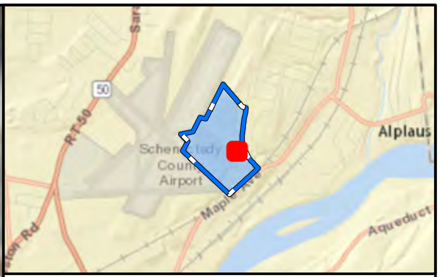

LEGEND

⊗ PA/SI Sampling Locations
◐ Existing Monitoring Well
▨ Demolished Building
▭ Installation Boundary
→ Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE 2-2
SITE LAYOUT MAP
SITE ZZ007
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.001.0401	AS SHOWN

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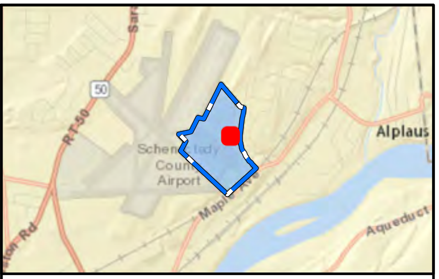

LEGEND

⊗ PA/SI Sampling Locations

▨ Former Heating Oil UST #41 Area

⬚ Demolished Building

▭ Installation Boundary

→ Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

FIGURE **2**-3
SITE LAYOUT MAP
SITE TU008
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.001.0401	AS SHOWN

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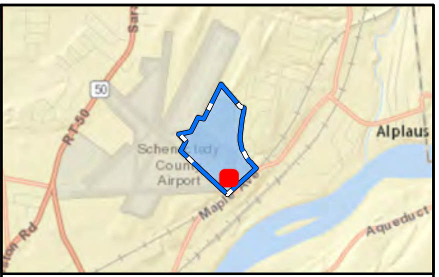

LEGEND

- ⊗ PA/SI Sampling Locations
- ● Site 6 Monitoring Wells
- ▨ WWTP Bypass UST Area
- ▭ Installation Boundary
- → Approximate Groundwater Flow Direction

Note:
Presumed groundwater flow direction. Water levels from site-specific groundwater wells will be collected during the RI to confirm groundwater flow direction.

Imagery Source: ESRI Imagery Mapping Service, 2013

TEC-Weston Joint Venture

FIGURE 2-4
SITE LAYOUT MAP
SITE TU009
SCHENECTADY AIR NATIONAL
GUARD BASE
SCOTIA, NY

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.001.0401	AS SHOWN

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3. ACTIVITY HAZARD ANALYSIS

Activity hazard analysis (AHA) tables provide a task-specific evaluation of the known or potential hazards associated with performing project activities. Each analysis also includes task-specific information related to hazard control and mitigation, such as the use of specific engineering control measures, specific standard operating procedures to be implemented, and PPE to be used as required. AHAs for all field operations will be developed to comply with EM 385-1-1 and will be completed immediately prior to field work activities by the competent person for that task. Health and safety equipment, such as PPE, is described in Section 6 of the SSHP.

If site conditions or tasks change, the SSHO will evaluate the new conditions or task and will contact the EHS Leader and Program Health & Safety Officer for assistance in developing amendments to the SSHP. Amendments made to the SSHP will be submitted to the NGB Program Manager for approval, and all field personnel will be made aware of any changes.

4. STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

The TEC-Weston JV is ultimately responsible for the implementation of the health and safety program, APP, and SSHP. Personnel having the potential for exposure to site hazards are subject to the requirements of the SSHP. Work will not be performed in a manner that conflicts with the health, safety, or environmental precautions outlined in the APP or the SSHP. Personnel violating safety procedures are subject to dismissal from the Schenectady ANGB site.

Table 4-1 presents the key project personnel responsible for the EHS Program implementation. Roles and responsibilities for key project safety personnel are presented in **Table 4-2.**

Table 4-1 Project Safety Team

Name	Position	Phone No.*
Joseph Gross, Professional Engineer (P.E.)	Project Manager	(410) 612-5910 – office (410) 937-9697 – cell
Thomas Koch, Certified Industrial Hygienist (CIH)	Program Health & Safety Officer	(303) 273-0231 – office (303) 503-0442 – cell
Larry Werts	East EHS Leader	(610) 701-3912 – office (215) 815-6237 – cell
Louise Kritzberger, Construction Health and Safety Technician (CHST)	Site Safety and Health Officer (SSHO)	(610) 701-3618 – office (484) 571-9441 – cell
Dan Locurcio	Site Safety and Health Officer (SSHO)	(610) 701-3465 – office (610) 247-6454 – cell
Tom Dakin	Site Safety and Health Officer (SSHO)	(610) 701-3164 – office (302) 415-1496 – cell
Robert Wagner	Site Safety and Health Officer (SSHO)	(570) 466-4026 – cell
Michael Argue	Site Safety and Health Officer (SSHO)	(603) 656-5403 – office (413) 281-9572 – cell
Brenden Beaumont	Site Safety and Health Officer (SSHO)	(410) 612-5964 – office (443) 417-6398 – cell

*Phone numbers will be confirmed/revised prior to field mobilization and revised during the project, as necessary.

Table 4-2 Position Descriptions

Position	Description of Key Responsibilities
Project Manager (PM) Joseph Gross, P.E.	▪ Overall responsibility for the management and completion of the project. ▪ Responsible and accountable for project safety. ▪ Overall responsibility for ensuring that project personnel (including subcontractor personnel) comply with EHS regulations, program requirements, and procedures. ▪ Ensure development and implementation of project APP/SSHP and indicate concurrence with final plans after required EHS reviews. ▪ Ensure project personnel meet applicable safety certification requirements. ▪ Ensure project support is acquired from appropriately qualified safety personnel such as the Program Health & Safety Officer, EHS Leader, and SSHO. ▪ Ensure project personnel comply with applicable EHS requirements and corporate or client procedures. ▪ Halt any project work activities that represent an imminent hazard. ▪ Ensure appropriate safety equipment and materials are provided to the project. ▪ Ensure timely and accurate reporting and investigation of incidents, accident, or injuries involving project personnel, with support from the risk management department. Ensure corrective actions are implemented completely. ▪ Ensure proper response and internal notification regarding inspections by regulatory agencies. ▪ Ensure all project personnel have met the site-specific experience and training requirements.
Program Health & Safety Officer Thomas Koch, CIH	▪ Approve and support the implementation of the APP/SSHP and any amendments. ▪ Conduct field audits, as necessary, to assess the effectiveness and implementation of the APP/SSHP. ▪ Evaluate and authorize changes to the APP based on field and occupational exposure, as necessary. ▪ Function as a quality control (QC) staff member.
EHS Leader - East Larry Werts	▪ Oversee and maintain the EHS Program, the APP, and SSHP. ▪ Conduct site visits, as necessary, to audit the effectiveness of the APP and SSHP. ▪ Serve as a technical safety advisor and provide technical assistance and support.

Table 4-2 Position Descriptions (Continued)

Position	Description of Key Responsibilities
SSHO Louise Kritzberger, CHST Dan Locurcio Tom Dakin Robert Wagner Michael Argue Brenden Beaumont	▪ Responsible for implementing the APP by ensuring that all project personnel follow the requirements of the APP. ▪ Responsible for the development of AHAs. ▪ Be present during all field operations. ▪ Directly communicate with the PM and Program Health & Safety Officer. ▪ Conduct daily safety meetings for site personnel to discuss the day's activities and associated hazards. ▪ Review site personnel training and experience documentation to ensure compliance with the APP. ▪ Coordinate changes/modifications to the APP with the appropriate site personnel. ▪ Conduct or coordinate project-specific training. ▪ Report any incidents that occur on-site to the PM and Program Health & Safety Officer. ▪ Implement safety corrective actions through training and reinforced awareness. ▪ Maintain exposure data. ▪ Has stop-work authority for all safety issues.

The project organizational chart (**Figure 4-1**) is presented at the end of this section.

4.1 COMPETENT PERSON

OSHA Regulation 29 CFR 1926.32 defines a Competent Person. Specific OSHA and USACE regulations identify the need for involvement of competent persons. **Table 4-3** presents the competent person requirement and regulatory references. The SSHOs listed above meet the competent person requirements applicable to this scope of work and have been approved by the EHS Leader. **No work will be performed without a Competent Person on-site.**

Table 4-3 Competent Person Requirements

Competent Person Requirement	Regulatory Reference	Person Designated
SSHO Identification	EM 385-1-1 Sec. 01.A.17	SSHO
General Inspections of Construction Sites	EM 385-1-1.01.A.12 29 CFR 1926.20	SSHO
Unsanitary Conditions	EM 385-1-1.02 29 CFR 1926.27	SSHO
Hearing Protection	EM 385-1-1.05.C 29 CFR 1926.101	SSHO
Respiratory Protection	29 CFR 1926.103, EM 385-1-1, 05.G	SSHO
Hot Work	29 CFR 195.14, EM 385-1-1, 09	SSHO
Hazardous Energy Control	29 CFR 1910.147, EM 385-1-1, 12	SSHO
Surveying		Ravi Engineering & Land Surveying, P.C.

Note:
Engineering Manual (EM) 385-1-1 is the USACE Health and Safety Requirements Manual.

As required by EM 385-1-1, the SSHO has at least 5 years of applicable safety experience and has successfully completed the OSHA 40-hour HAZWOPER training with 8-hour annual refresher courses and the OSHA 30-hour construction safety course (or equivalent course). Additionally, the SSHOs have completed a minimum of 24 hours of safety training every 4 years. The SSHO has performed work on a site(s) of similar hazard, risk, and complexity to the task assignment, and is certified in first aid and cardiopulmonary resuscitation (CPR). The SSHO also has the training and the experience to conduct exposure monitoring/air sampling and to select/adjust protective equipment use; however, it is unlikely that such adjustments will be needed on the RI. The qualifications of all site-specific personnel will be maintained by the SSHO on-site. The certifications and overall qualifications of project personnel are maintained in a database.

4.2 QUALIFIED PERSON

Site personnel will also include a Qualified Person. According to OSHA 29 CFR 1926.32, “qualified” means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project. **Table 4-4** presents a Qualified Person’s requirements list.

Table 4-4 Qualified Person Requirements

Qualified Person Requirement	Project Applicability	Person Designated
Brief Visitors on Site Hazards and PPE	X	L. Kritzberger, D. Locurcio, T. Dakin, R. Wagner, M. Argue, B. Beaumont
Drill Rig Operator	X	Summit Drilling
Geoprobe Operator	X	Summit Drilling
Surveyor	X	Ravi Engineering & Land Surveying, P.C.
Utility Clearance	X	Master Locators

The qualifications of site personnel will be maintained in the on-site project vehicle. The certifications and overall qualifications of project personnel are maintained in a database. Records will be maintained and reviewed by the SSHO.

4.3 TEC-WESTON JV SUBCONTRACTORS

Subcontractors and suppliers to the TEC-Weston JV will be selected only after their safety and health program is thoroughly evaluated. They must complete an EHS questionnaire and must meet specific safety and occupational health selection criteria. Subcontractors will be under the ultimate direction of the senior on-site TEC-Weston JV representative and will adhere to all aspects of the SSHP.

4.4 PERSONNEL ASSIGNED TO THE PROJECT

All the TEC-Weston JV personnel who will be involved in on-site activities are responsible for the following:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees and being alert to potentially harmful situations.
- Performing only those tasks that they believe they can do safely and have been trained to do.
- Notifying the SSHO of any special medical conditions (i.e., allergies, contact lenses, diabetes).
- Notifying the SSHO of any prescription and/or nonprescription medication that they may be taking that might cause drowsiness, anxiety, or other unfavorable side effects.
- Preventing spillage and splashing of materials to the greatest extent possible.
- Practicing good housekeeping by keeping the work area neat, clean, and orderly.
- Reporting immediately all injuries to the SSHO.
- Complying with the SSHP, all safety and health recommendations and precautions, and properly using PPE as determined by the SSHP and/or the SSHO.

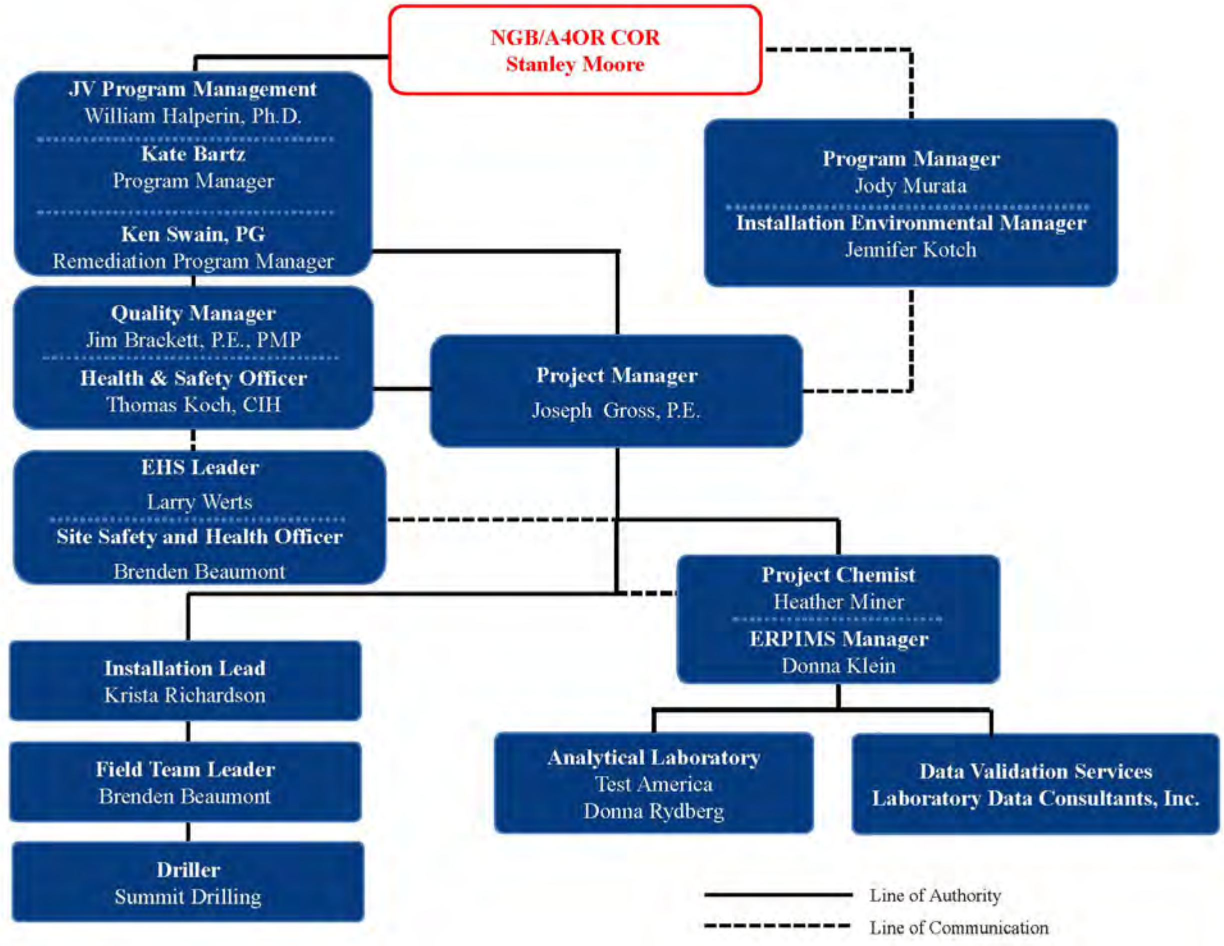

Figure 4-1 Organization Chart
and Lines of Authority

5. TRAINING

The TEC-Weston JV will provide staff whose training and certifications include the following:

- OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Training – All field personnel will have this training.
- OSHA 8-hour HAZWOPER Refresher – All field personnel will have this training when applicable.
- OSHA 30-hour Construction Safety Training – At a minimum, the SSHO will have this training.
- First-Aid/CPR/Bloodborne Pathogens (BBP) – A minimum of two people will have this training.

A copy of applicable training records for project personnel will be available on-site and will be maintained by the SSHO. **Table 5-1** presents personnel training and certifications for key field personnel. Copies of the certifications are provided in Attachment B of the Newly Eligible Restoration Sites (NERS) RI New England Region APP.

5.1 OSHA 40-HOUR HAZWOPER TRAINING

The SSHO will have taken the 40-hour HAZWOPER training course and will have at least 5 years of relevant field experience. The SSHO will also have an additional 8 hours of specialized supervisory training. Workers must have completed the initial OSHA 40-hour HAZWOPER training. Where applicable, workers will have also completed the mandatory 8-hour refresher training within the past 12 months. All training, including project-specific training, is documented, and the training records are maintained by the SSHO.

5.2 OSHA 30-HOUR CONSTRUCTION TRAINING

In compliance with USACE Health and Safety Requirements Manual (EM 385-1-1), 30 November 2014, all SSHOs, at a minimum, will have completed the 30-hour OSHA construction safety class or equivalent training, and will complete a minimum of 24 hours of formal safety coursework every 4 years. Training for the OSHA 30-Hour Construction Safety course or equivalent course includes the areas listed below:

- Occupational Safety and Health (OSH) Act/General Duties Clauses
- 29 CFR 1904, Recordkeeping
- Subpart C: General Safety and Health Provisions, Competent Person
- Subpart D: Occupational Health and Environmental Controls
- Subpart E: PPE, types and requirements for use
- Subpart F: Understanding fire protection in the workplace
- Subpart K: Electrical
- Subpart M: Fall Protection
- Rigging, welding and cutting, scaffolding, excavations, concrete and masonry, demolition, health hazards in construction, materials handling, storage and disposal, hand and power tools, motor vehicles, mechanized equipment, marine operations, steel erection, stairways and ladders, confined spaces, or any other safety procedures that are applicable to the work being performed.

Table 5-1 Personnel Training and Certifications

Personnel Name	Position	Medical Clearance (expires)	40-Hour HAZWOPER	8-Hour HAZWOPER Refresher (expires)	First Aid (expires)	CPR (expires)	30-Hour Construction Safety	Supervisors Health and Safety	Bloodborne Pathogens Refresher (expires)
Louise Kritzberger*	SSHO	7/9/2016	5/3/1991	8/3/2016	2/18/2017	2/18/2017	2/22/2008	8/10/1993	8/3/2016
Dan Locurcio*	SSHO	7/31/2016	3/22/2002	12/10/2016	6/8/2017	6/8/2017	8/17/2007	2/10/2005	12/10/2016
Tom Dakin*	SSHO	12/18/2016	4/1/2004	10/7/2016	12/1/2016	12/1/2016	6/12/2009	4/2/2009	10/7/2016
Robert Wagner*	SSHO	7/9/2016	1/11/1999	10/7/2016	1/19/2018	1/19/2018	3/17/2005	2/3/1999	10/7/2016
Michael Argue*	SSHO	2/2/2018	10/23/1998	1/27/2017	2/17/2018	2/17/2017	2/23/2007	01/21/1999	1/27/2017
Brenden Beaumont*	SSHO	1/22/2017	10/25/2002	3/27/2017	11/11/2017	11/11/2017	7/14/2006	4/2/2009	3/27/2017
Paul Landry	Geologist	1/28/2017	4/17/1987	10/7/2016	1/19/2018	1/19/2018	3/11/2011	3/19/1988	10/7/2016
Robin Dermigny	Geologist	3/10/2018	10/21/2004	3/27/2017	1/26/2017	1/26/2017	3/11/2011	5/18/2009	3/27/2017
Dane Kormos	Geologist	10/31/2016	5/15/2009	2/28/2017	12/01/2017	12/01/2017	3/22/2012	11/10/2011	2/28/2017
Dave Sena	Project Scientist	5/19/2016	5/10/2010	4/13/2017	1/19/2018	1/19/2018	NA	5/21/2010	4/13/2017
Craig Anderman	Project Scientist	11/24/2016	5/25/2007	4/13/2017	12/01/2017	12/01/2017	NA	10/16/2014	4/13/2017
Mary Boggs	Engineer	5/28/2016	9/19/2008	8/20/2016	7/24/2016	7/24/2016	NA	4/5/2013	8/20/2016
Brian Tolton	Scientist	8/28/2016	5/1/2015	2/10/2017	1/19/2018	1/19/2018	NA	NA	2/10/2017
Zachary Taylor	Geologist	3/23/2017	1/31/2014	7/7/2016	3/28/2018	3/28/2018	NA	NA	NA

*SSHO will be designated according to availability prior to the start of field work.

Note: PM will ensure all field personnel are current with their certifications prior to the start of field work.

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6. PERSONAL PROTECTIVE EQUIPMENT

PPE to be used for this work is described below. Personnel performing operations on-site will be required to use the appropriate level of protection. The minimum level of protection required to begin each activity of this project is shown in **Table 6-1**.

Table 6-1 Minimum Level of Protection Requirements

Activity	Level of Protection
Activity 1 – Mobilization/Demobilization	Level D
Activity 2 – Soil Borings	Level D
Activity 3 – Monitoring Well Installation	Level D
Activity 4 – Well Development and Groundwater Sampling	Level D
Activity 5 – Surface Water and Sediment Sampling*	
Activity 6 – Soil Sampling	Level D
Activity 7 – Surveying	Level D
Activity 8 – Temporary Well Abandonment*	

*Not applicable to this installation.

The effectiveness of the PPE program will be evaluated by the SSHO. If additional hazards are identified requiring a higher level of protection and changes to the program are necessary, the SSHO will inform the EHS Leader and amend the PPE requirements.

In accordance with OSHA 29 CFR 1910, Subpart I - Personal Protective Equipment, PPE will be provided, used, and maintained in a sanitary and reliable condition. PPE will be of the construction, design, and material to provide employees with protection against known or anticipated hazards. PPE that properly and appropriately fits the employee will be selected. Project personnel have received OSHA-compliant training. Any concerns regarding the use of appropriate PPE will be brought to the attention of the SSHO, who will contact the EHS Leader for assistance in the evaluation of PPE, as necessary.

Work at Schenectady ANGB will be completed in Level D or Modified Level D. If higher levels of protection are required, an addendum to the APP and SSHP will be prepared and approved.

The SSHO will review the following criteria with employees:

- Proper selection of PPE.
- When PPE is anticipated for use.
- Proper uses and limitations of equipment during temperature extremes, heat/cold stress, and in relation to employee medical conditions.
- Proper donning and doffing, and adjusting of PPE.
- Maintenance, cleaning, and storage of PPE.
- Inspection procedures for PPE.

6.1 LEVEL D PERSONAL PROTECTIVE EQUIPMENT

Level D PPE consists of the following:

- Work clothes such as coveralls, long pants, and shirts with sleeves.
- Safety glasses (American National Standards Institute [ANSI]/American Society of Safety Engineers [ASSE] Z87.1).
- Approved hardhat (ANSI/ASSE Z89.1).
- Approved safety shoes (American Society for Testing and Materials International [ASTM] F2413-05).
- ANSI Class 2 high-visibility reflective vest.
- Nitrile gloves will be included for field work that involves potential exposure to chemicals of concern (COCs).
- Heavy duty work gloves (drilling and hand tool operations).

7. MEDICAL SURVEILLANCE

7.1 MEDICAL SUPPORT FUNCTIONS

All personnel who enter the Schenectady ANGB site when operations are being conducted must comply with an Occupational Health Program (OHP). All medical records are maintained in accordance with 29 CFR 1910.1020. If an unforeseen hazard becomes evident during the performance of work, the SSHO will bring such hazard information to the attention of the EHS Leader, Program Health & Safety Officer, and NGB Program Manager, both verbally and in writing for resolution as soon as possible. In the interim, the necessary action will be taken to reestablish and maintain safe working conditions. Medical certifications for site personnel are summarized in **Table 5-1**. Additional personnel certifications will be available on-site for review.

7.2 OCCUPATIONAL HEALTH PROGRAM

To comply with OSHA requirements, Dr. Peter Greaney of WorkCare® will oversee the site-specific medical surveillance and OHP. Dr. Greaney is a board-certified physician in internal and occupational medicine. **Dr. Greaney can be reached during regular business hours at (800) 455-6155.**

The purpose of the OHP is to ensure suitable job placement of employees, to monitor the health effects of hazards encountered in the workplace, and to maintain and to promote good health through preventive measures. Medical examination criteria are established by WorkCare in compliance with 29 CFR 1910.120.

8. EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Based on the hazard/risk assessment of the Schenectady ANGB, the nature of the work, and previous experience performing RIs, it is not expected that any airborne contaminants or nuisance dust level exposure limits will be exceeded.

Monitoring will be conducted during site activities to evaluate potential physical and chemical hazards. Evaluation of these hazards will assist in determining the effectiveness of control measures, requirements for upgrading or downgrading PPE, and safe work practices. Various direct-reading instruments as described in the following subsections may be used during operations to detect and quantify the potential presence of airborne chemical hazards.

8.1 MONITORING RESPONSIBILITIES AND EQUIPMENT

The SSHO and other site personnel trained in the proper calibration and operation of monitoring equipment will conduct monitoring. Any readings at or above the action levels presented in **Table 8-1** will be reported to the SSHO or EHS Leader as appropriate.

Direct-reading monitoring equipment that may be used during site characterization may include:

- Photoionization detectors (PIDs) with a 10.6 electron volt (eV) lamp for volatile organic contaminants.
- Flame ionization detectors (FIDs).
- Combination combustible gas indicator/oxygen meter (CGI/O_2).
- Personal dataRAM (PDR) real-time aerosol monitor for total dust measurements of organic or inorganic dusts, as necessary based on site conditions.
- Draeger tubes or equivalent for specified COCs.
- MultiRAEs, in lieu of PID and CGI/O_2.

The selection of monitoring equipment will be determined by the SSHO for the specific contaminants at the site location.

Table 8-1 Action Levels for Direct-Reading Air Monitoring Instruments

Hazard	Instrument	Action Level [a]	Action
Explosive atmosphere	CGI/O_2	*Ambient Air*	
		<10% LEL	Work may continue. Consider toxicity potential.
		> 10 % LEL	Work must stop. Ventilate area before returning.
Oxygen content	CGI/O_2	*Ambient Air*	
		<19.5% O_2	Leave area. Re-enter only with self-contained breathing apparatus (SCBA).
		19.5 to 23% O_2	Work may continue. Investigate changes from 21%.
		>23% O_2	Stop work. Ventilate area before returning.
Organic gases and vapors [b]	PID/FID	<2.7 units above background	Level D PPE[c]; monitor at 30-min intervals for organics.
(Benzene/ solvents not present)		>2.7 units above background	Upgrade to Level C; continue organics monitoring.
		>65 units above background	Upgrade to Level B PPE; continue organics monitoring.
		>135 units above background	Stop work. Withdraw from area, and reevaluate SSHP actions. Contact Program Health & Safety Officer or EHS Leader.
Benzene[d]	PID	>1 unit above background	Withdraw from area, upgrade to Level C PPE. Monitor for benzene with colorimetric tube.
	Colorimetric tubes	0.5 parts per million (ppm) or greater benzene	Contact Program Health & Safety Officer or EHS Leader; implement Benzene Exposure Control Plan.
Solvents (vinyl chloride, 1,1,1-dichloroethene [DCE])[e]	PID	Any level above background.	Upgrade to level C PPE. Monitor for vinyl chloride with colorimetric tubes.
	Colorimetric tubes	Presence of vinyl chloride or 1,1,1-DCE	If vinyl chloride or 1,1,1-DCE detected, Level B PPE required.
Particulates	Personal dataRAM (PDR)[f]	Action level of 2.5 milligrams per cubic meter (mg/m^3)	Level D (Use dust suppression as appropriate to maintain dust levels below action levels).
		Above action levels	Level C[g]

[a] Instrument concentrations are measured as "instrument response units." The instrument only measures in units of ppm if its response to a material's airborne concentration is 100%.

[b] If benzene, vinyl chloride, or 1,1,1-DCE are not present, then the VOC action level is 27 units above background.

[c] Or PPE level specified in AHA.

Table 8-1 Action Levels for Direct-Reading Air Monitoring Instruments (Continued)

[d] In areas where benzene (and no solvent) is of concern, the VOC action level is 1 unit above background. Level C PPE must be used to perform the detector tube check to verify benzene is below the 0.5 ppm action level. An MSA Ultra-Twin full-face APR with GME-P100 (or equivalent) cartridges must be used. The respirator cartridges will be disposed of after each use or after 1 hour, whichever occurs first. If benzene is present at concentrations greater than 0.5 ppm, the Benzene Exposure Control Plan must be followed.

[e] In areas where solvents are of concern, if VOC levels are above background, Level C PPE must be used to perform the detector tube check to verify vinyl chloride and 1,1,1-DCE are not present. An MSA Ultra-Twin full-face APR with GME-P100 (or equivalent) cartridges must be used. The respirator cartridges will be disposed of after each use or after 1 hour, whichever occurs first. If vinyl chloride or 1,1,1-DCE is detected, Level B PPE must be used.

[f] Personal dataRAM measures particulates of 0.1 to 10 µm, preferentially as mg/m^3. Action levels for particulates are based on the nuisance dust permissible exposure limit (PEL) of 5 mg/m^3 (respirable fraction) divided by 2 for an action level of 2.5 mg/m^3.

[g] Dust control measures such as water in the air stream while drilling or wetting excavation areas to suppress dust can be implemented and exclusion zone re-monitored prior to making the decision to upgrade to Level C.

8.2 AIR MONITORING SCHEDULE

Real-time air monitoring will focus on the potential exposure to airborne contamination generated during site activities. Real-time monitoring using direct-reading instruments will be conducted to identify potential exposure levels or immediately dangerous to life or health (IDLH) conditions. Real-time monitoring will also be used to identify the need for time-weighted average (TWA) sampling methods. The type of monitoring equipment, the contaminant or hazard to be monitored for, the monitoring method to be employed, the contaminant/hazard action level, and the positive monitoring result action are described in this section.

These guidelines represent the minimum requirements. Monitoring frequency will be escalated or reduced based on the results of previous monitoring and/or other signs of potential exposures (including visual inspection or odor detection), as determined by the SSHO.

8.2.1 Location

Personnel/Zone Monitoring: Personnel monitoring (using direct-reading/real-time instrumentation) will be undertaken to characterize the worker exposure to site chemical contaminants, if necessary. Employee or location selection will be based on work task and duration of exposure. Areas monitored and personnel selected for breathing zone monitoring will be chosen to determine worst-case exposure potential. Work site perimeter monitoring will be performed at locations in the predominant upwind and downwind locations when site activities or work area monitoring results indicate that contaminant levels in the general environment may exceed 10% of the applicable regulatory limits.

8.2.2 Frequency and Duration

Monitoring for chemical hazards will be conducted periodically during all activities, as appropriate, and will be continuous throughout the project.

Personnel/Zone Monitoring: Direct-reading instruments will be used to monitor the workers' breathing zones for the tasks identified by the AHA. Personnel and zone monitoring will be conducted at a minimum of 30-minute intervals (or more frequently as determined by the SSHO) until readings are below half of the strict predetermined action levels. Subsequent monitoring will be conducted at a minimum of 1-hour intervals (or more frequently as determined by the SSHO). Any readings at or above the action levels will be reported as appropriate. The SSHO or EHS Leader and Program Health & Safety Officer will determine if more frequent monitoring or personal sampling is to be performed to verify compliance with OSHA criteria.

8.2.3 Methods/Instruments/Equipment

Monitoring will be conducted using a PID/FID, PDR, CGI/O_2, and colorimetric tubes as described in **Table 8-1.**

8.2.4 Action Levels, Reporting, and Documentation

Personnel/Zone Monitoring: The SSHO will monitor the work zone of all workers when warranted by site activities, as specified in the AHA. If monitored levels warrant upgrading or downgrading the level of PPE, the results and the justification for upgrade or downgrade will be documented.

The SSHO is required to record the results of initial and periodic monitoring conducted at the site. Documentation is to include at least the following information: date, type of equipment utilized, equipment identification number, monitoring results for each work location monitoring station, and miscellaneous information related to site conditions and monitoring performed.

8.2.5 Task Monitoring

The SSHO will be responsible for identifying areas where exposure is a possibility during all intrusive and sampling activities. Air monitoring will be performed at these areas using instruments identified in the following subsections. Task-specific air monitoring will be conducted in accordance with **Table 8-1**, Action Levels for Direct-Reading Air Monitoring Instruments.

Air monitoring will be conducted on this project to ensure personnel safety. The measurements obtained by these instruments are intended to indicate when the use of respirators is required, validate the use of air-purifying respirators (APRs), determine when or if supplied air respirators are required, alert personnel of potentially explosive conditions, and ensure sufficient oxygen is available for work. Daily monitoring will be conducted as dictated by the schedule of work activities for each day. Air monitoring will be under the direction of the SSHO.

8.2.5.1 Flame Ionization Detector/Photoionization Detector

A FID or a PID will be used in areas of site operation to determine the concentration of ionizable volatile organics. Measurements will be taken periodically during intrusive activities. Additional or continuous monitoring will be conducted when any unusual event occurs or as otherwise appropriate according to the action levels established in **Table 8-1.**

8.2.5.2 Combustible Gas Indicator (CGI)/Oxygen (O_2) Meter

When required, a CGI/O_2 meter may be used to monitor explosive or oxygen-deficient or rich atmospheres. If any area shows airborne lower explosive limit (LEL) concentrations of 10% or greater, no work will take place until the source of the emission has been identified and control measures instituted. If any area shows oxygen concentrations less than 19.5%, then supplied air respirators will be worn. If oxygen concentrations are greater than 23%, then work will be stopped and the area evacuated. If permissible exposure limits (PELs) are exceeded using mechanical ventilation, proper respirator protection will be used. Additional or continuous monitoring will be conducted when any unusual event occurs or as otherwise appropriate according to the action levels established in **Table 8-1**.

8.2.5.3 Personal DataRAM

A PDR will be used to monitor worker dust exposure levels. Dust monitoring will be required for any activity that will potentially produce amounts of dust exceeding action levels. Action levels are based on a nuisance dust PEL of 5 mg/m^3 (respirable fraction) divided by 2 for an action level of 2.5 mg/m^3.

8.2.5.4 Colorimetric Tubes

Colorimetric tubes will be used for monitoring benzene, 1,1-dichloroethene (DCE), and vinyl chloride levels as appropriate.

8.2.5.4.1 Benzene

In areas where benzene is a potential COC for a particular task, a Benzene Exposure Control Plan may need to be implemented. If VOC readings exceed 1 unit above background, colorimetric tube monitoring for benzene is required. Before using the detector tubes, the field personnel will leave the exclusion zone and allow the area to ventilate. The field team will contact the EHS Leader and Program Health & Safety Officer to reevaluate the situation. The AHA will be amended, if necessary, for upgraded PPE levels. Benzene detector tubes (e.g., benzene 0.5/a Dräeger tube) will be used to determine breathing zone benzene concentrations. If colorimetric tubes indicate the concentration of benzene exceeds 0.5 ppm, a Benzene Exposure Control Plan will be implemented.

8.2.5.4.2 Solvents

In areas where solvents are potential COCs, and VOC readings are any value above background, detector tubes sensitive to both compounds (e.g., vinyl chloride 0.5/b Dräeger tube) will be used to verify that vinyl chloride or 1,1-dichloroethylene are not present. Before using the detector tubes, the field personnel will leave the exclusion zone and allow the area to ventilate. The field team will contact the EHS Leader and Program Health & Safety Officer and reevaluate the situation. The AHA will be amended, if necessary, for upgraded PPE levels. The breathing zone will be monitored using vinyl chloride 0.5/b Dräeger detector tubes. If vinyl chloride and 1,1-DCE are not detected, then the field personnel can downgrade PPE as described in **Table 8-1**. If vinyl chloride or 1,1-DCE is detected, Level B PPE is required.

8.2.6 Calibration and Maintenance Requirements

Instruments will be calibrated each day prior to use and again when site conditions change, in accordance with manufacturer's specified procedures. A log will be kept detailing date, time, span gas or other standard, and name of person performing the calibration. Maintenance of the instruments will be as specified in the manufacturers' manuals. The SSHO will maintain at the site the SDSs for calibration gases.

8.3 TIME-WEIGHTED AVERAGE SAMPLING

TWA sampling may be conducted at active areas of the site to determine personal exposures. The results of this sampling shall be used to confirm the results of the direct-reading sampling and the suitability of the PPE.

TWA samples shall be collected by drawing a known volume of air through a collection media over an 8-hour period. The type of collection media and the method used to analyze the media are dependent on the compounds or substances under evaluation. For this project, air sampling will be completed only if direct-reading instruments show airborne concentrations that warrant upgraded levels of PPE and as directed by the SSHO.

This sampling will provide a better definition of the chemicals and the exposures that employees received while working in the area. Sampling shall be performed to evaluate the exposure with regard to both applicable TWA concentrations and short-term exposure limits.

9. HEAT AND COLD STRESS/WEATHER

Personnel will be provided information about heat and cold stress symptoms. Weather conditions will be discussed during morning safety briefings.

9.1 HEAT STRESS

One of the most common types of stress that can affect field personnel is heat stress. Heat stress can be a serious hazard to workers at project sites because of the PPE required. The SSHO is responsible for evaluating the conditions, work tasks, and requirements for PPE, and for implementing the emergency response procedures. The following subsections describe the signs and symptoms, monitoring requirements, prevention and treatment procedures for heat rash, heat cramps, heat exhaustion, and heat stroke. These requirements and procedures will be followed at all times.

During hot conditions, cool drinking water will be provided for employees. Employees will be encouraged to drink at least one cup every 20 minutes and take breaks in a cooler, shady location. Personnel not acclimated to the climate or taking medications that might make them sensitive to heat should be allowed additional breaks. When possible, work should be scheduled during cooler periods of the day. Personnel working outside should use sun screen with a high SPF.

9.1.1 Heat Stress Symptoms and Treatment

9.1.1.1 Heat Rash

Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation, and skin is aggravated by chafing clothes. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impairs a worker’s performance.

- **Symptoms —** Mild red rash, especially on areas of the body that come into contact with protective gear.
- **Treatment —** Decrease amount of time spent working in protective gear and provide body powder to help absorb moisture and decrease chafing. Heat rash can be prevented by showering, resting in a cool place, and allowing the skin to dry.

9.1.1.2 Heat Cramps

Heat cramps are caused by inadequate electrolyte intake. The individual may be receiving adequate water; however, if not combined with an adequate supply of electrolytes, the blood can thin to the point where it seeps into the active muscle tissue, causing cramping.

- **Symptoms —** Acute painful spasms of voluntary muscles, most notably of the abdomen and extremities.
- **Treatment —** Move the victim to a cool area and loosen clothing. Have the victim drink 1 to 2 cups of cool potable water or diluted commercial electrolyte solution (e.g., Gatorade®, Quench®) immediately, and then every 20 minutes thereafter until symptoms subside. Electrolyte supplements can enhance recovery; however, it is best to double the amount of water required by the dry mix package directions or to add supplemental water to the liquid form.

9.1.1.3 Heat Exhaustion

Heat exhaustion is a state of weakness or exhaustion caused by the loss of fluids from the body. Heat exhaustion is not as dangerous as heat stroke, but if not properly managed in the field, it may lead to heat stroke.

- **Symptoms** — Pale, clammy, and moist skin, profuse perspiring, and extreme weakness. Body temperature is normal, pulse is weak and rapid, and breathing is shallow. The person may have a headache, may vomit, may feel dizzy, and may be irritable or confused.
- **Treatment** — Move the victim to a cool, air-conditioned or temperature-controlled area, loosen clothing, place in a position with the head lower than the feet (shock prevention), and allow the victim to rest. Consult a physician. Ensure that the victim is not nauseated or vomiting. If not nauseated or vomiting, give the victim small sips of cool water or diluted electrolyte replenishment solution (1 to 1 dilution with water, or if mixing from powder, double the water added). If this is tolerated, have the victim drink 1 to 2 cups of fluid immediately, and every 20 minutes thereafter until symptoms subside. Seek medical attention at the advice of the consulting physician.

9.1.1.4 Heat Stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the body's heat regulating mechanisms, i.e., the individual's temperature control system (sweating) stops working correctly. Body temperature rises so high that brain damage and death may result if the person is not cooled quickly.

- **Symptoms —** Red, hot, dry skin (although the person may have been sweating earlier); nausea, dizziness, confusion, extremely high body temperature [i.e., 104 degrees Fahrenheit (°F) or greater as measured with a tympanic thermometer], rapid respiratory and pulse rate, seizures or convulsions, unconsciousness or coma.

- **Treatment —** Immediately call for emergency medical assistance. Remove the victim from the source of heat and cool the victim quickly. If the body temperature is not brought down quickly, permanent brain damage or death may result. Remove all PPE and as much personal clothing as decency permits. Fan the person while sponging or spraying with cool or tepid water. Apply ice packs (if available) to the back of the neck, armpits, groin area, or behind the knees. Place the victim flat on his or her back or with head and shoulders slightly elevated. If conscious, and not nauseated or vomiting, the victim may be provided sips of cool water. Do not give the victim coffee, tea, or alcoholic beverages. Emergency medical personnel will take over treatment upon arrival.

9.1.2 Heat Stress Prevention

The following measures should be followed to prevent heat stress:

- The most important measure is to prevent heat-related illness through adequate fluid intake.

- Ensure workers drink 1/2 to 1 quart of liquid per hour in high heat conditions. Most of this liquid should be water.

- Provide a shaded area for rest breaks.

- Ensure that adequate shelter is available to protect personnel against heat and direct sunlight. When possible, shade the work area.

- Discourage the intake of caffeinated drinks during working hours.

- Monitor for signs of heat stress.

- Encourage workers to maintain a good diet during these periods. In most cases, a balanced diet and lightly salted foods should help maintain the body’s electrolyte balance. Bananas are especially good for maintaining the body’s potassium level.

- If using commercial electrolyte mixes, double the amount of water called for in the package directions. Indications are that “full-strength” preparations taken under high heat stress conditions may actually decrease the body’s electrolytes.

- Acclimate workers to site work conditions by slowly increasing workloads (i.e., do not begin work activities with extremely demanding tasks).
- Encourage workers to wear lightweight, light-colored, loose-fitting clothing.
- In extremely hot weather, conduct field activities in the early morning and evening.
- Maintain good hygienic standards through frequent showering and changes of clothing.
- Allow clothing to dry during rest periods.

9.1.3 Heat Stress Monitoring and Work Cycle Management

When strenuous field activities are part of ongoing site work conducted in hot weather, the following guidelines should be used to monitor the body's physiological response to heat, and to manage the work cycle, even if workers are not wearing impervious clothing. These procedures should be instituted when the temperature exceeds 70 ^{O}F and the tasks and risk analysis indicate an increased risk of heat stress problems. Consult the safety professional (e.g., EHS Leader or SSHO) if questions arise as to the need for specific heat stress monitoring. In all cases, the site personnel must be aware of the signs and symptoms of heat stress and be provided adequate rest breaks and proper aid as necessary. The SSHO will conduct heat stress monitoring. The SSHO will use a tympanic thermometer for body temperature and a standard thermometer for ambient temperature.

NOTE: For purposes of this operating practice, a break is defined as a 15-minute period.

A physiological monitoring schedule is determined by following the steps below:

- Measure the air temperature with a standard thermometer.
- Estimate the fraction of sunshine by judging the percentage of time the sun is out (refer to **Table 9-1**).
- Calculate the adjusted temperature based on the following formula:
- *Adjusted Temperature = Actual Temperature + 13 X (where X = sunshine fraction from **Table 9-1**)*
- Using **Table 9-2**, determine the physiological monitoring schedule for fit and acclimated workers for the calculated adjusted temperature.

The length of the work period is governed by the frequency of physiological monitoring (**Table 9-2**). The length of the work period is governed by physiological parameters (heart rate and body temperature). As noted above, the rest period will be set at 15 minutes in duration. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period. Body temperature can be checked with a tympanic thermometer after work but before the employee drinks water. If the body temperature taken exceeds 99.7 °F, shorten the next work cycle by one third. These adjustments of the work period based on heart rate and body temperature were recommended in OSHA Technical Manual TED 01-00-015, January 1999, Section III: Chapter 4, Heat Stress.

Table 9-1 Percent Sunshine Factors—Heat Stress Prevention and Monitoring

Percent Sunshine (%)	Cloud Cover	Sunshine Fraction
100	No cloud cover	1.0
50	50% cloud cover	0.5
0	Full cloud cover	0.0

Table 9-2 Physiological Monitoring Schedule—Heat Stress Prevention and Monitoring

Adjusted Temperature	Level D (Permeable clothing)
90 °F (32.2 °C) or above	After each 45 minutes of work
87.5 °F (30.8° - 32.2 °C)	After each 60 minutes of work
82.5 °F - 87.5 °F (28.1 °C - 32.2 °C)	After each 90 minutes of work
77.5 °F - 82.5°F (25.3 °C - 28.1 °C)	After each 120 minutes of work
72.5 °F - 77.5 °F (22.5 °C - 25.3 °C)	After each 150 minutes of work

9.2 COLD STRESS

In the planning stages of a project, the potential for cold-related hazards are considered during risk assessment. The SSHO must make decisions on the proper safety procedures. The SSHO will be responsible for implementing the program as well as attaining data on cold stress monitoring using a kestrel or other similar device, which measures wind speed, humidity, and ambient temperature.

Each worker must evaluate the risk associated with his or her work and be actively alert to these hazards. Any site worker may stop work if safety procedures are not followed or if the risk is too great.

Personnel working outdoors are subject to cold stress at temperatures below 40 °F. Exposure to extreme cold can cause skin injury or death if the core body temperature is unchecked and permitted to drop. Chemical-protective clothing does not provide protection against cold stress and may increase susceptibility. The following subsections describe the signs and symptoms, monitoring requirements, prevention, and treatment procedures for cold stress. These requirements and procedures will be followed at all times.

During cold conditions, employees will be encouraged to take rewarming breaks. Any employee whose clothes become wet will immediately be wrapped in a blanket and will change into dry clothes as soon as possible. Thermally protective gloves should be worn and extremities covered by appropriate clothing. Clothing should allow sufficient ventilation or wick moisture away from the skin. Metal hand-held equipment should have a barrier between the equipment and skin.

9.2.1 Cold Stress Symptoms and Treatment

9.2.1.1 Frostbite

Frostbite is the freezing of tissue and most commonly affects the toes, ears, fingers, and face. Frostbite occurs when an extremity loses heat faster than it can be replaced by the circulating blood. Frostbite may result from direct exposure to extreme cold or to cool, high wind. Damp socks or shoes may contribute to frostbite of the toes.

- **Symptoms —** Cold, tingling, aching, or stinging feeling followed by numbness; skin color is red, purple, white, or very pale and is cold to the touch; blisters may be present (in severe cases).
- **Treatment —** Call for emergency medical assistance. Move the victim indoors and/or away from additional exposure to cold, wet, and wind. Wrap the affected area in a soft, clean cloth (sterile, if available). Give a warm drink (water or juices, not coffee, tea or alcohol). Do not allow the victim to smoke. Do not rub the frostbitten part (this may cause gangrene). Do not use ice, snow, gasoline, or anything cold on the frostbitten area. Do not use heat lamps or hot water bottles to rewarm the frostbitten area. Do not place the frostbitten area near a hot stove. Do not break blisters. After rewarming, elevate the area and protect it from further injury.

9.2.1.2 Hypothermia

Hypothermia means “low heat” and is a potentially serious condition. Systemic hypothermia occurs when body heat loss exceeds body heat gain and the body core temperature falls below the normal 98.6 ºF. Although some hypothermia cases are caused by extremely cold temperatures, most cases develop in air temperatures between 30 ^{O}F and 50 ^{O}F, especially when compounded with water immersion and/or windy conditions. The victim of hypothermia may not know, or may refuse to admit, that he or she is experiencing hypothermia. All personnel must be observant for these signs for themselves and for other team members.

- **Symptoms —** Cool bluish skin; uncontrollable shivering; vague, slow, slurred speech; irritable, irrational, or confused behavior; memory lapses; clumsy movements, fumbling hands; fatigue or drowsiness. Below the critical body core temperature of 95 ºF, the body cannot produce enough heat by itself to recover. At this point, emergency measures must be taken to reverse the drop in core temperature. The victim may slip into unconsciousness and can die in less than 2 hours after the first signs of hypothermia are detected. Treatment and medical assistance are critical.

- **Treatment —** Call for emergency medical assistance. Do not leave the victim alone. Prevent further heat loss by moving the person to a warmer location out of wind, wet, and cold. Remove cold, wet clothing, and replace with warm, dry clothing or wrap the victim in blankets. If the victim is conscious, provide warm liquids, candy, or sweetened foods. Carbohydrates are the food most quickly transformed into heat and energy. Do not give the victim alcohol or caffeine. Have the person move his or her arms and legs to create muscle heat. If he or she is unable to move, place warm bottles or hot packs on the arm pits, groin, neck, and head. Do not rub the arms and legs or place the person in warm water.

9.2.2 Prevention and Protection

The following general guidelines are recommended for preventing or minimizing cold stress:

- Wear loose, layered clothing, masks, woolen scarves, and hats. Wear liners under hard hats.

- Protect hands with gloves or mittens.

- Never touch cold metal with bare hands.

- Wear waterproof, slip-resistant, insulated boots.

- Use chemical foot and hand warmers (commercially available) inside boots and gloves.

- In extreme cold, cover the mouth and nose with wool or fur to “pre-warm” the air you breathe.

- If wearing a face protector, remove it periodically to check for frostbite.

- Ensure that clothing remains secure around the body, especially at the neck and waist.

- If required to wear chemical protective clothing, remember that it generally does not afford protection against cold stress. In many instances, chemical protective clothing increases susceptibility. Dress carefully if both chemical protection and thermal insulation are required.

- Remove outer layers to avoid overheating, and remove clothing soaked with perspiration; replace layers to avoid becoming chilled.

- Keep clothes dry by wearing water-resistant and wind-resistant clothing and outerwear.

- Wear clothing that will “breathe” or allow water vapor to escape.

- Eat well-balanced meals, ensure adequate intake of liquids and avoid alcoholic beverages. Drink warm, sweet beverages and soups. Limit the intake of caffeinated drinks due to the diuretic and circulatory effects.

- Use available warm shelters and implement work-rest schedules.

- If warm shelters are not available, use cars/vehicles as shelters from the cold. (Ensure that tailpipes are not covered by heavy snowfall).

- Use radiant heaters to provide warmth (if using propane heaters ensure adequate ventilation to avoid carbon monoxide poisoning).

- Monitor yourself and others for changes in physical and mental condition.

- Use the buddy system or supervision to ensure constant protective observation.

- If heavy work must be done, resulting in sweating/wet clothing, take rest periods in heated shelters and change into dry clothing as necessary.

- New employees should not work full-time in the cold during the first days of employment until they become accustomed to the working conditions and the use of required protective clothing.

- Include the weight and bulkiness of clothing in estimating the required work performance and weights to be lifted by the worker.

- Arrange the work in such a way that sitting or standing still for long periods is minimized.

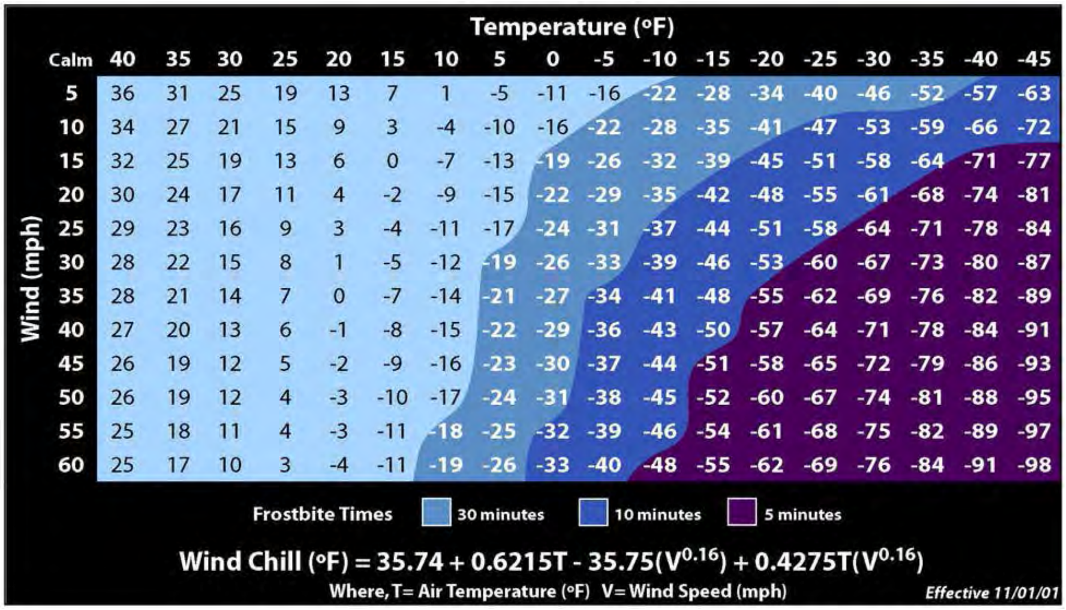
- Perform work protected from drafts to the greatest extent possible. If possible, shield the work area from wind.

Table 9-3 and **Table 9-4** should be consulted to adjust working schedules for wind chill conditions based on equivalent chill temperature (ECT). These tables are guidelines only; ambient temperatures and wind conditions should be monitored frequently, and work schedules adjusted as required. If workers show signs or symptoms of cold stress, the work schedule must be adjusted, as required.

9.2.3 Work/Warming Regimen

Work should be performed during the warmest part of the day. If work is performed continuously in cold or winter conditions or where rain or cool winds are expected, provide heated warming shelters, tents, cabins, or break rooms nearby. Encourage workers to use the shelter at regular intervals, depending on the severity of the cold exposure. **Table 9-4**, Cold Work/Warm-up Schedule for 4-Hour Shifts, provides guidance for working in severe cold weather. The onset of heavy shivering and/or the feeling of excessive fatigue, drowsiness, irritability, or euphoria indicate the need to immediately return to the shelter. Pain, numbness, or tingling in the extremities is indication of the need to immediately return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation, or the worker should change into dry clothing. Never return to work in wet clothing.

Table 9-3 Wind Chill Chart



Temperature (°F)

Wind (mph)

Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times ▨ 30 minutes ▨ 10 minutes ▨ 5 minutes

Wind Chill (°F) = $35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

Table 9-4 Cold Work/Warm-up Schedule for 4-Hour Shifts

Equivalent Chill Temperature	Maximum Work Period	Number of Breaks
≥–24 °F	Normal	1
-25 °F to –29 °F	75 minutes	2
-30 °F to –34 °F	55 minutes	3
-35 °F to –39 °F	40 minutes	4
-40 °F to -44 °F	30 minutes	5
≤–45 °F	Stop work	Stop work

9.3 WEATHER HAZARDS

It is possible that severe weather will occur during this project. In the event that a storm threatens the area through observation of a storm system (lightning observation and thunder), all field work will be halted and weather service bulletins and civil defense messages will be monitored on local radio or through cell phone applications. The SSHO will determine through visual observations and weather updates (gathered through the radio or cell phone) when it is necessary to halt work and when to re-start field activities, which include observing the "30-30" rule that states:

- If you see lightning and thunder is heard within 30 seconds (approximately 6 miles), seek shelter.
- If you hear thunder, but did not see the lightning, assume that lightning is within 6 miles and seek shelter.
- Remain in the shelter for 30 minutes following the last lightning strike.

When a tornado warning goes into effect, the following actions will be taken:

- If in your vehicle: Leave your vehicle and seek shelter in a sturdy building. As a last resort, seek shelter in a ditch or culvert.
- In buildings: Take shelter in an interior hallway on a lower floor. A closet, bathroom, or other small room with short, stout walls will give some protection from collapse and flying debris. Otherwise, get under heavy furniture and stay away from the windows.
- Out in open country: Seek inside shelter immediately. If a tornado approaches, lie flat in the nearest depression, such as a ditch or culvert, and cover your head with your arms.

Additionally, when wind speed exceeds 40 miles per hour (mph), the following actions will be taken:

- Follow manufacturer instructions in assessing the limitations associated with field equipment.
- Shut down outdoor activities involving work at elevation.
- Move mobile items stored outside to indoor locations.
- Secure any items that cannot be moved inside.
- Be careful opening exterior doors.
- Stay away from power lines.
- Be cautious about downed power lines, tree limbs, and debris on roads.

If weather remains unstable for more than 1 hour, the SSHO will monitor weather bulletins to further assess changing conditions.

10. STANDARD OPERATING SAFETY PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

Using common sense, operating under the “buddy system” (or two-person rule), and following safe practices can reduce the hazards of normal project activities.

The general site safety procedures contained in the EHS Program field operating procedures guide (which will be on-site) will be followed. No running or horseplay will be allowed at the Schenectady ANGB site.

10.1 SITE RULES/PROHIBITIONS

10.1.1 Buddy System

All work at the Schenectady ANGB site will be performed using the buddy system. Team members will keep in contact with each other at all times. Team members will be made aware of any slip, trip, and lifting hazards along with any potential exposure to chemical substances, heat or cold stress, and general hazards within their work area.

10.1.2 Designated Eating/Break Areas

Eating and break areas will be located away from the active work area. No food or beverages will be allowed in any work environments.

10.1.3 Designated Smoking Areas

All regulations governing approved areas for smoking and spark generation will be strictly followed. Smoking is prohibited except in designated smoking areas. The SSHO will identify designated smoking areas. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines.

10.2 WORK PERMITS

Any facility work permits will be obtained prior to accessing the site. None are anticipated at this time.

10.3 MATERIAL HANDLING PROCEDURES

Work areas and means of access will be maintained in a safe and orderly condition. Tools, materials, extension cords, hoses, or debris will not cause tripping or other hazards. Storage and construction sites will be kept free from the accumulation of combustible materials. There are no radioactive materials present on-site. Drum, container, and/or tank handling is not anticipated during this project. Spill contingencies are listed in Section 15.

10.4 SPILLS

Employees will be handling small quantities of fuel during brush clearing operations. Spill prevention measures and response procedures for small spills are provided in Section 15.

10.5 DRUM/CONTAINER TANK HANDLING

No drums or container handling will be part of this project.

10.6 DRUG AWARENESS AND DRUG-FREE WORKPLACE

A Drug and Alcohol Testing Procedure, which is in accordance with Federal Acquisition Regulation (FAR) Subpart 23.500, will be enforced. Strict disciplinary actions will be enforced for any violation of the Drug-Free Workplace policy.

The TEC-Weston JV subcontractors are expected to comply fully with the requirements of this policy and all provisions and clauses of the contract. Employee drug testing is not required in the performance of this contract.

While on duty, employees will not use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances. Employees found to be under the influence of or consuming such substances will be immediately removed from the job site. Contractors will also adhere to the drug-free workplace requirements.

Any employee under a physician’s treatment and taking prescribed narcotics or any medication, including over–the-counter medication, that may prevent a person from being ready, willing, and able to safely perform his/her duties will provide a medical clearance statement to his/her supervisor from the attending physician.

The Drug-Free Workplace policy includes supervisor training, a provision for self-referral to treatment, and maximum respect for individual confidentiality as well as a provision for identifying and dealing with illegal drug users, including testing. Education, counseling, rehabilitation, and coordination with available community resources will also be provided.

10.7 EMPLOYEE DUTY SCHEDULE/BASIC FATIGUE MANAGEMENT PLAN

10.7.1 Employee Duty Schedule

Personnel will follow the TEC-Weston JV's Employee Schedule. If extended periods of working long hours are required, the SSHO will monitor employees for outward signs of fatigue. Employee rotations may need to be adjusted to allow for individual differences in how fatigue-related stress is handled and for employee-specific roles on the project.

When employees are working extended hours, employee travel time to and from work will be minimized to allow for sufficient rest and travel time should be taken into account in determining limits on hours per day and per week. Group transportation to and from the work location and lodging will be used to address this situation. Consideration should be given to "awake" time and not just the hours logged on a time sheet.

10.7.2 Fatigue Symptoms

Intrinsic Symptoms

- **Physical —** Frequent, unexplainable headaches, muscle aches and pains, breathing difficulties, blurred/double vision, and/or burning urination.
- **Mental —** Difficulty focusing attention, distracted easily, depression, impaired judgment, and/or poor visual perception.

Extrinsic Symptoms

- **Physical —** Degraded motor skills, tenseness and tremors, intolerant/irritable, increased reaction time, and/or social withdrawal.
- **Mental —** Absentmindedness, poor short-term memory, lack of interest and drive, confusion and fearfulness, slow startle response, worry, and/or anxiety.

10.7.3 Fatigue Management

Project personnel should not work in excess of 84 hours per week (12 hours per day, 7 days per week) unless approved by the Project Manager.

10.8 SECURITY PLAN

10.8.1 Site Access

Visitors to the project are required to sign in with the SSHO, and the SSHO will document the presence of visitors in the logbook. Visitors will be escorted by site personnel.

10.8.2 Site Control

The Schenectady ANGB site is located within a secured area. Sign-in procedures for all project staff will be required for access to the site, and coordination with the facility will be conducted daily during site activities to ensure that all stakeholders are kept informed.

10.8.3 Theft

On-site theft of equipment is not expected. No equipment or valuable items will be kept inside vehicles. If it is necessary that equipment remain inside a vehicle, it will be kept out of obvious sight, and the vehicle will be locked and all windows closed. Personnel will secure vehicles, even if parking for only brief periods, and will carry vehicle keys with them at all times. Vehicles will be parked in well-lit areas.

In the event a theft does occur, local authorities will be promptly notified and appropriate TEC-Weston JV personnel will be notified. Notice of Incident (NOI)Track information will be completed within 24 hours.

10.8.4 Confrontation

Personnel will be observant of their surroundings. They should ensure their own safety, the safety of their co-workers, and the safety of the public by not confronting or challenging aggressive perpetrators. Schenectady ANGB security and the appropriate authorities should be contacted if site personnel observe any unusual circumstances.

10.9 MOTOR VEHICLE SAFETY

Safety is of utmost importance to the TEC-Weston JV. Employees must act responsibly every day to ensure the safety of themselves and others. This safety commitment also applies when driving vehicles. All employee drivers are required to operate vehicles safely, obeying federal, state, and local laws, and company policies. Driving is a privilege, not a right.

10.10 TRAFFIC

Posted speed limits will be obeyed at all times, and seat belts will be worn when driving. All drivers will be licensed. All sampling activities will be coordinated to minimize impacts to nearby traffic and roads, and safety distances shall be adhered to for all site activities.

10.10.1 Employee Requirements/Responsibilities

Compliance with all federal, state, and local laws is expected.

TEC-Weston JV drivers must possess a current, valid driver’s license of the appropriate class required for their driving needs, e.g., Class C, Commercial Driver’s License (CDL).

All driving duties and functions are to be performed in a safe, legal, and professional manner.

Employee drivers are to attend periodic defensive driving training and other driver safety meetings as scheduled through their local Safety Officers.

Driving requires a high level of skill and alertness. When fatigue, illness, or medication impact alertness, reflexes, and decision-making capabilities, an employee driver should cease driving until the situation improves or is corrected and contact his/her manager to discuss the situation.

Unsafe vehicles and related equipment will be reported and repaired. Unsafe vehicles are not to be driven for TEC-Weston JV business.

NOITrack will be used to report any vehicle accident while on the job or any accident occurring at any time if a company-owned or insured “allowance” vehicle is involved.

A driver orientation program and/or driving evaluation tests may be required of drivers to assess overall driving skills.

10.10.2 Compliance Issues/Driving Practices

10.10.2.1 Speed Limits

Drivers are required to obey posted speed limits and other traffic laws. Fines for any traffic violations are the employee's responsibility.

10.10.2.2 Seat Belts

The TEC-Weston JV drivers and their passengers are required to wear seat belts at all times while the vehicle is in operation.

10.10.2.3 Distracted Driving

It is recognized that distracted driving can contribute to accidents; accordingly, the TEC-Weston JV employees are to exercise caution and good judgment when driving. Reading maps, eating, placing or receiving a call on a cell phone, and other activities may contribute to an accident. Cell phone use while driving, including the use of hands-free devices, creates a distraction and driver inattention. The following basic guidelines should always be observed:

- Make outgoing calls after you have pulled over to a safe area.
- Let incoming calls go to voice mail, or if answering the phone is necessary, make sure the caller knows you are driving and keep the call short. Be aware of local or state laws governing the use of cell phones while driving.
- At all times, drivers are to operate vehicles in a safe, legal, and professional manner.

10.10.2.4 Transporting Weapons

Transporting weapons (such as firearms, large knives) or dangerous property (significant or placardable quantities of regulated hazardous materials or substances) is prohibited unless specifically authorized.

10.10.3 Other Issues

Additional safety procedures may be established at a particular job site or within a division. The TEC-Weston JV employees are responsible for compliance with any additional safety procedures and safety solutions that apply or that may be identified.

10.11 SANITATION

Employers will establish and maintain hygienic sanitation provisions for all employees in all places of employment. General housekeeping activities will occur daily.

10.11.1 Drinking Water

An adequate supply of potable water will be provided in all places of employment, for both drinking and personal cleansing. Cool drinking water (bottled water) will be provided.

10.11.2 Toilets

Toilets are required in all places of employment. Toilet facilities will be made available at Schenectady ANGB near the site activities. Hand soap or similar cleansing agents will be made available.

10.11.3 Procedures for Vermin Control

The work areas will be kept clean and organized. Organics, such as foods, will be wrapped and then properly discarded to avoid attracting pests.

10.11.4 Waste Disposal

A dumpster or other disposal container for garbage will be made available.

11. SITE CONTROL

The SSHO coordinates access control and security on-site. Because of the nature of the activities, only authorized personnel are allowed in the work zone. Authorized personnel are those who have completed the required training and who meet medical requirements. Unauthorized personnel will not be allowed in the work zone. The potential of cross-contamination is not applicable to this project based on the project characterization.

During on-site operations, the SSHO will order operations to cease if nonauthorized personnel are observed within the operating area. To ensure safety, site controls include the following:

- Eating, drinking, and smoking are prohibited except in designated areas.
- Operations will cease if nonauthorized personnel are present.
- The SSHO or his designee will escort authorized site visitors.
- All personnel entering the site, including visitors, will wear the proper PPE and sign in and out on the Site Control Log.
- The SSHO will maintain the Site Control Log to ensure accurate accountability of personnel on-site.
- The SSHO will provide an SSHP safety briefing to all personnel entering the Schenectady ANGB to inform them of potential site hazards. Personnel must acknowledge this briefing by signing the SSHP Review Form.
- In case of an emergency, personnel will exit the Schenectady ANGB and move to a designated safe area. The SSHO will determine the designated safe area and will notify the Project Manager and the EHS Leader if an emergency warrants site evacuation.

11.1 ON-SITE COMMUNICATIONS

In an emergency, important messages will be conveyed quickly and accurately. Verbal communication will be the primary form of communication at the Schenectady ANGB. The anticipated distance between the site workers will be no more than 1,000 yards. Verbal communication can be impeded by on-site background noise and the use of PPE. A vehicle horn or air horn will be available with each team for emergency alerting purposes.

Outside support sources will be reached, assistance obtained, and measures for public notification ensured, if necessary. Separate internal emergency signals will be developed and rehearsed daily at safety meetings. External communications will be obtained through cellular phones or radios located at the facility, and procedures will be posted in a location accessible to site workers.

The emergency telephone numbers, which are listed in **Tables 15-1** through **15-3**, will be prominently posted in the field vehicles. The emergency telephone numbers, along with the APP and SSHP, OSHA 300 Log, safety and health promotional posters, date of last work day injury, and OSHA Safety and Health poster, will be kept unobstructed and readily available to the workers.

12. PERSONAL HYGIENE AND DECONTAMINATION

12.1 CONTAMINATION PREVENTION

Based on field tasks and appropriate PPE usage, no contact with contamination is expected.

12.2 PERSONAL HYGIENE

Employees will practice sound hygiene practices, including washing hands, face, and arms at the hygiene station after operations have concluded. Appropriate hand-washing facilities with soap will be available at the facility. In addition, hand sanitizer will be available. Following Centers for Disease Control and Prevention (CDC) guidelines, personnel should wet their hands with clean running water and apply soap. Use warm water if it is available. Rub hands together to form lather and scrub all surfaces. Continue rubbing hands for 20 seconds. Rinse hands well under running water, then dry hands using paper towels. If possible, use that same paper towel to turn off the faucet. Good personal hygiene should be in effect at all times.

13. EQUIPMENT DECONTAMINATION

All equipment and tools will be cleaned prior to site entry to remove grease, oil, dirt, or any other off-site materials. The SSHO will inspect the equipment prior to approving the items for use on-site. The SSHO is responsible for inspecting equipment for adequate decontamination prior to removal off-site.

Sampling equipment will undergo a dry gross decontamination. Dedicated sampling equipment will be used to the extent practicable.

Decontamination of drilling equipment will be completed with detergent and water and a long-handled brush will be used to remove potential contamination from areas contacting surfaces of the exclusion zone (EZ) (i.e., tires, equipment bases, and shovels). Electrically powered equipment shall be de-energized prior to contacting water. Care shall be exercised to capture potentially contaminated wash water for subsequent testing and proper disposal. Systems for containing decontamination wash water include permanent decontamination pads with sumps, commercially available temporary decontamination pads, and tubs (for smaller equipment).

Personnel performing equipment decontamination will wear at a minimum Level D PPE.

13.1 DISPOSITION OF DECONTAMINATION WASTE

Any excess sample soil and decontamination fluids will be drummed after completing sampling. PPE and other disposable sampling equipment will be double-bagged and disposed of as solid waste.

No other investigation-derived waste (IDW) is anticipated during this sampling. If site information necessitates sampling additional matrices and using alternative sampling approaches, a change to this document will be completed detailing the IDW anticipated and the procedures and protocols required for disposal.

14. EMERGENCY EQUIPMENT AND FIRST AID EQUIPMENT

14.1 EMERGENCY EQUIPMENT

The emergency equipment listed in **Table 14-1** will be maintained in proper working order and frequently inspected for completeness during operations at the Schenectady ANGB site.

Table 14-1 Emergency Equipment

Equipment	Location	Operation
First-aid kit	Support vehicle(s)	All operations
BBP kit	Support vehicle(s)	All operations
Eye wash	Support vehicle(s)	All operations
10-lb ABC fire extinguisher	Support vehicle(s)	All operations
Allergy response kit	Support vehicle(s)	All operations

14.2 FIRST RESPONDER KIT

Medical supplies required to be on-site are listed in **Table 14-2**. The minimum requirements of ANSI Z308.1-2009 and EM 385-1-1, 14 November 2014, Section 03.B will be met. Documented monthly inspections of first-aid kits will be performed by the SSHO.

Two appropriately trained TEC-Weston JV or subcontractor personnel will provide on-site first aid/CPR support. In the event that specialized/elevated care is necessary, either the TEC-Weston JV personnel or the on-call ambulance service will transport the injured person to the appropriate medical facility.

Personnel needing basic first-aid treatment will also be documented as discussed in Subsection 15.7.4. An updated copy will be sent to the EHS Leader monthly to watch for trends in minor incidents.

Table 14-2 Contents for First Responder Kit

Description	Qty	Description	Qty
Absorbent compress, 32 sq. inches	1	Adhesive Tape, 3/8"x 5 yds	1
Adhesive Bandages, 1"x 3"	16	Analgesic/ pain reliever	16
Antibiotic Treatment, 1/32 Oz.	6	Antiseptic Wipes	6
Bandage Compress, 2" x 36"	4	Bandage Compress, 3" x 36"	2
Bandage Compress, 4" x 36"	1	Breathing Barrier	1
Burn Dressing, 4" x 4"	1	Burn Treatment, 1/32 Oz.	6
CleanseAway Poison Oak & Ivy Cleanser	1	Cold Pack, 4"x 5"	1
Eye Covering, 2.9 sq. inches per eye	2	Eye Wash, 4 Oz.	1
Medical Exam Gloves	2 pair	Roller Bandage, 2" x 6 yds	2
Roller Bandage, 4" x 6 yds	1	Sterile Pad, 3" x 3"	4
Triangular Bandage, 40 x 40 x 56 inches	1		
Contents for BBP Kit			
Breathing Barrier	1	Bodily Fluid Disposal Kit	1
Medical Exam Gloves	1 pair	PDI SaniCloth wipes	2

15. EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

15.1 EMERGENCY PROCEDURES

The site evacuation route and predetermined meeting location map will be developed and posted prior to mobilization. The evacuation route and predetermined meeting location map will be reviewed with all employees prior to the start of work and prior to the start of each new task.

Within a few days of the startup of work, a drill will be run for the emergency response plan. The TEC-Weston JV has evaluated the emergency medical services. The SSHO will have a roster of individuals on-site so that they can be accounted for in the event of an emergency.

15.2 PERSONNEL AND LINES OF AUTHORITY FOR EMERGENCY SITUATIONS

Fire and Emergency Medical Services (EMS) will provide support as necessary. The SSHO will be appointed as an Emergency Coordinator (EC), and a system will be implemented to provide a common framework within which people can work together effectively.

15.3 CRITERIA AND PROCEDURES FOR EMERGENCY RECOGNITION AND SITE EVACUATION

15.3.1 Medical Emergency and Personal Injury

The first worker who notices that a medical emergency or personal injury has occurred will immediately make a subjective decision whether the emergency is life-threatening and/or otherwise serious and will then proceed as described in the following subsections.

15.3.2 Life-Threatening and/or Otherwise Serious Incident

If a life-threatening and/or serious incident occurs, emergency medical assistance will be immediately requested. The first person who identifies the situation will contact the Fire Department. After contacting the Fire Department, the SSHO or Site Manager will be notified, who will notify the NGB Program Manager and the ANG Installation Environmental Manager. The SSHO or Site Manager, whoever arrives first, will assume the role of EC. The EC will be apprised of the situation and told where the injured person(s) is/are located. As the EC proceeds to the accident scene, communications channels will be opened and kept on standby until the EC has surveyed the scene and performed a primary survey of the injured person. The EC will then determine whether emergency assistance should be summoned and the information that must be relayed, and will provide emergency action principles that are consistent with the injury. The EC will appoint a staff person or persons who will meet the emergency responders and take them quickly to the injured person. The NGB Program Manager, ANG Installation Environmental Manager, and ANGB security will be notified of any incident.

15.3.3 Non-Life-Threatening Incident

If it is determined that no threat to life is present, the worker will assist the injured person to a safe location and contact the SSHO. The injured person will then be treated and monitored in accordance with standard first-aid procedures and this SSHP.

15.3.4 Worker Injury or Illness

The SSHO will be responsible for monitoring the general health of site workers. Site illnesses, conditions, or injuries that can be expected given the working conditions include heat stress, construction-related injuries, insect bites, and injuries caused by slips, trips, and falls.

These conditions will be prevented by properly training site workers in the appropriate use of health and safety equipment, dressing appropriately, monitoring the breathing zone atmosphere when necessary, and maintaining good housekeeping procedures.

The specific response to an injury or illness will depend on its type and severity, but in general, first aid will be administered in the field by the SSHO, who is certified in first aid and CPR. The worker may then be transported to the hospital designated in this SSHP (see **Table 15-1** and **Figure 15-1** for hospital information and directions). General guidelines for first aid are as follows:

- For minor injuries, routine first-aid procedures will be used and documented.
- For major injuries, an ambulance will be called immediately and the appropriate first aid administered while awaiting arrival of the ambulance.
- Trained personnel will use approved measures to administer treatment.

15.3.5 Emergency Response

During an emergency, the following actions will be taken, with some actions conducted concurrently. No one will attempt emergency response/rescue until the situation has been assessed and the appropriate response outlined. Emergency response planning may involve the following circumstances or activities:

- Fire or explosion and prevention
- Spills and spill prevention
- Inclement weather
- Evacuation planning

The minimum actions taken in case of emergency will be as follows:

- All work will cease.
- All affected employees and subcontractors will be warned/notified of the emergency.
- The area will be isolated.
- Appropriate notifications will be made.

Rescue/response may include the following:

- Assess: Assess existing and potential hazards to site personnel and the off-site population.
- Determine:
  - Whether and how to respond.
  - The need for evacuation of site personnel and off-site population.
  - The resources needed for evacuation and response.
- Survey Casualties:
  - Locate all injured persons and assess their condition.
  - Determine resources needed for stabilization and transport.
- Request Aid: Contact the required off-site/on-site personnel or facilities, such as the ambulance, fire department, and/or police.
- Allocate Resources: Allocate on-site personnel and equipment to rescue and initiate incident response operations.
- Extricate: Remove or assist injured persons from the area, using appropriate PPE equipment and procedures.

- Control: As trained, and as determined safe, assist in bringing the hazardous situation under complete or temporary control and use measures to prevent the spread of the emergency.
- Decontaminate (if necessary): Remove any protective clothing.
- Stabilize: Administer any medical procedures that are necessary before the injured person(s) can be moved. Stabilize or permanently fix the hazardous condition. Attend to what caused the emergency and anything damaged or endangered by the emergency.
- Transport: Transport personnel following any necessary decontamination for unforeseen or unexpected potential exposure or measures necessary to avoid contaminating others.
- Log Casualties: Record name of individual, time, destination, and condition upon transport.
- Evacuate:
    - Move site personnel to a safe distance upwind of the incident.
    - Monitor the incident for significant changes. The hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.
- Casualty Tracking: Record disposition, condition, and location.
- Notification: Notify appropriate individuals/entities.

15.3.5.1 Evacuation Routes and Procedures

Personnel will exit the site by the nearest means of egress during accidents requiring evacuation. Once personnel are off-site, the personnel will assemble at a location designated by the SSHO for accountability. Any missing personnel will be brought to the attention of the emergency responders.

15.3.5.2 Emergency Alarm Systems

Portable telephones will be available for site and emergency communications (Project Manager, SSHO, and field staff). In addition, equipment spotters will be provided with emergency air horns to alert all personnel to stop work immediately. All field personnel will be trained regarding site emergency signals.

Emergency service personnel (police/fire/ambulance) will be summoned by requesting support from the Department of Emergency Services personnel. Emergency contact numbers are provided in **Tables 15-1** through **15-3,** and the hospital location and directions from the Schenectady ANGB site are provided in **Figure 15-1**.

15.3.5.3 Hand and Emergency Signals Communications

It is essential that workers have a means of communicating rapidly and effectively during heavy equipment operations, construction, hazardous waste operations, and other types of activities. Communication while wearing PPE can be extremely difficult. The following information provides guidance for uniform communication protocols to be used, as needed, in field operations. **Tables 15-4** and **15-5** present emergency and general hand signals for uniform communication use.

15.3.5.4 Emergency Signals

Emergency signals are critical for alerting workers of danger and for maintaining site control during an emergency. Bullhorns, radios, air horns, and similar devices will be used as described below for emergency communications. Emergency hand signals should be used as a secondary means of communication.

Table 15-1 Emergency Contact Numbers

Organization/Point of Contact	Telephone Number
Department of Emergency Services (Ambulance, Fire, Police)	911
Thomas Corners Fire District	(518) 399-5621
Glenville Police Department	(518) 384-0123
Emergency Hospital: Ellis Hospital 1101 Nott Street Schenectady, NY 12308	(518) 243-4121

Table 15-2 TEC-Weston JV Emergency Contact Numbers

Organization/Point of Contact	Telephone Number
PM: Joseph Gross, P.E.	(410) 612-5910 (office) (410) 937-9697 (cell)
Program Health and Safety Officer: Thomas Koch, CIH	(303) 273-0231 (office) (303) 503-0442 (cell)
EHS Leader: Larry Werts	(610) 701-3912 (office) (215) 815-6237 (cell)
Medical Programs Manager: Herold Hannah, CIH	(610) 701-3024 (office) (267) 516-0274 (cell)

Table 15-3 Other Emergency Contact Numbers

Organization/Point of Contact	Telephone Number
Poison Control Center	(800) 962-1253
ChemTel (Acct. # MIS0003701)	(800) 255-3924
Spill Response - CHEMTREC	(800) 424-9300
National Response Center	(800) 424-8802
WorkCare Intervention	(888) 449-7787
WorkCare Medical Director: Dr. Peter Greaney WorkCare Program Administrator Heather Lind	From 06:00 to 16:30 Pacific Time, call (800) 455-6155 dial 0 or extension 175, Heather Lind to request the on-call clinician
WorkCare After-Business Hours Contact (Emergency Only)	16:31 to 05:59 Pacific Time and weekends and holidays, call (800) 455-6155 and dial 3 to reach the after-hours answering service. Request that the service connect you with the on-call clinician or the on-call clinician will return your call within 30 minutes.

Table 15-4 Emergency Signals

Signal	Meaning
One long sound/blast of the emergency alarm signal, air horn, siren, whistle	Emergency situation: face safety watch and watch or listen for directions
Pause; followed by a number of short sounds, 1, 2, 3, or 4	Evacuate to the predesignated emergency meeting place indicated by the number of sounds
Two long blasts of the emergency alarm signal, air horn, siren, whistle	All clear
Point one arm in direction of evacuation, make a large circling motion with the other arm in direction of evacuation	Evacuate the area
Hand clutching throat	Cannot breathe; out of air
Grip partner’s wrist or place both hands around partner’s arm	Leave area immediately

Table 15-5 General Hand Signals

Signal	Meaning
Point index finger toward self	I; me
Point index finger toward object	It; them
Point index finger toward person	You; them
Circle index finger at group	We; us; all of us
Pointed finger on extended arm	Look in that direction
Beckon with index finger	Come here
Point with thumb in a particular direction	Move this way; go this way
Hold index finger up near head	Wait
Slowly ease palm face down	Relax; slow down
Put palm over brow	Scout it out; check it out
Move hand far away from body	Stay away
Hands on top of head	Need assistance
Grip partner’s wrist or place both hands around partner’s arm	Leave area immediately
Thumbs up	OK; I’m all right
Thumbs down	No; negative; bad; not OK
Hand gripping throat	Cannot breathe; out of air
Wave hands over head from side-to-side	Attention; stand-by for the next signal

Table 15-5 General Hand Signals (Continued)

Signal	Meaning
Swing hand from direction of person receiving signal to directly overhead and through in circle	Come here
Clenched fist of extended arm	Stop motion/hold position
Draw index finger across front of throat	Shut off engine; cut off power; quit
Place palm face down and rotate from side to side	Unsure; can't decide
Form a circle with thumb and index finger	OK; I understand; agree
Military salute	I understand and will comply

15.3.5.5 Radio Communications

When radio communication will be used, personnel will be instructed about the use of the radio, which channel should be used, and the following radio guidelines. TEC-Weston JV staff will confirm radio channels with Schenectady ANGB. Personnel will use the radio only for necessary work-related communication and will use the following procedures:

- Speak clearly.
- Call the name or call sign of the individual or unit you are trying to reach, and identify yourself (e.g., "Unit 1; this is Safety").
- Wait for acknowledgement (e.g., "Safety, this is Unit 1") before you continue transmission.
- Proceed with your transmission. When finished, say "Over" when you expect a response. When transmission is complete and no response is expected, say "Out."
- When receiving a radio call, acknowledge the call immediately unless doing so would interfere with safety.
- If a transmission is incomplete or not understood, request clarification.
- Emergency calls should begin with the words "Emergency, Emergency, Emergency." Give absolute priority to emergency communication. Unless answering or aiding the emergency call, do not use the radio until certain it will not interfere with further emergency communication.
- Ensure that radios are charged and tested prior to each work shift and as necessary thereafter.

- Malfunctioning radios must not be used and must be replaced immediately.
- Do not transmit false information or unidentified communication.
- Profanity and indecent language are prohibited. Transmittal of sensitive information over the radio is prohibited.

15.3.5.6 Decontamination and Medical Treatment of Injured Personnel

If medical treatment is required for injured personnel, emergency decontamination will be conducted, including removal of any PPE and visibly contaminated clothing or footwear.

15.3.5.7 Emergency Medical Facilities and Phone Numbers for Responders

The emergency telephone numbers listed in **Tables 15-1** through **15-3** will be prominently posted in site vehicles. The emergency telephone numbers, along with the APP and SSHP, OSHA 300 Log, deficiency tracking system documents, safety and health promotional posters, date of last work day injury, and OSHA Safety and Health poster, will be kept unobstructed and readily available to the workers.

15.3.5.8 Criteria for Alerting Local Community Responders

In the event of an emergency requiring outside emergency services, the TEC-Weston JV personnel will immediately dial 911 to contact the appropriate organization. Following the phone call, personnel will contact on-site personnel to inform them that emergency service personnel and equipment will be entering the work area. Subsequent to these notifications, appropriate TEC-Weston JV personnel will be contacted and informed regarding the situation.

15.4 SPILL PLAN

The following procedures comprise the spill containment program in place for activities at the Schenectady ANGB. Spill procedures will be reviewed by the SSHO with team members.

15.4.1 Measures for Preventing Fuel Spills

- Care shall be taken when transferring fuels.
- A containment dike around fuel storage tanks shall be constructed.
- Inspect all fuel storage tanks and containment structures for leaks daily.

- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (e.g., absorbent, pillow, shovels) will be stationed in the immediate area. The spill containment equipment must be sufficient to contain and isolate the entire volume of fuel being transferred.
- Fire-extinguishing equipment meeting 29 CFR Part 1926, Subpart F, shall be on hand and ready for use to control fires.

15.4.2 Fuel Spills Greater than Five Gallons

The following response procedures shall be followed for spills of flammable fuels greater than 5 gallons in volume:

- Shut down operation in area immediately.
- Limit ignition sources.
- Suppress vapors as required.
- Survey area with combustible gas indicator (CGI) if available; don protective equipment as necessary.
- Pump liquids into drums.
- Recover contaminated solids and place in containers.
- Clean up all residues.

15.5 FIREFIGHTING PLAN

Potential sources of fuel include grass and leaves. Types of fire suppression systems include multipurpose ABC portable fire extinguishers. In case of fire, evacuate the area immediately. Activate 911 or the established Fire Emergency Number from a safe location. Indicate what is happening, the location of the fire, and whether there are injuries. Comply with requests from the 911 operator for information. Do not hang up until told to do so by the operator, or allow the operator to hang up first. Upon completion of the emergency phase, comply with incident notification procedures.

If the fire is small and manageable with fire-extinguishing equipment at hand, and you are trained in the use of this equipment, you may make the decision to use this equipment while waiting for advanced assistance. Never place yourself in danger, always have a plan for escape, and never attempt to fight a fire if there are any doubts about the type of fire or your ability to successfully fight the fire. Never allow the fire to get between you and your escape route.

15.5.1 Fire Extinguishing Equipment

Fire extinguishing equipment that meets 29 CFR Part 1926, Subpart F, will be on hand and ready for use to control fires. The following procedures will be followed:

1. Flammable and Combustible Materials (liquids, gases):
    - Flammable materials must be properly labeled, stored, handled, and used.
    - No smoking or use of open flame-producing devices within 50 feet of flammable and combustible materials.
    - Obtain SDSs for all flammable materials in use and ensure all personnel are aware of hazards.
    - Label all containers with the contents, the word “Flammable”, and in accordance with hazard communication requirements.
    - Store materials in well-ventilated areas that are free of ignition sources and flame or sparks.
    - Ensure that incompatible materials are stored in remote locations from each other (e.g., keep flammables from oxidizers).
    - Limit quantities to minimum required.
    - Store cylinders in upright and secure positions.
    - Bond and ground containers as (and where) necessary.
    - Use proper storage cabinets for flammable and combustible materials. Contact EHS Staff for assistance.
    - Use only approved containers.
    - Use and dispense only in well-ventilated areas.
2. Combustible Materials (solids):
    - Solid combustible materials include wood, paper, and cloth. Proper housekeeping reduces concerns for combustion of these materials. Use proper receptacles for disposal, and dispose of solid combustible materials routinely.

3. Oxidizers:

    - An oxidizer is a substance that increases the flammability of materials, allowing them to burn more easily. Examples include pure oxygen, chlorine, and ammonium nitrate. Store oxidizers in a remote location from flammable and combustible materials.

4. Electric Appliances:

    - Do not use electric appliances near flammable or combustible materials. Never place an appliance on an unstable surface. Use only Underwriters Laboratories, Inc. (UL)- or Factory Mutual Research Corp. (FM)-approved appliances. Follow the manufacturer's recommendations or requirements for use and maintenance.

5. Smoking:

    - Smoking is prohibited indoors. Smoking is allowed only in outdoor, designated areas. Smokers are to maintain smoking areas in a clean and safe condition. Ensure that receptacles for disposal of cigarettes and other smoking materials are appropriately constructed, free of combustible debris, and, when necessary, are cool before emptying into waste receptacles.

6. Housekeeping:

    - Personnel are responsible for keeping work areas free of combustible materials and debris.
    - Weeds and grass must be properly maintained to limit potential fire hazard.
    - The SSHO will document and inspect all project fire extinguishers on a monthly basis.

15.6 WILD FIRES

15.6.1 Prevention

Site personnel should practice smart fire safety habits and watch out for hazardous conditions. If conditions are dry, wild fires can pose a threat—not only because there is plenty of fuel to burn, but also because rural areas and remote locations often do not have easy access for firefighters. There also is a chance that embers from a fire a mile or more away may fall onto nearby vegetation and cause them to catch fire. The following preventive measures will be observed:

- Smoke only in designated areas.
- Avoid driving through high grass or areas where vehicle exhaust or hot engine surfaces could cause fires.

- Keep a fire extinguisher handy.
- Be extra cautious during the dry season and observe warnings and prohibitions established by the Forestry Service or other agencies.
- Be aware of wild fires in neighboring areas.

15.6.2 Awareness and Response

Wild fires can spread quickly and without warning. A subtle shift in the wind could send the flames in your direction even though authorities may have deemed your area safe. Make sure you have a plan in place:

- Be aware of wild fires in neighboring areas.
- Do not attempt to fight forest fires. If fire or smoke is observed, notify all site personnel, initiate evacuation, and report the fire to the designated emergency agencies.
- Designate a place to meet if there is a fire.
- Identify multiple places you could evacuate to, such as a motel outside the danger zone.

It is very easy to panic, but if you remain calm and prepare for emergency situations, you will increase your chances of evacuating safely. If you are driving:

- Roll up your windows and close your air vents.
- Drive slowly and turn on your headlights.
- Do not drive through heavy smoke.

15.7 MEDICAL SUPPORT

15.7.1 On-Site Medical Support

In the event specialized/elevated care is necessary, either the TEC-Weston JV personnel or the local on-call ambulance service will transport the injured person to the hospital. The local Fire and EMS Department can be notified of emergency situations by using the telephone numbers listed in **Table 15-1**. There will be fewer than 100 people on-site; therefore, the TEC-Weston JV will not be providing on-site medical support.

A first aid kit complying with the criteria contained in ANSI Z308.1-2009 will be provided on-site.

- For minor injuries, routine first aid procedures will be used and documented.
- For major injuries, an ambulance will be called immediately, and the appropriate first aid administered while awaiting the arrival of the ambulance.
- Trained personnel will use approved measures for treatment based on the training they have received.

15.7.2 Off-Site Medical Support

The TEC-Weston JV has contacted the local emergency resources to verify their availability and ability to respond to any emergencies encountered.

15.7.3 Directions and Map to Nearest Hospital

The appropriate emergency vehicle will travel to the closest emergency hospital to Schenectady ANGB, which is the Ellis Hospital (see **Figure 15-1)**. **Figure 15-1** shows the route to the hospital from the Schenectady ANGB site (the driving distance is approximately 3.6 miles and the driving time is approximately 9 minutes). A map showing the route will be posted near the site telephone and in each site vehicle, and a written description of the route is included on the map. The hospital route will be verified prior to work initiation in case of unforeseen construction or other changes in the route.

15.7.4 First Aid Treatment

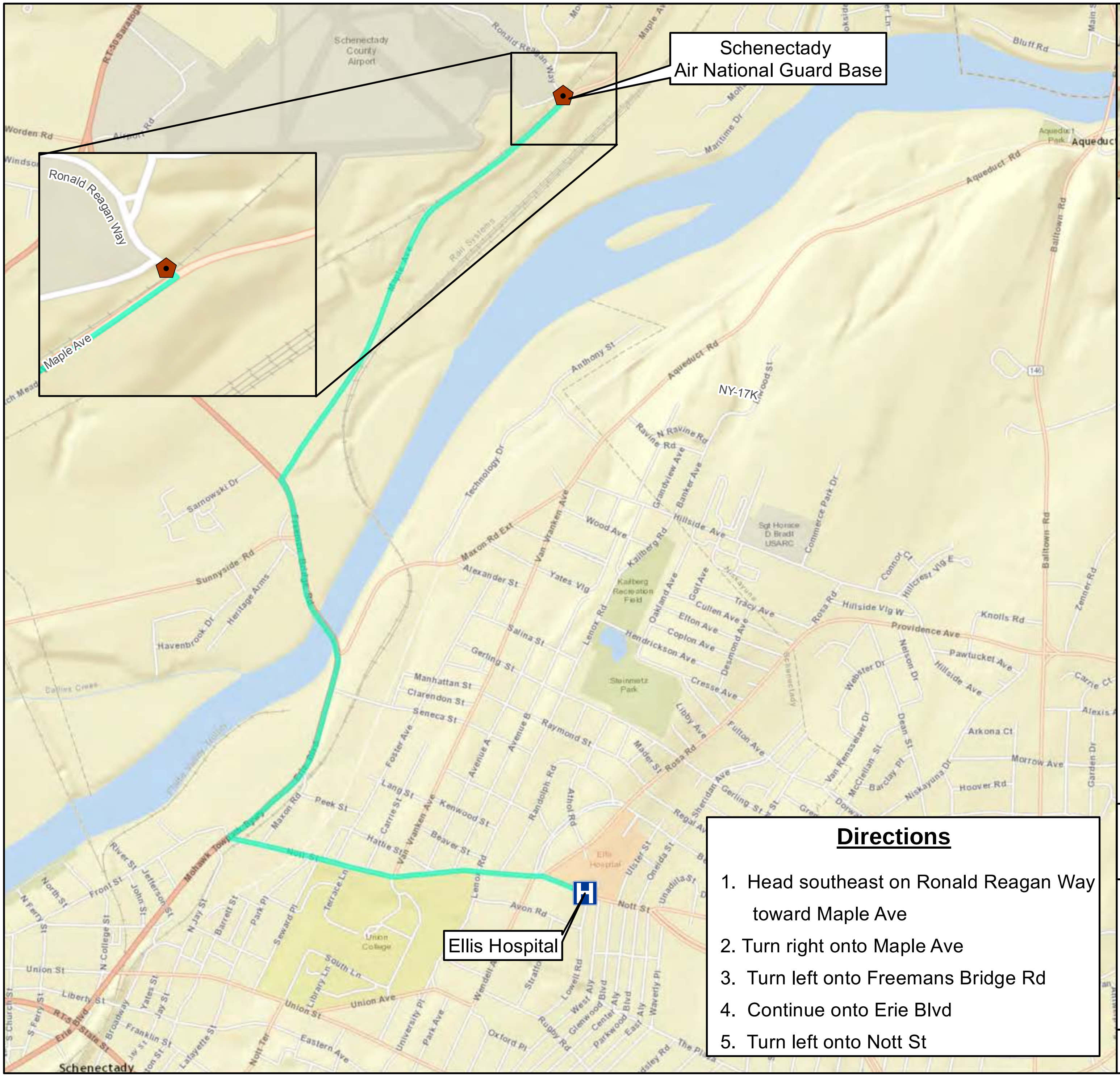
Personnel needing basic first-aid treatment will also be documented using the form presented as **Figure 15-2**. An updated copy will be sent to the EHS Leader monthly to watch for trends in minor incidents.

Copies of certifications for the individuals presented in **Table 15-6** are presented in Attachment B of the APP. The individuals presented below are included to ensure that all staff that may be present during field activities are listed.

Table 15-6 First Aid and CPR Training

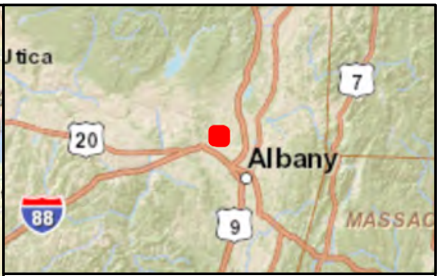
Personnel Name	First Aid (expires)	CPR (expires)	Bloodborne Pathogens Refresher (expires)
Louise Kritzberger	2/18/2017	2/18/2017	8/3/2016
Dan Locurcio	6/8/2017	6/8/2017	12/10/2016
Tom Dakin	12/1/2016	12/1/2016	10/7/2016
Robert Wagner	1/19/2018	1/19/2018	10/7/2016
Michael Argue	2/17/2018	2/17/2017	1/27/2017
Brenden Beaumont	11/11/2017	11/11/2017	3/27/2017
Paul Landry	1/19/2018	1/19/2018	10/7/2016
Robin Dermigny	1/26/2017	1/26/2017	3/27/2017
Dane Kormos	12/01/2017	12/01/2017	2/28/2017
Dave Sena	1/19/2018	1/19/2018	4/13/2017
Craig Anderman	12/01/2017	12/01/2017	4/13/2017
Mary Boggs	7/24/2016	7/24/2016	8/20/2016
Brian Tolton	1/19/2018	1/19/2018	2/10/2017
Zachary Taylor	3/28/2018	3/28/2018	NA

Note: PM will ensure all field personnel are current with their certifications prior to the start of field work.



Directions

1. Head southeast on Ronald Reagan Way toward Maple Ave
2. Turn right onto Maple Ave
3. Turn left onto Freemans Bridge Rd
4. Continue onto Erie Blvd
5. Turn left onto Nott St



LEGEND

⬟ Schenectady Air National Guard Base

H Ellis Hospital

— Hospital Route

N

0 0.25 0.5

Miles

Imagery Source: ESRI Imagery Mapping Service, 2013

Cardno TEC WESTON SOLUTIONS

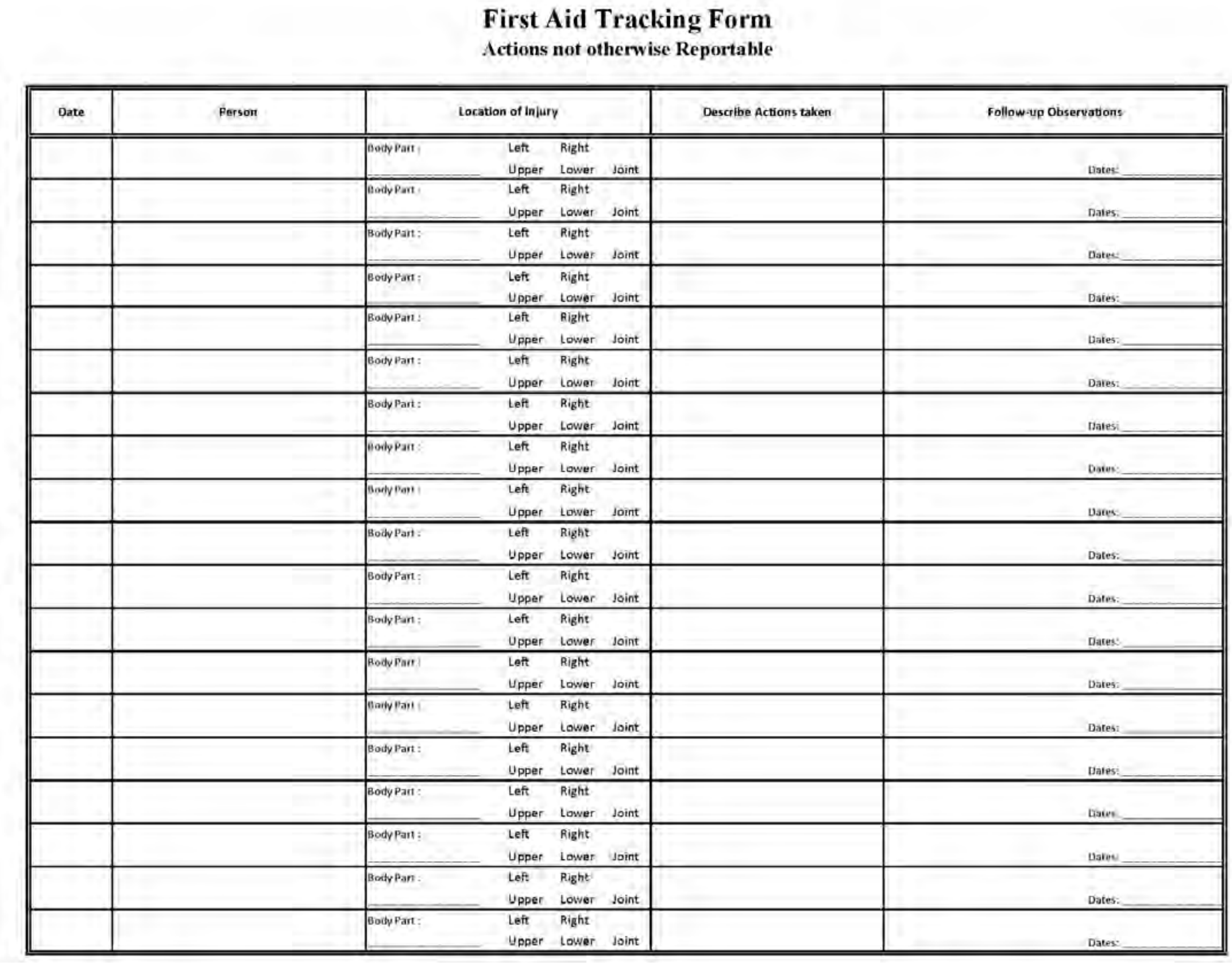
TEC-Weston Joint Venture

FIGURE 15-1
HOSPITAL ROUTE MAP
SCHENECTADY ANG BASE
SCOTIA, NEW YORK

DATE	PROJECT NO	SCALE
FEB 2016	15363.100.005.1101	AS SHOWN

FILE: Y:\ANG_NE_Sites\Schenectady_ANG\MXD\Hospital_Route.mxd 7:34:29 AM 2/16/2016 ricksc

Figure 15-2 First Aid Dealings Not Otherwise Reportable



First Aid Tracking Form

Actions not otherwise Reportable

Date	Person	Location of Injury	Describe Actions taken	Follow-up Observations
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____
		Body Part : ____ Left Right Upper Lower Joint		Dates: ____

16. LOGS, REPORTS, AUDITS, INSPECTIONS, AND RECORDKEEPING

16.1 SAFETY LOG

The SSHO will maintain a safety log of all safety-related activities. The SSHO is responsible for ensuring that health and safety activities for the day, as well as safety meeting minutes, are documented in the safety log or filed appropriately. In addition, the SSHO will maintain a site OSHA 300 log.

16.2 TRAINING LOG

The SSHO is responsible for ensuring that all training conducted relative to job site activities is documented appropriately.

16.3 SITE CONTROL LOG

A log of all personnel visiting, entering, or working at the Schenectady ANGB site will be maintained. The log will include the following: date, name, agency or company, and the time entering and exiting the site. This information, including dates, will be recorded in the site control log.

16.4 INSPECTION FORMS

Daily safety and health inspections will be conducted by the SSHO with the results recorded in the safety log. The SSHO will conduct periodic safety and health audits to ensure site personnel are performing the tasks in accordance with the work plan and this SSHP.

The SSHO will also complete the Site-Specific Hazard Communication Checklist (see **Attachment 1**) and ensure that it is kept up to date.

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ATTACHMENT 1

SITE-SPECIFIC HAZARD COMMUNICATION PLAN/CHECKLIST

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SITE-SPECIFIC HAZARD COMMUNICATION PLAN/CHECKLIST

To ensure an understanding of and compliance with the Hazard Communication Standard, the TEC-Weston JV will use this checklist/document (or similar document) in conjunction with the TEC-Weston JV Written Hazard Communication Program as a means of meeting site- or location-specific requirements.

Although responsibilities for activities within this document are the primary responsibility of the TEC-Weston JV Site Safety and Health Officer (SSHO), it is the responsibility of all the TEC-Weston JV and subcontractor personnel to ensure compliance. Responsibilities under various conditions can be found within the TEC-Weston JV Written Hazard Communication Program.

To ensure that information about the dangers of all hazardous chemicals used by the TEC-Weston JV is known by all affected employees, the following hazard communication program has been established. All affected personnel will participate in the hazard communication program. This written program, as well as the TEC-Weston JV's Hazard Communication Program, will be available for review by any employee, employee representative, representative of Occupational Safety and Health Administration (OSHA), National Institute for Occupational Safety and Health (NIOSH), or any affected employer/employee on a multi-employer site.

☐ Site or other location name/address: Schenectady ANGB
☐ Project Manager: Joseph Gross, P.E.
☐ Site/Location Safety Officer: L. Kritzberger; D. Locurcio; T. Dakin, R. Wagner, M. Argue, B. Beaumont
☐ List of chemicals compiled, format: HASP: ⊗ Other:
☐ Location of SDS Files: SSHO vehicle
☐ Training Conducted by: Name: Date:
☐ Indicate format of training documentation: Field Log: ☒ Other: Follow-up meetings
☐ Client briefing conducted regarding hazard communication: Entry
☐ If multi-employer site (client, subcontractor, agency, etc.), indicate name of affected companies: Subcontractor
☐ Other employer(s) notified of chemicals, labeling, and SDS information: All subs and vendors:
☐ Has the TEC-Weston JV been notified of other employer's or client's hazard communication program(s) as necessary?

List of Hazardous Chemicals

A list of known hazardous chemicals used by the TEC-Weston JV personnel must be prepared and available in a centrally identified location with the Safety Data Sheets (SDSs). Further information on each chemical may be obtained by reviewing the appropriate SDSs. The list will be arranged to enable cross-reference with the SDS file and the label on the container.

Container Labeling

The SSHO will verify that all containers received from the chemical manufacturer, importer, or distributor for uses on-site are clearly labeled.

The SSHO is responsible for ensuring that labels are placed where required and for comparing SDS and other information with label information to ensure correctness.

Safety Data Sheets (SDSs)

The SDSs will be obtained for all hazardous materials to be used in performance of this contract in accordance with Federal Acquisition Regulation (FAR) 52.223-3. These SDSs and an inventory of hazardous material will be compiled prior to bringing the material on-site. SDSs will be maintained at the job site and available to all employees and inspectors. The subcontractor must have an active Hazardous Communication Program in place for all employees as required by Code of Federal Regulations (CFR) 29 CFR 1910.1200. To assist this effort, the SSHO is responsible for establishing and monitoring the SDS program for the location. The SSHO will ensure procedures are developed to obtain the necessary SDSs and will review incoming SDSs for new or significant health and safety information. He/she will inform affected employees of any new information. If an SDS is not received at the time of initial shipment, the SSHO will contact the manufacturer and request delivery of an SDS for that product, in accordance with the requirements of the Hazard Communication Program.

The SSHO will maintain an SDS file that contains a log of, and copies of, SDSs for all hazardous chemicals in use at the site, and inform all site workers of the file’s location. SDSs will be readily available to all employees during each work shift. If an SDS is not available, immediately contact the TEC-Weston JV SSHO or designated alternate. When a revised SDS is received, the SSHO will immediately replace the old SDS.

Employee Training and Information

The SSHO is responsible for the TEC-Weston JV site-specific personnel training program. The SSHO will ensure that the following program information is supplied to all affected employees.

At the time of initial assignment for employees to the work site or whenever a new hazard is introduced into the work area, employees will attend a health and safety meeting or briefing that includes the information indicated below:

- Hazardous chemicals present at the work site.
- Physical and health risks of the hazardous chemicals.

- Signs and symptoms of overexposure.
- Procedures to follow if employees are overexposed to hazardous chemicals.
- Location of the SDS file and written hazard communication program.
- How to determine the presence or release of hazardous chemicals in the employee’s work area.
- How to read labels and review SDSs to obtain hazard information.
- Steps the TEC-Weston JV has taken to reduce or prevent exposure to hazardous chemicals.
- How to reduce or prevent exposure to hazardous chemicals through use of control procedures, work practices, and personal protective equipment (PPE).
- Hazardous, nonroutine tasks to be performed (if any).
- Chemicals within unlabeled piping (if any).

Hazardous Nonroutine Tasks

When employees are required to perform hazardous nonroutine tasks, the SSHO will provide affected employee(s) with information about the hazardous chemicals he or she may be using during such activity. This information will include specific chemical hazards, protective and safety measures the employee can use, and steps the TEC-Weston JV is using to reduce the hazards. These steps include, but are not limited to, ventilation, respirators, presence of another employee, and emergency procedures.

Multi-Employer Worksites

The SSHO is responsible for providing other employers with information about hazardous chemicals imported by the TEC-Weston JV to which their employees may be exposed, along with suggested safety precautions. The SSHO is responsible for obtaining information about hazardous chemicals used by other employers and that the TEC-Weston JV employees may be exposed to. The TEC-Weston JV’s chemical list will be made available to other employers upon request. SDSs will be provided as necessary.

The location, format, and/or procedures for accessing SDS information must be relayed to affected employees.

Hazardous Chemicals

Potentially Brought to Site

The hazardous materials that may be used on-site are presented in the following list, and Safety Data Sheets (SDSs) for all reagent type chemicals, solutions, or other identified materials are presented in **Attachment 2**. All subcontractors and other parties working nearby will be informed of the presence of these chemicals and the location of the SDSs.

Chemical Name	Quantity

ATTACHMENT 2

SAFETY DATA SHEETS

(Will be provided on-site)

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ATTACHMENT B

RESUMES AND CERTIFICATIONS FOR IDENTIFIED SAFETY PERSONNEL

Name	**Employed By:**
THOMAS KOCH, C.I.H.	Cardno
Education and Training	**Professional Registration /Certification(s)**
MA, Environmental Policy and Management, 1994 BS, Biology, 1986	Certified Industrial Hygienist: October 1994, American Board of Industrial Hygiene; Certified Asbestos Building Inspector; Certified Asbestos Air Monitoring Specialist, Certified Asbestos Project Designer
Total Years EH&S Consulting Experience: 25	**Experience Gov Projects: 20**

<table>
<tr><th colspan="3">Special Qualifications and Experience Record from Last Five Years</th></tr>
<tr><td colspan="3">Remedial Investigation: Munitions Response Site Interim Removal Action, Arnold Air Force Base, TN</td></tr>
<tr><td><i>Start Date:</i> 10/4/14</td><td><i>Completion Date:</i> 7/27/15</td><td><i>Cost:</i> $181,000</td></tr>
<tr><td colspan="3">Health and Safety Manager.</td></tr>
<tr><td colspan="3">Military Munitions Response Program Site Investigation, Joint Base Cape Cod, Camp Edwards, MA</td></tr>
<tr><td><i>Start Date:</i> 06/23/14</td><td><i>Completion Date:</i> 9/27/14</td><td><i>Cost:</i> $85,000</td></tr>
<tr><td colspan="3">Project Health and Safety Manager. Reviewed and approved the Health and Safety Plan (HASP).</td></tr>
<tr><td colspan="3">Remedial Investigation/Feasibility Studies for Multiple Air National Guard Sites in the Sunbelt Region</td></tr>
<tr><td><i>Start Date:</i> 02/03/15</td><td><i>Completion Date:</i> 9/30/18</td><td><i>Cost:</i> $2.3 million</td></tr>
<tr><td colspan="3">Project Health and Safety Manager for RI/FS project at six Air National Guard installations. Reviewed and approved the HASP for each Installation.</td></tr>
<tr><td colspan="3">Compliance Restoration Program Remedial Investigation/Feasibility Study, Eastern Region</td></tr>
<tr><td><i>Start Date:</i> 10/04/14</td><td><i>Completion Date:</i> 10/01/17</td><td><i>Cost:</i> $2.8 million</td></tr>
<tr><td colspan="3">Project Health and Safety Manager. Project includes 9 separate Installations in the US and Puerto Rico. Reviewed and approved the HASP for each Installation.</td></tr>
<tr><td colspan="3">Newly Evaluated Restoration Sites (NERS) Remedial Investigations/Feasibility Studies at Multiple Air National Guard Installations, New England Region</td></tr>
<tr><td><i>Start Date:</i> 10/01/15</td><td><i>Completion Date:</i> 10/30/18</td><td><i>Cost:</i> $2.1 million</td></tr>
<tr><td colspan="3">Project Health and Safety Manager for project that includes 12 separate Installations in the US. Reviewed and approved the HASP for each Installation.</td></tr>
<tr><td colspan="3">Groundwater Infrastructure Upgrades and Groundwater Monitoring & Treatment, former Chevron Phillips Refinery</td></tr>
<tr><td><i>Start Date:</i> 01/15/15</td><td><i>Completion Date:</i> 08/20/15</td><td><i>Cost:</i> $125,000</td></tr>
<tr><td colspan="3">Site Health and Safety Officer. Developed site HASP and conducted daily oversight during groundwater infrastructure upgrades and groundwater monitoring & treatment.</td></tr>
<tr><td colspan="3">Asbestos Assessment Surveys, Plans and Abatement Plans, Metropolitan School Districts, Rocky Mountain Region</td></tr>
<tr><td><i>Start Date:</i> 06/30/09</td><td><i>Completion Date:</i> 06/30/10</td><td><i>Cost:</i> $105,000</td></tr>
<tr><td colspan="3">Project Manager. Performed asbestos assessment surveys, developed management plans, developed asbestos abatement specifications and bid documents, and performed abatement project manager duties at numerous rural and metropolitan school districts throughout the Rocky Mountain Region. Responsible for turn-key operations involving lead and asbestos abatement for the client, including asbestos/ lead identification, abatement design, conducting bid walk-throughs, performing air monitoring, and project management.</td></tr>
</table>

Lawrence J. Werts, III

Qualifications Summary

- Twenty-five years of professional experience.
- Eleven years of experience as a sampling/process technician. Duties include sampling soils, groundwater, surface water, and building surfaces; and pilot studies involving activated carbon, ion exchange, and activated aluminum technologies.
- Three years of experience coordinating reviews of aboveground storage tank (AST) compliance with federal regulations.
- One year of experience sampling asbestos for use in risk analyses and real estate assessments.
- Four years of experience coordinating training activities for an Army Reserve Unit.
- Three years of experience as an operator of a radioactive waste processing unit. Duties include personnel monitoring.
- Two years of experience providing training and inspections in hazardous waste management requirements.

Training, Memberships & Awards

- Electrical Safety Training Level II, NFPA 70E, OSHA 1910.331, KRT Associates (2010)
- CPR/First Aid Refresher, 29 CFR 1910, American Red Cross (2015)
- AED Refresher, 29 CFR 1910, American Red Cross (2015)
- AED Initial, 29 CFR 1910, MEDIC First Aid International (2009)
- Global Harmonization System Hazard Communication Training, 29 CFR 1910.1200, WESTON (2013)
- IATA/DOT Dangerous Goods Shipping Advisor Training Refresher, CFR 49 Parts 100 To 185, Bureau of Dangerous Goods, LTD. (2013)
- IATA/DOT Shipping and Transporting Dangerous Goods - Admin/Field Personnel Initial, CFR 49 Parts 100 To 185, Bureau of Dangerous Goods, LTD. (2010)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2012), WESTON (2015)
- 30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926 Subparts C, E, M, P, & X, WESTON (2007)
- 40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), WESTON (1988)

- Bloodborne Pathogens Training, OSHA 29 CFR 1910.1030, (2007)
- Bloodborne Pathogens Refresher Training, OSHA 29 CFR 1910.1030, WESTON (2013) (2015)
- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), (1989)
- DOT/IATA Hazardous Materials Training, 49 CFR 172 Subpart H, Bureau of Dangerous Goods, LTD (2006)
- DOT/IATA Hazardous Materials Training – Refresher, 49 CFR 172 Subpart H, Bureau of Dangerous Goods, Ltd. (2013)
- Confined Space Training – Entrant, Attendant, Non-Entry Rescue, OSHA 29 CFR 1910.146, WESTON (2000)
- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1026 Subpart P, WESTON (2007)
- Fall Protection Competent Person Training Course – Initial, OSHA 29 CFR 1926 Subpart M, WESTON (2007)
- Fall Protection Competent Person Training Course – Refresher, OSHA 29 CFR 1926 Subpart M, WESTON (2005)
- Dangerous Goods Shipping Procedures, 49 CFR 172 Subpart H, FedEx (2000)
- Dangerous Goods Shipping Waste, 49 CFR 172 Subpart H, PADEP (2002)
- CPR/First Aid Training, 29 CFR 1910, Medic First Aid (2009)
- The Emergency Program Manager, Federal Emergency Management Agency (FEMA) (1990)
- Emergency Management U.S.A., FEMA (1991)
- Hazardous Materials: A Citizens Orientation, FEMA (1991)
- Radiological Emergency Management, FEMA (1991)
- Preparedness Planning In Nuclear Crisis, FEMA (1991)
- Fundamentals Course for Radiological Monitors (1992)

Employment History

1988 to Present WESTON

1990 to Present U.S. Army Reserve

1987 to 1988 Alternative Ways, Inc.

1983 to 1987 New Jersey Department of Defense

1980 to 1983 Hydro Nuclear Services

1977 to 1980 Philadelphia Inquirer

Key Projects

Technical Operations and Maintenance, Pennsylvania, Confidential Client, Technician. Oversee the operation of six groundwater remediation systems. Responsibilities include minor electrical repairs and the rehabilitation of groundwater pumps and managing the overall sampling of the six remediation systems.

Technical Operations and Maintenance, Gibbsboro, NJ, Confidential Client, Technician. Oversee the operation of a Thermal Oxidizer and Product Recovery System, and perform minor adjustments on both.

Hazardous Waste Management Training and Inspections, Philadelphia, PA, Philadelphia International Airport, Division of Aviation, Technician. Co-authored a training manual and presented training on hazardous waste management, and provide airport facilities personnel with technical advice on management of hazardous and nonhazardous waste by way of monthly inspections.

Air Monitoring for Abandoned Pipeline Removal, Philadelphia, PA, Philadelphia International Airport, Division of Aviation, Technician. Provided emergency air monitoring immediately after a 10-foot, 18-inch-diameter pipe was encountered during construction activities at the airport. This was followed by additional air monitoring and construction oversight during the safe removal of the pipe.

Hazardous Waste Removal, Philadelphia, PA, Philadelphia International Airport, Division of Aviation, Technician. Provided sampling and oversight for the removal of numerous waste drums from airport property. Also made arrangements with a subcontractor for the safe disposal of the drums.

Soil Sampling, Philadelphia, PA, Philadelphia International Airport, Division of Aviation, Technician. Collected more than 150 soil samples to determine levels of total petroleum hydrocarbons. Using a field screening kit, determined areas needing further characterization.

Absorption Pilot System Installation and Operations Project, Various Locations, U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Senior Crew Chief. Installed and operated a granular-activated carbon (GAC) alumina and ion exchange resin adsorption pilot system for the removal of explosives, arsenic, and volatile organic compounds (VOCs) from groundwater. Sampling, plumbing of columns, pumps, air stripper, tanks, and laboratory data management.

Soils Characterization, Various Locations, Confidential Client, Senior Technician. Characterized petroleum- and polychlorinated biphenyl (PCB)-contaminated soils from natural gas compressor stations. Project included the mapping and collection of soil, water, destructive, wipe, and groundwater samples.

Water Characterization, Industrial Manufacturing Facility, AVTEX Fibers, Senior Technician. Characterized water contaminated with zinc from unknown sources at a large industrial manufacturing facility. The project included remote sampler setup, lithium chloride testing, and stormwater system mapping.

Groundwater Characterization, Tooele Army Depot, Tooele, UT, Senior Technician. The project included installation and operation of a small-scale air stripper collecting samples of trichloroethylene (TCE) to evaluate the effectiveness of removing TCE from groundwater.

Groundwater Sampling, Chattanooga, TN, USATHAMA, Senior Crew Chief. Conducted groundwater monitor well sampling, both on-site and domestic.

Weir Construction, Iron Mountain, CA, ICI, Senior Crew Chief. Assisted in the construction of weirs in remote locations. In addition, assisted in the installation of measurement devices.

Planning and Coordination, Pennsylvania, Chester County, Federal Emergency Management Agency (FEMA), Plans/Operations NCO. Duties include the review and production of plans, and the implementation of procedures relating to attack preparedness, radiological defense, and shelter. Review of nuclear power plant emergency procedures and emergency plans. Review of Nuclear Material License in Chester County. In addition, participates in the review of Part B applications regarding public safety and radiological exercises at nuclear power plants.

Sludge Dewatering Study, Delaware, Star Refinery, Senior Technician. Monitored sludge dewatering unit operations and conducted sludge sampling for process control/monitoring purposes.

Drum Removal, Lanchester Landfill, Chester County, Senior Technician. Oversaw the removal and overpacking of buried drums in Level B protection.

Remedial Investigation/Feasibility Study (RI/FS), Massachusetts, U.S. Army, Senior Technician. Sampling and data evaluation for a U.S. Army site whose mission involved the production and handling of depleted uranium, beryllium, heavy metals, organics, and radionuclides associated with the operation of a nuclear reactor on-site. Assisted the field team leader in scheduling and overseeing field operations, attended public meetings, and assisted in data interpretation. In addition, involved in the radiological surveys of buildings, including reactor building survey, and sanitary and stormwater pipes. Team leader providing health physics support for a mixed waste study, including drum sampling, equipment, contractor, and environmental sampling.

Decontamination Support and Health Physics Support. Decontamination Support and Health Physics Support, Various Locations, Public Service Electric and Gas Company (PSE&G), Salem Nuclear Generating Station, Indiana and Michigan Electric Company, Donald C. Cook Nuclear Power Plant, Decontamination Technician, Respirator Fit Test Technician, Whole Body Count Technician, Health Physics Technician, and Radwaste Technician. Operator of a mobile counting laboratory and a radioactive waste processing unit involved in all types of decontamination motion work (floors, tools, walls, tanks, pumps, steam generators, reactor cavities, reactor parts, sump, and all other equipment associated with a nuclear power plant). Involved in health physics support (including radiation surveys, air monitoring, as low as reasonably achievable [ALARA] planning in high-radiation areas, to routine surveys of all types of equipment).

Lead-Based Paint Sampling, Fort Drum, NY, U.S. Army Corps of Engineers (USACE), Senior Technician. Involved in the development of a sampling procedure to obtain representative samples of building debris on a weight basis. Acts as a Team Leader in the sampling of 253 buildings slated for demolition.

Michael Argue, CHMM

Qualifications Summary

- 13 years of professional experience.
- Over 6 years of experience conducting Responsible Party oversight on the GE/Housatonic River Site under WESTON's Professional Services Contract with U.S. EPA Region 1.
- Over 6 years of experience leading investigations into varied CERCLA-regulated sites within U.S. EPA Region 1 as part of the START contract.
- Extensive experience in providing health and safety oversight of field teams, and collection and shipment of environmental and hazardous material samples for laboratory analysis.
- Led multiple Level B entries into various metal plating operations and defunct industrial facilities.
- Five years of experience serving as part of the START emergency response rotation. Led multiple emergency responses.
- Developed quick-reference startup/calibration instructions for all emergency response air monitoring/sampling instruments, and conducted refresher training for all START emergency response personnel.

Credentials

Construction Quality Management for Contractors Certification (No. NAE-0012-0025), MA (2012)

Education

M.S., Environmental Studies - Antioch New England Grad School (1996)

B.F.A., Illustration - Syracuse University (1988)

Training, Memberships & Awards

- Behavior-Based Safety Training – Phase I, WESTON (2007)
- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (1999)
- 30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, WESTON (2007)
- Confined Space Training – Entrant, Attendant, Non-Entry Rescue, OSHA 29 CFR 1910.146, WESTON (2006)

- Fall Protection Competent Person Training Course – Refresher, OSHA 29 CFR 1926 Subpart M, WESTON (2011)
- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1926 Subpart P, WESTON (2007)
- Shipping and Transporting Dangerous Goods – Administrative/Field Personnel - Refresher Weston Solutions, Inc., Manual of Procedures for Shipping and Transporting Dangerous Goods Training Course, 49 CFR 172 Subpart H, WESTON (2011)
- Underground Utilities Competent Person Training, WESTON (2008)
- Construction Quality Management for Contractors Certification, USACE (2005)
- Lead Awareness Training, WESTON (2009)
- REG IV Federal 40-Hour Wetland Identification, Delineation, and Classification course, Humboldt Field Research Institute (2009)
- 40-Hour HAZWOPER training course, OSHA 29 CFR 1910.120(e)(3), EnviroBusiness, Inc. (1998)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2016)
- ERT EPA Warehouse Air Sampling Equipment Training, (2004)
- Basic Incident Command System Training, IS-195, Emergency Management Institute (2004)
- Function-Specific Dangerous Goods Shipping Procedures Training, WESTON (2003)
- Inland Oil Spill Response Training Course, Dowcar Environmental Management, Inc. (2002)
- Forms 2 Lite Training, DynCorp (2003)
- Asbestos Awareness Training, Institute for Environmental Education, Inc. (2000)
- Bloodborne Pathogens Training Course, 29 CFR 1910.1030, WESTON (2005); Refresher (2016)
- Adult CPR/Standard First Aid, American Red Cross (2005); Refresher (2015)

Employment History

2005 to Present WESTON
1998 to 2005 TerranearPMC, LLC
1996 to 1998 The Nature Conservancy
1996 Living on Earth - World Media Foundation
1995 Antioch New England Graduate School
1995 Society for the Protection of New Hampshire Forests

Key Projects

Removal Action, Pittsfield, MA, U.S. Army Corps of Engineers, Construction Oversight Manager/Site Safety and Health Officer, GE/Housatonic River Project, Pittsfield, MA, U.S. Army Corps of Engineers, Construction Oversight Manager/Site Safety and Health Officer. As Construction Oversight Manager, oversaw Responsible Party contractors on behalf of USACE and EPA to verify consistent quality control and adherence to EPA-approved work plans and technical specifications. Large-scale removal and remedial construction activities, including soil removal/replacement, engineered barrier installation, Toxic Substances Control Act (TSCA) landfill construction, in situ sediment capping, light nonaqueous phase liquid (LNAPL) extraction system installation and maintenance, and demolition activities, were implemented within the numerous Removal Action Areas and Groundwater Management Areas that constitute the site. Reviewed and provided comments on RP work plans and maintained daily communications with EPA as removal and remedial construction activities were implemented in the field. Attended weekly meetings between EPA, WESTON, the RP, and RP contractors; generated weekly Field Activity Projections and Summaries, and distributed these to EPA, USACE, the U.S. Fish and Wildlife Service, and the Massachusetts Department of Environmental Protection.

As Site Safety and Health Officer (2007 until 2013), co-authored the project Accident Prevention Plan following revised USACE EM 385-1-1 guidance; provided all WESTON personnel and subcontractors with appropriate project orientation and site-specific safety training. Conducted vehicle safety and emergency preparedness training; conducted daily safety meetings and oversaw all aspects of field activities to ensure that safety protocols were understood and implemented in accordance with applicable Activity Hazard Analyses. Conducted regular office inspections and maintained the office Hazard Communication Plan to ensure that a safe office environment was maintained for all WESTON employees, clients, subcontractors, and visitors. [5-05 to Present]

Removal Action, Troy Mills Landfill Superfund Site, Troy, NH, Site Leader. Coordinated on-site activities, including installation of monitoring wells and piezometers, performance of hydraulic conductivity tests, and environmental sampling in support of WESTON’s Manchester, NH, design team. Provided on-site health and safety oversight, construction quality assurance, and documentation of construction activities conducted by the EPA Emergency Rapid Response Services (ERRS) contractor during installation of an Interim Remedial Measure at the site, and during removal of the on-site source. Authored the site Health and Safety Plan, the Sampling Quality Assurance/Quality Control Plan, and After Action Report.

Preliminary Assessment/Site Investigation (PA/SI) and Removal Action, Jaffrey, NH, Elite Laundry, Site Leader. During the PA/SI, guided field team that conducted an extent-of-contamination survey using a truck-mounted soil probing machine to collect subsurface soil samples for on-site volatile organic compound (VOC) screening. Provided health and safety oversight, environmental sampling, and documentation for the subsequent soil removal action.

Removal Action, Plainfield, CT, Brunswick Mill, Site Leader. Assisted structural engineers during analysis of the structural integrity of on-site mill buildings that were partially destroyed by fire. Assisted a survey team with conducting a topographical survey of the site during development of demolition specifications. Coordinated communications between EPA, ERRS, and WESTON engineers; and provided health and safety oversight, and documentation during demolition activities. Sampling activities included collecting composite waste pile samples for disposal characterization analysis; collecting daily perimeter air samples from five locations for lead and asbestos analyses; collecting approximately 50 confirmatory composite surface soil samples to determine whether cleanup goals were attained; and collecting subsurface soil cores from 11 locations using the Superfund Technical Assessment and Response Team (START) Geoprobe from which soil samples were collected for on-site screening.

PA/SI and Removal Action, Winchester, NH, A.C. Lawrence Tannery, Site Leader. As part of the preliminary assessment/site inspection (PA/SI), led a team of six field personnel, established a grid system, and conducted an extent-of-contamination survey utilizing a Geoprobe to collect soil cores from which 100+ samples were collected for on-site screening. Additional soil samples were collected for polychlorinated biphenyl (PCB) and anthrax analyses. During the removal, provided health and safety oversight and documentation, collected soil samples from excavation floors and side walls for on-site screening, and shipped confirmation samples to a private laboratory for analysis.

PA/SI, Tewksbury, MA, Rocco's Disposal, Site Leader. Led a team of up to five START personnel for a 15-day surveying and sampling event. Established grid systems, performed a geophysical survey, and conducted an extent-of-contamination survey during which Geoprobe soil cores were collected for on-site screening. Oversaw input of screening data into the Surfer program for generation of volume and lateral extent-of-contamination estimates. Researched innovative technologies for remediation of the on-site drum disposal area, and calculated the weight, in pounds, of organic vapors that would be released to the ambient air during excavation of the drums and contaminated soil.

CERTIFICATE OF ACHIEVEMENT

EBI TRAINING SERVICES CAMBRIDGE, MA

HAZARDOUS WASTE OPERATIONS

THIS IS TO CERTIFY THAT

Michael Argue

HAS SUCCESSFULLY COMPLETED 40 HOURS OF TRAINING IN HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE IN ACCORDANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS 29 CFR 1910.120 AND 1926.65

Julie MacDonald
Training Coordinator, Training Services
October 23, 1998

WESTON
SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

MICHAEL ARGUE

Has Completed the

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 02/23/2007 in Manchester, NH

TRAINING MANAGER
Conrad W. Lehr, CET, CIT

INSTRUCTOR
Theodore L. Blackburn CSP, CET

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Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

ROY F. WESTON, INC.

THIS CERTIFIES THAT

MIKE ARGUE

HAS COMPLETED THE

Site Health and Safety Coordinators Training
meets 29 CFR 1910.120 (e) (4)

Burlington, MA
January 21, 1999

TRAINING MANAGER

WESTON®
MANAGERS DESIGNERS/CONSULTANTS

CSP, CET

INSTRUCTOR

ROY F. WESTON, INC · 1 WESTON WAY · WEST CHESTER, PA · 19380-1499

98P-1709a

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

MICHAEL ARGUE

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 01/27/2016 in Concord, NH

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Herold S Hannah
INSTRUCTOR
Herold S. Hannah Jr CIH, CSP

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WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

MICHAEL ARGUE

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 01/27/2016 in Concord, NH

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Herold S Hannah
INSTRUCTOR
Herold S. Hannah Jr CIH, CSP

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NSC First Aid Course

Name: **Mike Argue**
Address:
Address:
City, State, Zip:

Security Control No.
045458

Course Completion Date: **February 17, 2015**
Expiration Date: **February 17, 2018**

Training Center: **National Safety Council of NNE**
Instructor Name: **Raymond Seddon**
Instructor Number: **177784**

Mike Argue

has successfully completed the NSC First Aid Course.

The National Safety Council saves lives by preventing injuries and deaths at work, in homes and communities and on the roads through leadership, research, education and advocacy.

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More life-saving courses from NSC

- NSC First Aid, CPR & AED
- NSC CPR & AED
- NSC Bloodborne & Airborne Pathogens

NSC—in it for life™ nsc.org/fatraining

Security Control No.
045458

Mike Argue

has completed the
NSC First Aid Course

Training Center: **National Safety Council of NNE**
Completion Date: **February 17, 2015**
Expires: **February 17, 2018**
Instructional Hours:

Raymond Seddon **177784**
Instructor Signature Instructor No.

Keep this card for your records. Void if reproduced.

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NATIONAL SAFETY COUNCIL®

NSC CPR Course

Name: **Mike Argue**
Address:
Address:
City, State, Zip:

Security Control No.
587931

Course Completion Date: **February 17, 2015**
Expiration Date: **February 17, 2017**

Training Center: **National Safety Council of NNE**
Instructor Name: **Raymond Seddon**
Instructor Number: **177784**

Mike Argue

has successfully completed the NSC CPR Course based on the current Guidelines for CPR and ECC.

The National Safety Council saves lives by preventing injuries and deaths at work, in homes and communities and on the roads through leadership, research, education and advocacy.

THIS DOCUMENT IS VOID IF REPRODUCED

NATIONAL SAFETY COUNCIL®

More life-saving courses from NSC

- NSC First Aid, CPR & AED
- NSC First Aid
- NSC Bloodborne & Airborne Pathogens

NSC—in it for life™ nsc.org/fatraining

NATIONAL SAFETY COUNCIL®

Security Control No.
587931

Mike Argue

has completed the
NSC CPR Course

Training Center: **National Safety Council of NNE**
Completion Date: **February 17, 2015**
Expires: **February 17, 2017**
Instructional Hours:

Raymond Seddon **177784**
Instructor Signature Instructor No.

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Brenden J. Beaumont

Qualifications Summary

- More than 11 years of diverse experience in the fields of construction quality control, groundwater treatment systems O&M, fuel systems O&M, environmental remediation, health and safety, and environmental science.
- Maintain OSHA CFR 1926 and EM 385-1-1 health and safety requirements with over 20 subcontractors on a construction site. Ensure scope of work and quality of work are carried out within the requirements of the project plans and specifications.
- Experience with commissioning and delivery of secure, turnkey facilities and infrastructure on schedule to DOD clients.
- Experience in site decommissioning via characterization and remediation under multi-regulatory agency frameworks.
- Ability to perform comprehensive Phase I and Phase II environmental site assessments, including asbestos and lead-based paint surveys.
- Managed hydrocarbon investigations from initial contamination assessments through ensuing soil and groundwater remediation activities.

Credentials

Sewage Enforcement Officer (SEO), PA (2000)

Education

B.S., Watershed Management - Pennsylvania State University (2001)

Training, Memberships & Awards

- Construction Site Manager/Field Safety Officer Compliance Course, WESTON (2007)
- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1026 Subpart P, WESTON (2006)
- Fall Protection Competent Person Training Course – Initial, OSHA 29 CFR 1926 Subpart M, Miller Training (2013)
- Facilities and Infrastructure 101 Training, WESTON (2006)
- Facilities and Infrastructure 201 Training, WESTON (2007)
- 30-Hour Construction Course Certification. Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, and X, OSHA 29 CFR 1926, WESTON (2006)

- 40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), All American Environmental Services (2002)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2016)
- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (2009)
- Confined Space Entry-Entrant, Attendant, Non-Entry Rescue Training Course, OSHA 29 CFR 1910.146, WESTON (2009)
- Bloodborne Pathogens Training – Initial, OSHA 29 CFR 1910.1030, (2006); Refresher, WESTON (2016)
- Shipping and Transporting Dangerous Goods—Administrative/Field Personnel – Initial, Weston Solutions, Inc., Manual of Procedures for Shipping and Transporting Goods Training Course, 49 CFR 172 Subpart H, WESTON (2008)
- General Radiation Worker Training, 10 CFR 1912, (2005)
- First Aid/CPR/AED Training, American Heart Association (2015)

Employment History

2002 to Present WESTON

2002 to Present East Bradford Township, Chester County, PA

Key Projects

Advanced Metering Infrastructure, Site Safety and Health Officer, Naval Station Newport, Newport RI, Naval Facilities Engineering Command (NAVFAC). Provided safety oversight to WESTON employees and multiple subcontractors during the installation of communications network and electric, steam, and water meters. Conducted daily safety briefs and multiple daily work site inspections. Procured, prepared and issued permits and plans for confined space entry, work at elevation and hot work. Managed Lock Out/Tag Out program for meter installation to prevent damage to equipment and injury to personnel. Worked with base personnel to coordinate utility outages. Ensured compliance in accordance with Occupational Safety and Health Administration (OSHA) Code of Federal Regulations (CFR) 1910 and 1926, EM 385-1-1, National Fire Protection Association (NFPA) 70E. [6-15 to 3-16]

Advanced Metering Infrastructure, Site Safety and Health Officer, Portsmouth Naval Shipyard, Portsmouth, NH, Naval Facilities Engineering Command (NAVFAC). Provided safety oversight to WESTON employees and multiple subcontractors during the installation of communications network and electric steam, and water meters. Conducted daily safety briefs and multiple daily work site inspections. Procured, prepared, and issued permits and plans for confined space entry, work at elevation, and hot work. Managed Lock Out/Tag Out program for meter installation to prevent damage to equipment and injury to personnel. Worked with base personnel to coordinate utility outages. Ensured compliance in accordance with OSHA 1910 to 1926, EM 385-1-1, and NFPA 70E. [8-14 to 2-15]

Advanced Metering Infrastructure, Site Safety and Health Officer, Naval Weapons Station Earle, Colts Neck, NJ, Naval Facilities Engineering Command(NAVFAC). Provided safety oversight to WESTON employees and multiple subcontractors during the installation of communications network and electric, steam, and water meters. Conducted daily safety briefs and frequent work site inspections. Procured, prepared, and issued permits and plans for confined space entry, work at elevation, and hot work. Managed Lock Out/Tag Out program for meter installation to prevent damage to equipment and injury to personnel. Worked with base personnel to coordinate electrical outages. [5-14 to 8-14]

Advanced Metering Infrastructure, Site Safety and Health Officer, Naval Support Activity Philadelphia, Philadelphia, PA, Naval Facilities Engineering Command (NAVFAC). Provided safety oversight to WESTON employees and multiple subcontractors during the installation of communications network and electric, steam, and water meters. Conducted daily safety briefs and frequent work site inspections. Procured, prepared, and issued permits and plans for confined space entry, work at elevation, and hot work. Managed Lock Out/Tag Out program for meter installation to prevent damage to equipment and injury to personnel. Worked with base personnel to coordinate electrical outages. [3-14 to 4-14]

Advanced Metering Infrastructure, Site Safety and Health Officer, Sub Base New London, Groton, CT, Naval Facilities Engineering Command(NAVFAC). Provided safety oversight to WESTON employees and multiple subcontractors during the installation of communications network and electric, steam, and water meters. Conducted daily safety briefs and frequent work site inspections. Procured, prepared, and issued permits and plans for confined space entry, work at elevation, and hot work. Managed Lock Out/Tag Out program for meter installation to prevent damage to equipment and injury to personnel. Worked with base personnel to coordinate electrical outages. [8-13 to 5-14]

Advanced Metering Infrastructure, Site Superintendent and Site Safety and Health Officer, Naval District Washington, U.S. Navy. Provided safety oversight during the installation of smart utility meters. Acted as a construction liaison between the Navy building managers, tenants, and affected end users in the scheduling, construction, and implementation of AMI at each installation. Balanced subcontractor resource, manpower (both Government and subcontractor support), and construction materials in the scheduling of electrical and mechanical meter outages. Provided construction quality control during meter installations and installation of the communications networks using the USACE three-phase approach. [9-10 to 8-13]

USACE SSHO Contractor Oversight, Site Safety and Health Officer, Infrastructure Upgrade and Abatement, Kensico Dam, NYSDEC. Responsible for SSHO oversight of construction contractors performing abatement of lead, asbestos, and polychlorinated biphenyl (PCB) and infrastructure upgrades to the Kensico Dam in West Chester, NY. Work was performed under New York State Department of Environmental Conservation (NYSDEC) contract. [5-10 to 9-10]

Advanced Metering Infrastructure, Naval District Washington, U.S. Navy, Construction Manager/Outage Coordinator. Act as a construction liaison between the Navy building managers, tenants and affected end users in the scheduling, construction and implementation of AMI at each installation. Balance subcontractor resources, manpower (both Government and subcontractor support), and construction materials in the scheduling of electrical and mechanical meter outages which include electrical meters, gas meters water meters and steam meters. Track parts inventory, ordering and deliveries to multiple construction sites working simultaneously. Provide construction quality control during meter installations and installation of the communications networks using the USACE three-phase approach. Provide safety oversight as necessary and escorting of WESTON/subcontractor personnel at highly secure locations with current TS cleared status.

Canal Creek Groundwater Treatment Plant – Design/Build/Operate, Aberdeen Proving Ground (APG), MD, Directorate of Safety, Health, and the Environment (DSHE), Assistant Plant Operator. Performed routine operations and maintenance (O&M) on a daily basis to sustain 24-hour/365-day operation of a pump-and-treat groundwater remediation facility. Carried out daily quality control (QC), verification, and documentation of system component testing and inspection, and ensured component/process installation in accordance with the plans, drawings, and specifications. Performed routine functionality inspections of the facility’s systems, components, and processes. Performed troubleshooting and bench testing resulting in modifications to the system to improve and enhance system processes. Documented and coordinated vendors and subcontractors to ensure seamless interaction between components and the Process Control System (PCS) as the systems were brought online. Operated the plant and performed routine sampling to ensure the treated discharge water was within the permitted regulatory criteria set forth by the Maryland Department of Environment (MDE) and U.S. Environmental Protection Agency (EPA).

Building 4031 Soil Vapor Extraction/Free Product Recovery (SVE/FPR) System, APG, MD, DSHE QA/QC and System Operator. Responsible for QA/QC construction oversight, commissioning, and O&M of an SVE/FPR of light nonaqueous phase liquids (LNAPL). Routinely collected operational data and routine vapor samples to ensure system was operating at optimal efficiency as well as confirmation of emissions compliance. Continually adjusted the cycle of the pump controllers based on interpretations of the LNAPL plume. Performed all routine maintenance on system blowers, compressors, controllers, lines, and pumps.

Clean, Inspect, Repair Aboveground Storage Tanks (ASTs), Marine Corps Air Station (MCAS) Quantico, VA, QA/QC and Health and Safety Officer. Responsible for subcontractor QA/QC as well as site worker health and safety of fuel AST tank repairs. Held preparatory, initial, and follow-up meetings with subcontractors and stakeholders. Oversaw internal and external tank modifications necessary for conformance to current codes. Documented and reviewed third party National Association of Corrosion Engineers (NACE) inspections. Reviewed subcontractor welding procedures and inspected weld quality. Inspected materials and component quality for conformance to API 650 and 653 specifications. Monitored surface preparation and the application of the internal and external coating systems. Performed personnel air monitoring to ensure compliance and minimize and/or eliminate exposure to respirable welding fumes, dust, and volatile organics. Coordinated and performed detailed inspections, testing and documentation prior to and during commissioning activities.

Construct Ft. Stevenson Marina (Time Critical) Garrison, North Dakota, U.S. Army Corps of Engineers (USACE) Omaha District, Construction QC Manager. Responsible for implementing QC system, and ensuring work was in compliance with the specifications and drawings utilizing the construction quality control (CQC) 3-phase approach. Supervised subcontractor activities. Implemented “behavioral based safety concept” with our subcontractors and finished the job with zero safety incidents or injuries in extremely cold, arctic conditions. Delivered marina to USACE ahead of schedule and under budget.

Construct Anti-Terrorism/Force Protection (AT/FP) POV Gate at the Main and Virginia Avenue Gates, Andrews Air Force Base (AFB), MD, Air Force Center for Environmental Excellence (AFCEE), Construction Site QA/QC and Health and Safety Field Team Leader. Served as a QA/QC field team lead at Andrews AFB for the AT/FP POV Gates Installation Project. Managed over 20 subcontractors performing different divisions of construction; there were zero safety-related incidents for over 35,000 man-hours of work. Ensured that the work performed by subcontractors was in accordance with the project plans and specifications, and the scope of work (SOW). Conducted CQC meetings for each definable feature of work. Instituted a “quality minute” along with each safety brief “tailgate meeting” to ensure that each individual performing work on the site performed exceptional work that would exceed our client’s expectations. Responsible for keeping accurate and up-to-date “as-built” drawings, in addition to preparing final deliverables, daily reports, and project submittals. Helped in identification of a design flaw in the structural steel gatehouse canopy. Verified compliance by ensuring the Welding Procedure Specifications (WPS) were adhered to during the welding performed to reinforce the structure.

Technical Support in Response to Hurricanes Katrina and Rita, U.S. Environmental Protection Agency (EPA), Geographic Information System (GIS) Specialist. Provided technical and cartographical GIS support to EPA Region 6 in response to Hurricanes Katrina and Rita. Post-processed Personal Digital Assistant/global positioning system (GPS) datasets to cartographically display data for field crews per Incident Action Plan (IAP) objectives.

- Spatial data processing and data normalization for upload to geodatabases.
- Performing spatial data queries to extract specific remediation datasets per request.
- Application of advanced methodological annotation processes for maps.
- Operating in high volume output and high demand environment for 12+ hour shifts.

Rad Yard Remedial Action, APG, MD, DSHE Base Environmental Support Team (BEST) Contract, Radiation Technician/Safety Officer. Familiarity with the Nuclear Regulatory Commission (NRC) framework for site decommissioning and license termination. Experienced in "cradle-to-grave" design of an approved final status survey and decommissioning SOW. Demonstrated compliance via a MARSIMM statistical survey. Proficient in instrument setup and correlation, exposure rate surveys, remedial action support surveys, equipment release, and assignment of radiation work permits. Surgically demolished four structures containing cesium-137 contamination. Utilized oxyfuel gas cutting (OFC) to cut structural steel and railroad rails into manageable sizes for recycle by Army Testing Center (ATC).

Environmental Investigations, APG, MD, DSHE BEST Contract, Assistant Geoscientist. groundwater sampling efforts at Cluster 13 and Canal Creek. Took part in the construction of the influent and effluent components of the Canal Creek groundwater treatment facility. Operated and maintained the treatment facility. Performed system maintenance while dressed out in Level B personal protective equipment (PPE). Entered vessels for inspection under confined space permits, and monitored vapors using various instruments. Work involved troubleshooting, diagnosis, and repair/replacement of treatment system components at height with scaffolding using proper fall protection. Assisted in discovering and diagnosing a failure of the coating within the resin vessels before the failed coating could adversely affect the tremendously expensive resin material and other system components. Assisted with seeking a remedy for the vessel failures in order to give the client a long-term viable solution.

Columbia Shuttle Recovery, Hemphill, TX, EPA Region 6 Superfund Technical Assessment and Response Team (START), Team Leader. Coordinated the efforts of a multidisciplinary effort for the search, screening, and recovery of the space shuttle Columbia debris/data.

GIS Services, East Bradford Township, Chester County, PA. Outfitted the municipality with a suite of GIS software with integrated computer-aided design (CAD) software. Worked with the county in digitizing zoning and floodplain maps. Performed a zoning assessment project using a handheld GIS database with GPS functionality.

ALL AMERICAN ENVIRONMENTAL SERVICES, INC.

This is to certify that

BRENDEN J. BEAUMONT

has successfully completed

HAZARDOUS WASTE SITE WORKER COURSE (40-HOUR)
SATISFYING 29 CFR 1910.120 (3)(e)(i) REQUIREMENTS

at

ALL AMERICAN SCHOOL OF OCCUPATIONAL SAFETY AND HEALTH
COLUMBIA, MARYLAND

OCTOBER 21 - 25, 2002
40S-0210B

School Director

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BRENDEN BEAUMONT

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 03/28/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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Rhode Island

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(O) 401-261-7604— 401-481-8881

(email) Charleenalves.cpr@gmail.com

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This letter is to serve as proof that the below named student successfully completed the stated class to American Heart Association Standards.

Please contact our office with any questions or for further verification.

STUDENT: **Brenden Beaumont**

COURSE NAME: **FIRST AID/ CPR/ AED**

COURSE NUMBER: **2011-15111-5548**

COURSE DATE: **11/11/2015**

COURSE EXPIRATION: **11/2017**

COURSE SCORE: **PASS**

COURSE LOCATION: **RI-CPR**

COURSE INSTRUCTOR: **Charleen Alves**

Misc. options : Adult, child, infant . Aed, cpr

Sincerely

Charleen alves

Charleen Alves

CPR Instructor

RI –CPR

(401) 261-7604

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In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 07/14/2006 in Houston, TX

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET, CIT

Conrad W Lehr, CET
INSTRUCTOR
Conrad W. Lehr

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Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 04/02/2009 in West Chester, PA

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET, CIT

Conrad W Lehr, CET
INSTRUCTOR
Conrad W. Lehr

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BRENDEN BEAUMONT

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 03/28/2016 in Westchester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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Thomas P. Dakin

Qualifications Summary

- More than 7 years of diverse experience in the fields of industrial hygiene, health and safety, field sampling, environmental science, and laboratory experience in wastewater remediation and research, and development of remediation techniques.
- Proficient in field sampling techniques of various matrixes, including soil, sediment, air, and water, in both residential and industrial settings.
- Experience in environmental health and safety, and industrial hygiene, including personal sampling for OSHA compliance.
- Performed various surface and groundwater well gauging and groundwater sampling projects.
- Experience with storage, handling, and disposal of hazardous wastes in compliance with RCRA regulations.

Credentials

Construction Quality Management for Contractors Certification, USACE (2015)

Education

B.S., Environmental Health - West Chester University (2008)

A.A.S., Environmental Technology - Delaware Technical and Community College (2005)

Training, Memberships & Awards

- 40-Hour Health and Safety Training for Hazardous Waste Operations, OSHA 29 CFR 1910.120, Delaware Technical and Community College (2004), Delaware Technical & Community College (2004)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2015)
- Bloodborne Pathogens Refresher Training, OSHA 29 CFR 1910.1030, WESTON (2015)
- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (2009)
- Confined Space Training – Entrant, Attendant, Non-Entry Rescue, OSHA 29 CFR 1910.146, WESTON (2013) (2013)
- 30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, WESTON (2009)

- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1026 Subpart P, WESTON (2009)
- Fall Protection Competent Person Training Course – Initial, OSHA 29 CFR 1926 Subpart M, WESTON (2012), WESTON (2012)
- Shipping and Transporting Dangerous Goods – Administrative/Field Personnel – Initial, Weston Solutions, Inc., Manual of Procedures for Shipping and Transporting Dangerous Goods Training Course, 49 CFR 172 Subpart H, WESTON (2014), WESTON (2014)
- Erosion and Sediment Control Certification, State of Maryland (2009)
- Behavior Based Safety, Phase I Training, WESTON (2008)
- First Aid/CPR/AED Training, American Red Cross (2014)
- Nitron XRF Spectrum Analyzer Training, ThermoFisher Scientific (2011)
- EPA START – Air Monitoring Exercise Training (2010)
- EPA START – Assessment Scenario Exercise Training (2010)
- EPA START – Emergency Response Orientation (2010)
- EPA START – HAZCAT (2010)
- EPA START – Level A Team Overview (2010)
- EPA START – Minor Containment and Control of Discharges, Spills, and Releases (2010)
- EPA START – Multi-Media Sampling Basics (2010)
- EPA START – Recognition and Identification of Hazards Training (2010)
- EPA START – START Orientation Training (2010)
- Transportation Worker Identification Credential, TSA (2011)
- XRF Spectrum Analyzer Training, Niton (2011)
- Roadway Worker Safety Training, SEPTA (2010)
- Medical Examiners Certificate for Commercial Drivers Fitness Determination, 49 CFR 391.41 – 391.49, Work Care (2014) (2014)
- Incident Command System for Single Resources and Initial Action Incidents, FEMA (2010)
- Basic Plus Initial Training, Tennessee Valley Training Center (2009)
- Environmental Health Training in Emergency Response, NEHA (2008)
- Hydrofluoric Acid Safety Training, DuPont (2007)
- Introduction to the Incident Command System, FEMA (2006)
- National Incident Management System, FEMA (2006)
- U.S. Coast Guard Boaters Safety Training, USCG (2001)
- Current Field Personnel Medical Clearance, Work Care (2014) (2014)
- Air and Waste Management Association
- National Environmental Health Association

Employment History

2008 to Present WESTON
2004 to 2008 Adecco Technical (DuPont Experimental Station)

Key Projects

Plating Facility Characterization, Philadelphia, PA, City of Philadelphia, Project Scientist. Philadelphia International Airport expansion. A former plating facility was incompletely remediated by former owners. Sludge and materials left behind were sampled and characterized for proper disposal purposes. All work conducted under Level C PPE. Served as Site Health and Safety Officer. [1-14]

Mt. Laurel, Fleetwood, PA, PADEP, Safety Officer. Performed a Time-Critical Removal Action of lead-impacted soils around several residences. Responsible for sampling and characterizing soils and drinking water. Created a work plan to expedite removal of impacted soil but also to minimize potential exposure to impacted soils. Conducted personal and perimeter air sampling and monitoring. Surveyed soils utilizing an XRF instrument. Conducted a hazard analysis and negative exposure assessment to justify the downgrade of PPE to level D modified. Served as Site Health and Safety Officer, managed the Site Safety Program. [1-13 to 7-13]

Mold Remediation, New York, NY, RXR Property Management, Engineering Clerk. Oversaw the removal of mold-impacted insulation materials inside of air handler units in a high-rise office building. Assisted with developing and installing temporary negative air and HEPA filtration units to reduce worker and building tenant exposure to mold spores during removal and cleaning procedures. Conducted clearance wipe and air sampling and oversaw the installation of closed cell foam insulation materials to reduce the future development of mold. Served as safety officer for multi-employer project. [1-13 to Present]

Mold Remediation, New York City, NY, CBRE, Project Scientist. Mold Remediation. Oversaw the removal of mold impacted insulation materials inside of air handler units in a high rise office building. Assisted with developing and installing temporary negative air and HEPA filtration units to reduce worker and building tenant exposure to mold spores during removal and cleaning procedures. Conducted clearance wipe and air sampling and oversaw the installation of closed cell foam insulation materials to reduce the future development of mold. Served as safety officer for multi-employer project. [1-10 to 1-11]

Westin Hotel, Wilmington, DE, BPG, Engineering Clerk. Westin Hotel brownfield redevelopment. A high rise hotel was constructed at a brownfield site at a former ship building facility. Collected soil, sediment and groundwater samples to characterize existing site conditions. Conducted air monitoring and oversaw construction work during cast auger pile and foundation phases involving worker contact with impacted soils. Developed safety program and developed controls to limit worker exposure to heavy metals in soils. Served as Site safety officer in a multi-employer workplace. [8-13 to 2-14]

Mold Abatement, Creston, IL, USPS, Engineering professional. Mold abatement at USPS facility with impacted indoor air quality. Developed work plan for abatement activities to eliminate any worker or building tenant exposure during abatement activities. [1-09 to 3-09]

Emergency Removal Action, Former Zurbrugg Hospital, EPA Region 2, Removal Support Team (RST), EPA, Environmental Technician. Emergency Removal Action, Former Zurbrugg Hospital, EPA Region 2, Removal Support Team (RST), Environmental Technician. Conducted an emergency stabilization of ACM debris piles from demolition activities. Responsible for collection of air samples, both personal and area, also real-time monitoring of particulate matter to determine exposure, determine if current PPE levels were appropriate, if particulate controls were sufficient to eliminate the offsite migration dust. Also was responsible for photo and other site documentation. [2-12 to 3-12]

National Pollutant Discharge Elimination System (NPDES) Sampling, Helicopter Manufacturing Facility, Pennsylvania, Project Scientist. Collected wastewater discharge and stormwater runoff samples for NPDES permit requirements. Responsible for collecting samples for polychlorinated biphenyl (PCB) analysis, using Delaware River Basin Commission (DRBC) methods, during both dry-weather and wet-weather events on an annual basis. Complete updates to HASP and also served as the Site Health and Safety Officer. [6-10 to Present]

ATC Quarterly Sampling Event, Aberdeen Test Center (ATC), Maryland, Aberdeen Proving Ground (APG), Project Scientist. Various matrices are sampled to detect the presence of depleted uranium (DU) in the environment. Nuclear Regulatory Commission (NRC) license requirements mandate quarterly sampling of groundwater, surface water, sediment, surface soil, and vegetation. Game species such as: deer, turkey, fish, and crabs are also sent for laboratory analysis to determine any uptake of DU. Sample locations include areas in live-fire artillery ranges and other restricted areas. Served as Site Health and Safety Officer. [3-10 to 9-14]

Kalamazoo River Oil Spill Emergency Response, Marshall, MI, U.S. Environmental Protection Agency (EPA) Superfund Technical Assessment and Response Team (START), EPA Region V, Environmental Technician. Served as a member of the shoreline cleaning assessment team and the submerged oil locating team. Collected product and water samples downstream from the release site, in remote areas only accessible by boat. Also responsible for potentially responsible party (PRP) contractor oversight, and documentation. [8-10]

Baseline Residential Water Sampling, Confidential Client, Project Scientist. Responsible for contacting land and property owners to make appointments to sample drinking water. Also responsible for the documentation and sampling of all drinking water sources within a 4,000-foot radius around a proposed natural gas well location prior to commencement of drilling operations. [9-10 to 9-12]

Stray Methane Gas Monitoring, Pennsylvania, Confidential Client, Project Scientist. Atmospheric conditions inside residences were monitored for the presence of methane. In addition, air monitoring equipment was used to headspace water from faucets following the suspected release of methane from natural gas drilling operations. Served as Site Health and Safety Officer. [9-10 to 9-12]

Local Discharge Limits Modeling, Pennsylvania, Delaware County Regional Water Quality Control Authority (DELCORA), Project Scientist. Local discharge limits were evaluated, and an EPA-developed spreadsheet was used to determine the feasibility of a wastewater treatment facility capacity or volume increase based on current local permit discharge limits. [9-10 to 9-11]

Time Critical Removal Action, EPA, Stoney Creek Technologies, EPA Region III, START, Environmental Technician. Conducted an inventory of all on-site ASTs to determine size and remaining product volume. Inspected condition of ASTs to prioritize cleanouts during site decommissioning using a risk-based approach. Conducted air-monitoring to measure atmospheric conditions for permit-required confined space entries to facilitate AST cleanouts in level B PPE. Selected proper PPE for contractors during AST cleanouts, including Level B, Level C and Level D modified PPE. Sampled areas of concern for potential asbestos-containing material (ACM). Also was responsible for conducting oversight of other EPA contractors and subcontractors during AST cleanouts and site decontamination. Also collected groundwater, soil, sediment, stormwater, and surface-water samples in support of a National Priorities List (NPL) Hazard Ranking System (HRS) ranking assessment. Assisted with two groundwater monitoring well installations. Assisted with daily safety and operations meetings. Drafted Site specific Health and Safety Plan. Served as Site Health and Safety Officer. [7-10 to 7-13]

Time Critical Removal Action, Tank Car Corporation of America, EPA Region III, START, Project Team Leader. Responsibilities included developing a Site Specific Health and Safety Plan, Air Monitoring Plan, Sampling Plan, coordinating with the Contract Laboratory Program (CLP) laboratory for soil analysis. Other investigative work involved the use of a Geoprobe to delineate the extent of contamination. Also coordinated with the Southeastern Pennsylvania Transportation Authority (SEPTA) for access to railroad right-of-way areas for removal of contaminants that migrated off-site. Recommendations were made for erosion and sediment controls. Assisted the EPA On-Scene Coordinator (OSC) with site documentation, submitted draft polreps, and assisted with other technical support during the removal of heavy-metals contaminated sandblasting grit covering the site, and tar-like contamination below ground surface. Served as Site Health and Safety Officer. [7-10 to 7-11]

Time Critical Removal Action, Powhatan Mining Company, EPA Region III, START, Environmental Technician. Collected surface soil samples to determine the presence of asbestos following a building demolition. Collected high volume air samples to analyze for the presence of asbestos fibers. Analytical results will be used to determine if follow-up action is necessary. [2-10 to 2-11]

Emergency Removal Action, Lighthouse Lane Laboratory, EPA Region III, START, Environmental Technician. Conducted air monitoring during the emergency removal of laboratory chemicals stockpiled inside of a residence. Assisted the EPA OSC with site documentation and cost tracking. Coordinated with CLP laboratory for SUMMA canister analysis used to verify effective site decontamination prior to the residents moving back into the home. [12-10]

West Canal Creek, Aberdeen Proving Ground (APG), MD Site, West Chester, PA, U.S. Army, Project Assistant. Provided data summaries, and sound conclusions and recommendations based on previous surface and groundwater sampling, field investigations, and literature reviews within the established project schedule. [4-08 to 6-08]

Indoor Air Sampling, Pennsylvania, Confidential Client, Project Scientist. Conducted indoor air quality sampling for a pharmaceutical manufacturing facility. Monitored indoor air quality for various parameters to ensure worker safety. Parameters included particulate matter, volatile organic compounds (VOCs), carbon dioxide, relative humidity, and carbon monoxide during a planned routine maintenance shutdown of a packaging line. Also responsible for submitting written reports documenting sample results to the client. [5-08 to 12-08]

Groundwater Sampling, Pennsylvania, Confidential Client, Project Scientist. Collected groundwater samples utilizing both hand and electronic means of collection in support of a bi-annual sampling campaign, monitoring the effects to groundwater caused by a wastewater spray irrigation system. [3-08]

Personal Air Sampling, Delaware, Confidential Client, Database Manager. Tasks during the reporting phase of this project included the following: database management, statistical analysis, and collection, entry, and recordkeeping of all sampling events conducted. Provided quality assurance/quality control (QA/QC) in collection and recording of data during the project. [4-08 to 6-08]

Industrial Hygiene Assessment, Pennsylvania, Insaco, Inc., Project Scientist. Provided the client with ongoing industrial hygiene support. Conducted a hazard analysis and assessed the health and safety impacts of all new materials to be handled and machined on-site to ensure all appropriate environmental and engineering controls are in place to avoid employee exposures. [2-08 to Present]

Greenhouse Gas (GHG) Inventory, West Chester, PA, WESTON, Project Scientist. Conducted a GHG inventory to fulfill the reporting requirements of the California Climate Action Registry, General Reporting Protocol. Assisted in producing an inventory management plan, and collected data from all actions that directly or indirectly produced GHG emissions for reporting year 2007. Data were used to calculate the total carbon dioxide emissions of WESTON's U.S. operations for 2007. [12-08]

Data Table Production, Chester, PA, Confidential Client, Project Scientist. Managed analytical data from soil and groundwater samples collected during field investigations. Excel was utilized to produce data tables for a remedial investigation (RI) report that was submitted to the Pennsylvania Department of Environmental Protection (PADEP). [11-08]

Soil Sampling, Somerset County, NJ, Montgomery Township, Project Scientist. Collected soil samples utilizing hand auger technique and direct push Geoprobe® technology, adhering to New Jersey Department of Environmental Protection (NJDEP) sampling standards, and according to a predetermined sampling plan. [7-08]

Groundwater Sampling, Somerset County, NJ, Montgomery Township, Task Manager. Supervised collection of groundwater samples utilizing electronic low-flow sampling techniques as a means of collection, adhering to NJDEP sampling standards, and according to a predetermined sampling plan. [9-08]

Groundwater Sampling, Chester, PA, Confidential Client, Project Scientist. Collected groundwater samples utilizing electronic low-flow sampling as a means of collection, in support of a remedial action investigation. [11-08]

Data Table Production, Real Estate Due Diligence, Williamsport, MD, Database Manager. Managed all analytical data from soil and groundwater samples collected during field due diligence investigations. Excel was utilized to produce data tables used in a due diligence investigation for a possible Integrated Redevelopment and Infrastructure Solution (IRIS) opportunity. [12-08]

Sustainability Action Team, West Chester, PA, WESTON, Team Member. Project involves an organized effort to increase sustainability efforts. As part of a team of volunteers, is conducting an evaluation of a building on the West Chester campus as a candidate to achieve Leadership in Energy and Environmental Design (LEED®) certification for Existing Buildings: Operations and Maintenance. [6-08 to Present]

Alternatives Assessment Report, Pennsylvania, PADEP, Project Scientist. Developed a report outlining options for groundwater remediation involving a plume of volatile organic compounds in a deep aquifer, near several residences. [3-09]

Aboveground Storage Tank (AST) Inspections, Aberdeen Proving Ground (APG), MD, Department of Public Works (DPW), Project Scientist. Responsible for monthly inspections of over 550 ASTs and process piping, containing various fuels, ranging in sizes up to 300,000 gallons, to ensure compliance with Code of Maryland Regulations (COMAR), and the Spill Prevention, Control, and Countermeasures (SPCC) Plan outlined in a Maryland Department of Environment (MDE)-issued Oil Operations Permit. Duties involved coordination of inspections in live-fire range areas, classified areas, and various environmentally sensitive areas encompassing over 70,000 acres. Responsible for performing inspections, notifying emergency response personnel of any findings, entering various inspection parameters and global positioning system (GPS) points for all AST locations into WESTON proprietary TankFAST database program, and producing monthly reports to submit to the client. Responsible for initiating proper work requests/service orders to correct noted deficiencies, monitoring deficiencies corrective actions to ensure timely compliance, and maintaining adequate record files to comply with regulatory guidance. Also participated in APG monthly storage tank committee meetings regarding AST and underground storage tank (UST) policies, maintenance, repair, replacement, and compliance with COMAR. Served as Site Safety Officer. [4-09 to 2-10]

Erosion and Sediment Control Inspections, Aberdeen Proving Ground (APG), MD, DPW, Project Scientist. Responsible for the oversight of erosion and sediment control devices for various construction projects related to Base Realignment and Closure (BRAC) expansion at the facility. These include secure facility gate upgrades, expansion to roads and intersection, secure building construction, demolition, adaptive building re-use, and various utility and infrastructure upgrades. Weekly inspections involved coordinating a site walk with project stakeholders including base personnel, U.S. Army Corps of Engineers (USACE) personnel, and contractor and subcontractor representatives. Served as Site Health and Safety Officer. [4-09 to 4-10]

Sediment Sampling, Southport Container Terminal, Philadelphia, Philadelphia Regional Port Authority, Project Scientist. Collected sediment cores of various lengths in up to 40 feet of water along a tidally influenced portion of the Delaware River aboard a boat equipped with a Vibracore drill rig. Also, collected grab samples utilizing a small ponar unit. Served as Site Health and Safety Officer, and produced float plan. Also, produced data tables from laboratory analysis electronic data deliverables (EDDs). [3-09]

Regulated Building Materials Survey, West Point, NY, U.S. Military Academy, Project Scientist. Responsible for a building walk-through survey to identify potential asbestos-containing material and lead-based paint, in areas impacted by a proposed building expansion. Also was responsible for developing a site-specific health and safety plan, which included work methods, personal air sampling, site-specific procedures, and personal protective equipment. The results were then used to conduct a hazard analysis and develop controls used in the building expansion. [3-09]

Personal Air Monitoring, Pennsylvania, Helicopter Manufacturing Facility, Project Scientist. Conducted personal air sampling overseeing contractor employees performing heating, ventilation, and air conditioning (HVAC) utility removal and upgrades. Personal air sampling pumps utilized NIOSH Method 7024 and 7300. Evaluated data to confirm appropriate PPE and respiratory protection was utilized and if upgrade/downgrade was warranted. [4-09]

Fish Sampling Event, Southport Container Terminal, Philadelphia, Philadelphia Regional Port Authority, Project Scientist. Methods of collection utilized in the Delaware River included the use of a boat-mounted electrofishing unit, seine netting, and setting trotlines. In an adjacent tributary stream/drainage channel, a portable electrofishing unit and seine net were utilized. Fish were identified, measured, and released. Fish species were identified in an effort to identify critical spawning grounds near a proposed dredging operation. Created a float plan and served as health and safety officer to ensure safe boating operations. [4-09]

Wastewater Treatability, Wilmington, DE, E.I. DuPont de Nemours, DuPont Engineering Technology (DuET) Environmental Group, Wastewater Laboratory Technician. While employed with Adecco Technical, projects involved design and oversight of wastewater treatability studies. Performed maintenance and calibration of laboratory analytical equipment, along with analysis of general wastewater quality parameters and other case-dependent parameters. Collected wastewater samples from manufacturing plant sites including grab samples and time-composite effluent outfall samples. Proficient with EPA Method 1669 for sampling of ambient water for trace levels of metals. Safely worked with Resource Conservation and Recovery Act (RCRA) wastes and other hazardous materials. [8-04 to 2-08]

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TOM P. DAKIN

has satisfactorily completed the prescribed courses of study in

OSHA 29 CFR 1910.120 40 HOUR HEALTH AND SAFETY TRAINING FOR HAZARDOUS WASTE OPERATIONS

4.0 CEU

and is awarded this certificate

F Tucker Mulrooney

Industrial Training Division/Corp & Community Programs

Lawrence Miller

Campus Director

DELAWARE TECH

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NEWARK, DE 19713-2197 (302) 453-3000 04/2

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THOMAS DAKIN

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30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 06/12/2009 in West Chester, PA

TRAINING MANAGER	INSTRUCTOR
Conrad W. Lehr, CET, CIT	**Conrad W. Lehr**

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Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

THOMAS DAKIN

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 04/02/2009 in West Chester, PA

Conrad W Lehr, CET
TRAINING MANAGER
Conrad W. Lehr, CET, CIT

Conrad W Lehr, CET
INSTRUCTOR
Conrad W. Lehr

195_15745_04022009 *Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380*

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

THOMAS DAKIN

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 10/08/2015 in West Chester, PA

Herold S Hannah

TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III

INSTRUCTOR
Lawrence J. Werts III

1_15745_10082015

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WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

THOMAS DAKIN

Has Completed the

Bloodborne Pathogens Training Course Initial

In accordance with 29 CFR 1910.1030 completed on 10/08/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

11_15745_10082015

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American Red Cross

Certificate of Completion

Thomas Dakin
has successfully completed requirements for

First Aid - valid 2 Years

conducted by
American Red Cross

Date Completed: 12/01/2014
Instructors: Lawrence John Werts III

Certificate ID: GR27FI

To verify, scan code or visit:
redcross.org/confirm

American Red Cross

Certificate of Completion

Thomas Dakin

has successfully completed requirements for

CPR/AED for Professional Rescuers and Health Care Providers - valid 2 Years

conducted by

American Red Cross

Date Completed: 12/01/2014

Instructors: Lawrence John Werts III

Certificate ID: GR27HJ

To verify, scan code or visit: redcross.org/confirm

Louise Kritzberger, CHST

Qualifications Summary

- Over 27 years of professional experience.
- Over 27 years of experience in emergency response.
- Five years as Lead Health and Safety Officer for WESTON's Mid-Atlantic Division Federal Team.
- Over 5 years of experience with construction safety, including excavations, critical lift, general construction, and concrete installation.
- Over 5 years of EPA Emergency Response experience.
- Over 10 years of experience writing complex Safety Plans.
- More than 20 years as a Field Safety Officer.
- Recipient of WESTON's Safety Recognition Coin.
- Over 25 years of experience as both a lead and support technician in ambient air, groundwater and soil sampling procedures.
- Construction safety audit and program evaluation experience.
- Oversight of environmental health and safety (EHS), respiratory protection, and medical monitoring programs.
- Responsible for audits and employee training in accordance with OSHA and EPA regulations.

Credentials

Firefighter Certification, Level I, Montgomery County Fire Academy, Pennsylvania (1984)
Construction Health & Safety Technician (CHST) (No. C2639) (2012)
Construction Quality Management for Contractors Certification, USACE (2013)

Training, Memberships & Awards

- Safety Officer Pro Board (2014)
- Electrical Safety Training Level II, WESTON (2014)
- 40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), WESTON (1991)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2015)

- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (1993)
- 30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, WESTON (2008)
- 10-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2004)
- Behavior Based Safety, Phase I Training, WESTON (2008)
- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1026 Subpart P, WESTON (2008)
- Confined Space Training – Entrant, Attendant, Non-Entry Rescue, OSHA 29 CFR 1910.146, WESTON (2007)
- Fall Protection Competent Person Training Course – Initial, OSHA 29 CFR 1926 Subpart M, WESTON (2008)
- Fall Protection Competent Person Training Course – Refresher, OSHA 29 CFR 1926 Subpart M, WESTON (2010)
- First Defender Chemical Identification Training, AHURA Scientific Inc. (2010)
- Erosion and Sediment Control Certification, Green Card (Initial), State of Maryland (2010)
- Dangerous Goods Shipping Refresher, WESTON (2013)
- First Aid/CPR/AED Training, American Red Cross (2015)
- Basic Plus Initial, South Jersey Gas Training Center (2008)
- Basic Plus, Tennessee Valley Training Center (2009)
- Basic Plus Refresher, Tennessee Valley Training Center (2013) (2014)
- Bloodborne Pathogens Training, OSHA 29 CFR 1910.1030, WESTON (1995)
- Bloodborne Pathogens Refresher Training, OSHA 29 CFR 1910.1030, WESTON (2015)
- Accident Prevention for USACE Contractors, AGC (2012)
- EPA START – Air Monitoring Exercise (2010)
- EPA START – Assessment Scenario Exercise (2010)
- EPA START – Emergency Response Orientation (2010)
- EPA START – HAZCAT (2010)
- EPA START – Level A Team Overview (2010)
- EPA START – Minor Containment and Control of Discharges, Spills, and Releases (2010)
- EPA START – Multi-Media Sampling Basics (2010)
- EPA START – Recognition and Identification of Hazards (2010)
- Tap-Root Lite Accident Investigation Training Course, WESTON (2008)
- Ergonomics Evaluator Training, WESTON (2007)
- IS-100 Incident Command, FEMA (2007)

- IS-200 Incident Command, FEMA (2007)
- IS-301 Incident Command, FEMA (2012)
- IS-302 Incident Command, FEMA (2012)
- IS-700 National Incident Command, FEMA (2004)
- IS-800 Incident Command, FEMA (2009)
- IS-906 Incident Command, FEMA (2011)
- ITRC 16-Hour Vapor Intrusion Pathway Training (2011)
- Function-Specific Dangerous Goods Shipping, WESTON (2004)
- Niton XRF Spectrum Analyzer Training (1998)
- Niton XRF Radiation Safety Training (2010)
- Emergency Response HAZMAT, Kimberton Fire Company (1996)
- Hazardous Materials Technician, 29 CFR 1910.120, ERM, Inc. (1995)
- First Responder Operations Level, 29 CFR 1910.120, ERM, Inc. (1994)
- AHERA Asbestos/Building Inspector Initial, WESTON (1993)
- Basic Fire Photography, PA State Fire Academy (1993)
- Hazardous Materials – First Responder, Chester County Fire Training School (1990)
- Basic Practical Hazardous Materials, HAZMAT, Inc. (1988)
- Recognizing and Identifying Hazardous Materials, National Fire Academy (1988)
- Recognizing and Identifying Hazardous Materials, PA Emergency Management Agency, State Fire Academy (1988)
- Emergency Medical Technician – MAST, PA Emergency Medical Services Program (1988)
- First Responder, National Highway Traffic Safety Administration, PA Emergency Medical Services Program (1985)
- Firefighting I, Montgomery County Fire Training School (1984)

Employment History

1988 to Present WESTON
1987 to 1988 Western Surety
1985 to 1987 Main Line Nursing Center
1984 to 1985 Pest-X

Key Projects

Warrington Site PFOS/PFAS, Warrington, PA, EPA Emergency Response, Response Safety Officer. Conducted groundwater sampling at residential and commercial locations for perfluorooctane sulfonate/perfluoroalkyl sulfonates (PFOS/PFAS) to determine the extent of contamination and to provide safe drinking water alternatives. [9-14 to Present]

Joint Base Andrews Naval Air Facility Washington, Camp Springs, MD, Site Lead. Conduct groundwater sampling in high-profile area; base escort for WESTON and subcontractors; airfield driving privileges. [6-10 to Present]

EPA Emergency Response, Multiple Locations, EPA Region 3, Response Specialist. Response Specialist on EPA Region 3 contract. Conducted responses at numerous site locations to assist On-Scene Coordinators (OSCs). [7-10 to Present]

AMSCS Building Dismantling, DLA Distribution Susquehanna, PA, Health and Safety Officer and Site Lead. Wrote in-depth Accident Prevention and Safety and Health Plans for site activities. Site work included one-call activities, moving electric supply to other buildings; removal and recycling of metals and concrete associated with the dismantling; site grading and seeding; photo documentation of all activities.

Groundwater Sampling Events, Joint Base Andrews Naval Air Facility (AFNS), MD, Health and Safety Officer and Site Lead. Utilized Hach testing for groundwater constituents, provided daily safety briefings, coordinated access to secure areas, conducted groundwater sampling using bladder pumps. Wrote Accident Prevention Plan (APP) for site activities.

Advanced Metering Infrastructure (AMI), Washington and Mid-Atlantic - Multiple Locations, Naval Facilities Command (NAVFAC), Health and Safety Officer. Involved with writing in-depth safety plans for construction sites where utility meters for natural gas, electric, and water were being replaced. [9-11 to 1-12]

Munitions and Explosives of Concern (MEC) Removal, Tobyhanna Army Depot (TYAD), Tobyhanna, PA, Health and Safety Officer. Wrote safety plan for forested-area MEC removal. [8-11]

Construction Activity, Site 1, Pennsylvania, Site Safety Officer. Safety oversight of daily construction activities including excavations, confined space, critical lifts, concrete installation, and building renovations. Tasks included daily safety briefings, weekly tailgate meetings, and monthly supervisor meetings; updated discrepancy list; tracked safety hours; and celebrated safety milestones. Provided asbestos awareness training to staff and subcontractors. [7-09 to 8-10]

Construction Activity, Alternate Site, Maryland, Site Safety Officer. Safety oversight of daily construction activities including excavations, critical lifts, concrete installation, and building renovations. Tasks included daily safety briefings, weekly tailgate meetings, and monthly supervisor meetings; updated discrepancy list; tracked safety hours; and celebrated safety milestones. [8-10 to 10-10]

Soil Vapor Extraction (SVE), Mountain Top, PA, U.S. Environmental Protection Agency (EPA). Responsible for the installation and sampling of 10 SVE points in residential basements, and the collection of Summa samples sent for laboratory analysis. Removed and sealed sample points. [11-10]

X-ray Fluorescence, Schnecksville, PA, EPA. Responsible for the collection and analysis of surface soils via XRF. Prepared samples by drying and pulverizing soils, and analyzed over 500 samples. [10-10 to 11-10]

Health and Safety Programs, West Chester, PA, WESTON, Mid-Atlantic Federal Team, Health and Safety Officer. Responsible for the health and safety programs for approximately 120 people on the Mid-Atlantic Federal Team. Involved in writing in-depth safety plans for construction and environmental sites, reviewing medical clearances and site requirements, providing new employee orientations, and instituting behavior-based safety (BBS). Provided support to Mid-Atlantic Environmental Health and Safety (EHS) Division Manager. Developed and implemented procedures, protocols, and site-specific plans for projects involving sampling, treatment, excavation, and drilling operations. Responsible for implementation of respiratory protection program, including provision of quantitative fit tests using the PORTACOUNT Plus Respirator Fit Tester and FitPlus Fit Test software package, in addition to qualitative fit testing. Provided training to division safety staff on PORTACOUNT operation. Site Health and Safety Officer for over 20 projects addressing site safety issues, safety enforcement, and compliance with approved plans. [5-03 to Present]

New Employee Orientation Program, West Chester, PA, WESTON. Responsible for the development and implementation of the Mid-Atlantic New Employee Orientation (NEO) Program. Program has been used as a template by the Corporate EHS Division for other locations. Program combines all safety and environmental facets, i.e., personal protective equipment (PPE), Code Blue, environmental compliance, ergonomics, Notice of Incident (NOI) reporting, security, training expectations, and Central and Regional Equipment Stores (CES/RES) EquipTrack. [12-07 to 12-09]

Safety Training, West Chester, PA, WESTON. Responsible for setup and implementation of various safety training for the Mid-Atlantic Division and subcontractors including BBS Overview, Underground Utilities, Asbestos Awareness, and WESTON’s Environmental Compliance Policy.

Groundwater Sampling, Former Nansemond Ordnance Depot (FNOD), Suffolk, VA, U.S. Army Corps of Engineers (USACE), Technician/Field Lead. Purged and sampled monitoring wells using a low-flow peristaltic pump. Instructed and evaluated junior-level personnel on sampling specifics.

GreenGrid® Installation, TYAD, Tobyhanna, PA, USACE, Safety/Field Lead. Responsible for safety watch for GreenGrid® green roof installation. Competent person for fall protection activities including crane lifting of supplies. [5-08 to 7-09]

GreenGrid® Installation, Baltimore, MD, University of Maryland, Safety Lead. Responsible for safety watch for GreenGrid® green roof installation. Competent person for fall protection activities including crane lifting of supplies along major highway and pedestrian travelways. [4-08]

Logistics and Equipment Management, Hurricane Ike, Houston, TX, EPA Region 6, Technician. Provided field service support for EPA emergency response for hurricane recovery. Responsible for equipment calibration and documentation, and equipment and supply acquisition. Assisted with management of logistics including setup, and managed multiple command post equipment stores. Supported technical staff of over 200 with global positioning system (GPS), Personal Digital Assistants (PDAs), photoionization detectors (PIDs), and supplies required for recovery. Responsibilities included tracking pieces of equipment from different agencies, and updating databases to ensure the return of capital equipment.

Closure of Former Nike Missile Silos, Various Sites in Maryland and Pennsylvania, Goel Services and USACE Baltimore District, Site Safety and Health Officer and Quality Assurance (QA) Oversight. Authored the APPs and safety plans for 12 former U.S. Army Nike missile silos in Maryland and Pennsylvania. Provided health and safety, and QA documentation and oversight for Goel Services during the silo water, lead paint, asbestos, underground storage tank (UST), and hydraulic fluid abatement activities. Duties included health and safety monitoring and technical guidance for compliance with Occupational Safety and Health Administration (OSHA) regulations and USACE EM 385-1-1 requirements. Collected QA documentation, including logbook and photodocumentation of abatement activities, and provided coordination of silo water sampling and disposal.

Logistics and Equipment Management, Hurricane Katrina, New Orleans, LA, EPA Region 6, Technician. Provided field service support for the EPA emergency response. Managed EPA response to OSHA challenge regarding equipment and supply acquisition, and for calibration and documentation. Assisted with management of logistics including setup; managed multiple command post equipment stores. Supported technical staff of over 400 with GPS, PDAs, PIDs, and supplies required for recovery. Was accountable for and tracked over 1,300 pieces of equipment from five agencies. Maintained databases to ensure the return of capital equipment. Assisted with logistics including facility setup, building services, general facility operations, and customer assistance. [9-05 to 8-06]

Columbia Shuttle Recovery Data Management, EPA Region 6, Technician. Responsible for photo and data management. Efforts involved linking paper data with electronic photos. Coordinated efforts between National Aeronautics and Space Administration (NASA) personnel and Weston. Supervised a team of 10 personnel for approximately 5 weeks.

Data Management, New York, Confidential Client, Technician. Responsible for electronic and paper data management of historic and current data. Involved map and spreadsheet coordination and development.

Earthwork at Worldgate Monument III Project, Herndon, VA, James G. Davis Construction Corporation, Field Safety Officer. Excavated and removed over 17,000 yd^3 of soil and rock in support of the mass and structural excavation activities at the site for a 191,000-ft^2, 7-story building completed by the end of 2006. Provided excavation and backfill (interior and exterior) and related tasks such as erosion and sediment control, stormwater management, transportation and disposal of soil and rock, sub-grade preparation, and rough and finish grading. Provided a fully trained earthwork team to complete the specific scope of work and other assigned tasks. No lost-time accidents occurred on this project. [12-00]

Soil Excavation, Diamond State Salvage Company, Wilmington, DE, EPA Region 3, Technician. Responsible for daily safety and oversight of contractors on soil excavation project, which included excavation and restoration of a riverbank protected by a cofferdam. Project involved the removal of 100,000 tons of soil and 5,190 tons of debris and iron. [12-98 to 12-99]

Groundwater Sampling, Chambersburg, PA, Letterkenny Army Depot (LEAD), Technician. Conducted semiannual groundwater monitoring and sampling using a Grundfos groundwater pump at various monitoring wells throughout the site. Samples were collected after three times the well volume had been purged and all physical parameters had stabilized. Responsible for groundwater sampling, equipment calibration, and documentation of field activities.

Groundwater Sampling, TYAD, Tobyhanna, PA, USACE, Technician/Field Lead. Conducted semiannual groundwater monitoring and sampling using a Grundfos groundwater pump at various monitoring wells throughout the site. Samples were collected after three times the well volume had been purged and all physical parameters had stabilized. Responsible for groundwater sampling, equipment calibration, and documentation of field activities.

SVE Air Sampling, Defense Depot Susquehanna Pennsylvania (DDSP), Technician/Field Lead. Responsible for multiple air sampling events and documentation of field activities at SVE locations.

Groundwater Sampling, Pease Air Force Base (AFB), NH, Technician/Field Lead. Conducted groundwater monitoring and sampling using Grundfos groundwater pumps at various monitoring well types. Conducted equipment calibration and documentation of field activities. Coordinated sampling events involving 200+ well locations and multiple teams. Performed field pH and conductivity tests on samples. [8-90 to 8-96]

Groundwater Sampling, Multiple Sites in Pennsylvania and New York, Confidential Client, Technician/Field Lead. Conducted groundwater monitoring and sampling using Grundfos groundwater pumps at various monitoring wells. Samples were collected after three times the well volume had been purged and all physical parameters had stabilized. Responsible for groundwater sampling, equipment calibration, and documentation of field activities.

Soil Excavation, Multiple Sites in Pennsylvania and New York, Confidential Client, Technician/Field Lead. Responsible for safety during soil excavations using Case 150 at various facilities to search for possible landfill following geophysical surveys. Soils were dug to a depth of 5 to 6 feet to confirm or deny landfill existence.

Groundwater Sampling, Enterprise Avenue Landfill, Philadelphia, PA, Technician. Responsible for groundwater sampling, equipment calibration, and documentation of field activities.

Field Testing for Polycyclic Aromatic Hydrocarbons (PAH) and Polychlorinated Biphenyl (PCB) Soils, Carlisle, PA, Carlisle Army Barracks, Technician. Performed laboratory field tests on soil samples to determine whether PAHs or PCBs were present. Test results were sent to a fixed laboratory for further analysis and disposal.

Soil Excavation, Washington National Airport, Technician/Field Lead. Responsible for safety for soil excavations using Case 150 to search for possible landfill following geophysical surveys. Soils were dug to a depth of 5 to 6 feet to confirm or deny landfill existence in preparation for runway construction activities.

Groundwater Sampling, Multiple Sites in West Virginia, Ohio, Kentucky, New York, Pennsylvania, Confidential Client, Technician. Responsible for groundwater sampling, equipment calibration, and documentation of field activities.

Data Management, West Chester, PA, and Pittsfield, MA, EPA/USACE, Technician. Responsible for electronic and paper data management of historic and current data. Involved map and spreadsheet coordination and development.

Stormwater Monitoring, Pittsfield, MA, EPA/USACE, Technician. Responsible for collection of stormwater data during multiple sampling events.

Soil Sampling, Multiple Sites in West Virginia, Ohio, Kentucky, New York, Pennsylvania, Confidential Client, Technician. Responsible for soil sampling, equipment calibration, and documentation of field activities.

Air Toxics and Groundwater Sampling Program, Valmont Site, West Hazleton, PA, Pennsylvania Department of Environmental Protection (PADEP), Technician/Field Lead. Responsible for the health and safety, sampling, setup, and QA of a 1-week air toxics and groundwater sampling program. Sampling included packer testing of monitoring wells, residential indoor air, residential soil gas, and ambient air. Health and safety responsibilities included writing and implementing safety plan, daily safety discussions, and monitoring.

Air Toxics and Groundwater Sampling Program, Dunmore Gas Site, Dunmore, PA, PADEP, Technician. Responsible for the health and safety, sampling, setup, and QA of a 3-week air toxics and groundwater sampling program. Sampling included packer testing of monitoring wells and ambient air. Health and safety responsibilities included writing and implementing safety plan, daily safety discussions, and monitoring.

Roy F. Weston, Inc.

6418

This certifies that

LOUISE KRITZBERGER

has completed the

40-HOUR HAZARDOUS WASTE SITE TRAINING COURSE
MEETS 29 CFR 1910.120 (e) (3)

WEST CHESTER, PENNSYLVANIA

APRIL 29, 30, MAY 1, 2, AND 3, 1991

	05/03/91
Corporate Health & Safety Director	Date

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

LOUISE KRITZBERGER

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 08/04/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_1098_08042015

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06P-0910-2

American
Red Cross

Louise Kritzberger

has successfully completed requirements for

Adult First Aid/CPR/AED: valid 2 Years

Date Completed: 02/18/2015

conducted by: American Red Cross

Instructor: Lawrence John Werts III

ID: GRBAWV
Scan code or visit:
redcross.org/confirm

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

LOUISE KRITZBERGER

Has Completed the

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 02/22/2008 in West Chester, PA

TRAINING MANAGER
Conrad W. Lehr, CET, CIT

INSTRUCTOR
Conrad W. Lehr CET

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06P-0910-2

10107

Roy F. Weston, Inc.

This certifies that

LOUISE KRITZBERGER

has completed the

SITE HEALTH AND SAFETY COORDINATORS TRAINING COURSE
MEETS 29 CFR 1910.120 (e) (4)

WEST CHESTER, PENNSYLVANIA
AUGUST 10, 1993

George M Crawford Jr
Corporate Health & Safety Director

08/10/93
Date

The Continuing Education Unit

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

LOUISE KRITZBERGER

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 08/04/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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06P-0910-2

Daniel P. Locurcio, LEED® AP

Qualifications Summary

- Fourteen years of experience in environmental science and health and safety.
- Twelve years of experience documenting site investigations, risk assessments, and remediation under the CERCLA program.
- Seven years of experience in the field of vapor intrusion.
- Authored technical reports concerning remediation of contaminated soil and groundwater.
- Authored technical reports concerning the sampling, analysis and mitigation of contaminated sub-slab vapor.
- Trained in hazardous waste operations, construction health and safety, CPR and basic first aid.
- Led multiple field efforts and performed groundwater and soil sampling.

Credentials

LEED Accredited Professional, U.S. Green Building Council (LEED AP), Green Building Certification Institute, Pennsylvania (2008)

Education

B.E., Chemical Engineering - Villanova University (2001)

Training, Memberships & Awards

- 40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), Compliance Solutions (2002)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2015)
- 10-Hour Construction Safety Training, OSHA 29 CFR 1926, WESTON (2004)
- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (2005)
- 30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, WESTON (2007)
- Field Safety Officer (FSO) Certification, WESTON (2009)
- Bloodborne Pathogens Training, OSHA 29 CFR 1910.1030, WESTON Initial (2006); Refresher WESTON (2015)

- Behavior Based Safety – Phase I Training, WESTON (2008)
- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1026 Subpart P, WESTON (2007)
- Fall Protection Competent Person Training Course – Refresher, OSHA 29 CFR 1926 Subpart M, WESTON (2007)
- Shipping and Transporting Dangerous Goods – Admin/Field Personnel – Initial, Weston Solutions, Inc., Manual of Procedures for Shipping and Transporting Dangerous Goods Training Course, 49 CFR 172 Subpart H, WESTON (2008)
- First Aid/CPR/AED Training, American Red Cross (2015)
- Boating Safety Training Course, BOAT-ED.com (2004)

Employment History

2004 to Present WESTON
2002 to 2004 Versar, Inc.
2001 Maida Engineering
2000 Maida Engineering

Key Projects

Gold King Mine Emergency Response, Dallas, TX, EPA Region 6, Environmental Scientist. Worked in the REOC in Dallas and tracked all samples collected as part of the Emergency Response in Region 6. Served as a liaison to EPA to explain issues related to field activities, field sampling, data delivery, and various other issues. [8-15 to 9-15]

Midway Cleaners, Wyoming, PA, EPA Region III, Environmental Scientist. Authored Sampling and Analysis Plan for soil gas investigation in the vicinity of a former dry cleaning facility (Midway Cleaners Superfund Site). [5-15 to 8-15]

Letterkenny Army Depot, Chambersburg, PA, United States Army, Engineering Project Leader. Authored various technical reports including a letter report to provide the results of dioxins sampling, a Feasibility Study, Proposed Remedial Action Plan, two Records of Decision, and a Sampling Plan. Coordinated directly with client and regulatory agencies to facilitate the review of the documents, respond to their comments, and obtain approval/concurrence from all. [1-15 to 11-15]

Letterkenny Army Depot, Chambersburg, PA, United States Army, Engineering Project Leader. Authored various technical reports including a Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and a Sub-Slab Depressurization System Remedial Design (SSDS RD). Coordinated with project chemist and technical managers to complete QAPP, which also served as a Work Plan for vapor intrusion sampling at the Building 37 Site at Letterkenny Army Depot. Conducted vapor intrusion sampling at the Building 37 Site. Provided letter report to the client describing results of the study. [1-15 to 11-15]

Letterkenny Army Depot, Chambersburg, PA, United States Army, Engineering Project Leader. Authored various technical reports including Feasibility Studies, Records of Decision, Land Use Controls Remedial Designs, Work/Sampling Plans. Coordinated directly with client and regulators to facilitate the review of documents. [3-13 to 11-15]

Arrowhead Plating, Montross, VA, EPA Region III, Environmental Scientist. Conducted vapor intrusion sampling in the former Arrowhead Plating manufacturing facility. Provided detailed letter report to client describing results of the study. [3-13 to 7-13]

Ordnance Products (EPA Region III START IV), North East, MD, EPA, Environmental Scientist. Conducted vapor intrusion sampling in two residences. Provided detailed letter report to client. Prepared a Feasibility Study to evaluate options to mitigate vapor intrusion pathway. Designed and installed vapor mitigation systems in both homes. [3-13 to 7-13]

Request for Bids for Vapor Intrusion Sampling and Analysis and Sub-Slab Mitigation System Installation, Frederick, MD, Fort Detrick, Project Scientist. Developed field sampling objectives and methodologies, and assisted in preparing costs for the associated work. Also assisted with design of sub-slab mitigation systems and associated costing to support proposal team. [1-12 to 12-12]

U.S. Environmental Protection Agency (EPA) Superfund Technical Assessment and Response Team (START) 4 Project Team - Ordnance Products Site, North East, MD, EPA, Project Scientist/WESTON Team Lead. Communicated with client on a regular basis, managed budget, and performed site visits, and made recommendations for sub-slab vapor mitigation. [1-12 to 12-12]

EPA START 4 Project Team – Douglassville Disposal Site, Douglassville, PA, EPA, Project Scientist/Field Safety Officer. Assisted WESTON Site Leader with preparations for sampling effort, collected groundwater samples, installed vapor probes for sub-slab sampling inside homes near the site, and packed and shipped samples. [1-11 to 12-11]

EPA START 4 Project Team - SGS Thomson Microelectronics Site, Montgomeryville, PA, EPA, Project Scientist/WESTON Site Lead. Communicated with client on a regular basis, analyzed groundwater flow direction and historical groundwater data with a WESTON Senior Geologist, managed the budget, acquired necessary equipment, and wrote the Health and Safety Plan (HASP) and Field Sampling Plan (FSP). Coordinated the field sampling effort, which included installing temporary vapor probes, collecting sub-slab, indoor air, and ambient air samples; and field documentation. Assumed responsibility of Field Safety Officer. Shipped samples to a laboratory. Discussed the results with the client and prepared a Findings Report, which included analysis of the data and conclusions based on the data. [1-10 to 1-11]

EPA START 4 Project Team - Boarhead Farms Site, Upper Black Eddy, PA, EPA, Project Scientist/WESTON Site Lead. Communicated with client on a regular basis, managed the budget, acquiring necessary equipment, and wrote the Health and Safety Plan (HASP) and Field Sampling Plan (FSP). Coordinated the field sampling effort, which included collecting aqueous samples from the basement of a residence at the site, and vapor intrusion (indoor and ambient air) sampling. Assumed responsibility of Field Safety Officer. Discussed the results with the client and prepared a Trip Report, which included analysis of the data and conclusions based on the data. [1-10 to 12-10]

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Documentation, Chambersburg, PA, Letterkenny Army Depot (LEAD), U.S. Army Corps of Engineers (USACE), Project Scientist. Compiled numerous technical reports under CERCLA process for various sites at LEAD. Types of reports included Remedial Investigation/Risk Assessment (RI/RA) Reports, Proposed Remedial Action Plans (PRAPs), Records of Decision (RODs), Feasibility Study (FS) Reports, Focused Feasibility Studies (FFSs), Findings of Suitability to Transfer (FOSTs), and Explanations of Significant Differences (ESDs). [1-05 to Present]

Groundwater Sampling, LEAD, Chambersburg, PA, Project Scientist/Field Team Leader. Led field sampling efforts at LEAD in Chambersburg, PA, which included overseeing sampling, staffing, and logistics. Field activities included coordination with client and collection of groundwater samples. Assumed responsibilities of Field Safety Officer, WESTON subcontractor oversight, and shipment of samples to laboratory for analysis. [1-06 to Present]

Groundwater/Surface Water Sampling, Defense Distribution Depot, Susquehanna, PA (DDSP), Project Scientist/Field Team Leader. Led field sampling efforts at the DDSP in Harrisburg, PA, which included overseeing sampling, staffing, and logistics. Field activities included coordination with client, collection of groundwater samples and surface water samples, and treatment of groundwater on-site, assuming responsibility of field safety officer, and coordination with a nearby laboratory for delivery of samples. [1-06 to 1-09]

Vapor Intrusion Pathway (VIP) Evaluation, LEAD, Associate Project Scientist/Field Team Leader. Coordinated the VIP evaluation at on- and off-post sites at LEAD and in the nearby community. Responsibilities included developing a Work Plan, which included contacting the client and WESTON subcontractors to plan and schedule installation of vapor probes in on-post buildings and coordinating installation of vapor probes with residents in or outside their homes. Led field sampling effort and assumed responsibilities of Field Safety Officer. Used data to evaluate the findings of the investigation and compiled several technical reports. [1-08 to 1-09]

Final Report Under the Pennsylvania Department of Environmental Protection (PADEP) Land Recycling Program for Releases to Soil at the Solid Waste Management Unit Number 2 (SWMU No. 2) Landfill Unit, New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at SWMU No. 2 and attainment of an Act 2 SSS for releases to soil. Analyzed data collected before and during the attainment period to ensure that VOC levels in groundwater were unaffected by remedial construction activities at the landfill. Developed figures and tables that were used in the final report to supplement the text. [1-08 to 12-08]

Final Report Under the PADEP Land Recycling Program for Releases to Soil at the Solid Waste Management Unit Number 4 (SWMU No. 4) Landfill Unit, New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at SWMU No. 4 and attainment of an Act 2 SSS for releases to soil. Analyzed data collected before and during the attainment period to ensure that VOC levels in groundwater were unaffected by remedial construction activities at the landfill. Developed figures and tables that were used in the final report to supplement the text. [1-08 to 12-08]

Well Abandonment Oversight, New Cumberland, PA, DDSP, USACE, Baltimore District. Provided oversight of well abandonment on-post by a WESTON subcontractor. Also assumed responsibilities of Field Safety Officer. [1-08 to 12-08]

Facility Investigation and Closure Plan for Buildings 1A and 1B, Tobyhanna Army Depot, Tobyhanna, PA, USACE Baltimore District, Project Scientist. Compiled a technical report and an addendum to the technical report concerning the current site conditions at Buildings 1A and 1B at Tobyhanna Army Depot. Analyzed data and compared to appropriate screening levels to determine the nature and extent of contamination at Buildings 1A and 1B. Developed figures and tables that were used in the final report to supplement the text. [1-07 to 12-07]

Final Report Under the PADEP Land Recycling Program for Releases to Soil and Groundwater at Solid Waste Management Unit Number 17 (SWMU No. 17), New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at SWMU No. 17 and the attainment groundwater sampling required to comply with PADEP Act 2 standards. Analyzed data collected during the attainment period to ensure that VOC levels remained below the site-specific standard for SWMU No. 17. Developed figures and tables that were used in the final report to supplement the text. [1-07 to 1-08]

Final Report Under the PADEP Land Recycling Program for Releases to Soil and Groundwater at Area of Concern (AOC) N – PX Gas Station, New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at AOC N and the attainment groundwater sampling required to comply with PADEP Act 2 standards. Analyzed data collected during the attainment period (June 2003 through March 2005) to ensure that VOC levels remained below the site-specific standard for AOC N. Developed figures and tables that were used in the final report to supplement the text. [1-07 to 1-08]

Remedial Investigation/Risk Assessment Report for Releases to Soil and Groundwater at Solid Waste Management Unit Number 17 (SWMU No. 17), New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at SWMU No. 17 and the most recent eight quarters of groundwater sampling required to comply with PADEP Act 2 standards. Analyzed data to ensure that VOC levels remained below the site-specific standard. Developed figures and tables that were used in the final report to supplement the text. [1-07 to 12-07]

Remedial Investigation/Risk Assessment Report for Releases to Soil and Groundwater at AOC N – PX Gas Station, New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at AOC N and the most recent eight quarters of groundwater sampling required to comply with PADEP Act 2 standards. Analyzed data to ensure that VOC levels remained below the site-specific standard. Developed figures and tables that were used in the final report to supplement the text. [1-07 to 12-07]

Request for Bids for Large Specimen Tank Prototype Design and Construction, Museum Support Center, Suitland, MD, Smithsonian Institution, Project Engineer. Compiled a Scope of Work that included various technical specifications for the design of six prototype specimen holding tanks for the Museum Support Center at the Smithsonian Institution. Created a checklist for Smithsonian Institution staff to use in rating the effectiveness of the prototype tanks on a weekly basis. [7-04 to 10-04]

Final Report Under the PADEP Land Recycling Program for Releases to Groundwater at Solid Waste Management Unit Number 6 (SWMU No. 6), New Cumberland, PA, DDSP, USACE, Project Scientist. Compiled a technical report concerning the current site conditions at SWMU No. 6 and the attainment groundwater sampling required to comply with PADEP Act 2 standards. Analyzed data collected during the attainment period (March 2002 to March 2004) to ensure that VOC levels remained below the site-specific standard for SWMU No. 6. Developed figures and tables that were used in the final report to supplement the text. [6-04 to Present]

Surface Water Sampling, Passaic River Project, Passaic County, NJ, REHEIS, Project Scientist/Field Team Leader. Led a team of Weston employees to collect surface water samples from the Passaic River in Berkley Heights, NJ. Coordinated field efforts with client and coordinated sample pickup with laboratory on a daily basis. Recorded all events that took place daily in a field log book. [6-04]

Summary Report, West Chester, PA, Smithsonian Institution, Project Scientist. Compiled a summary report concerning the replacement of specimen holding tanks at both the Smithsonian Institute and the National Museum of Natural History. Analyzed data collected from existing specimen tanks, and based on concentrations of various compounds, made suggestions as to what materials could be used to fabricate new specimen tanks. [6-04]

Environmental Evaluation/Cost Analysis (EE/CA), Wrightstown, NJ, Fort Dix, USACE, Project Scientist. Compiled a technical report concerning the risks and subsequent removal costs of unexploded ordnance (UXO) in the Holly Crest and Grove Park residential areas at Fort Dix. Determined risks of UXO based on field data and historical information about the activities conducted at the Holly Crest and Grove Park areas of Fort Dix. [4-04 to 5-04]

Remedial Investigation/Risk Assessment Report, Chambersburg, PA, LEAD, Project Scientist. Compiled technical reports concerning the closure of Resource Conservation and Recovery Act (RCRA) solid waste management units (SWMUs) that are located in the Base Realignment and Closure (BRAC) Area of Letterkenny Army Depot, Chambersburg, Pennsylvania. [1-04 to Present]

Enhanced Bioremediation Pilot Study at SE OU 10, Chambersburg, PA, LEAD, Project Scientist. Analyzed groundwater data results and compiled technical report concerning the remediation of trichloroethene, tetrachloroethene, and 1,1,1-trichloroethane at SE Operable Unit (OU) 10 at Letterkenny Army Depot. [1-04 to Present]

Demilitarization Program, Votkinsk, Russia, Russian Federation, Assistant Engineer. Completed data management tasks, assisting the organization of the high volume of file transfers between Versar and various companies in Russia. Researched various equipment that could be used in the demilitarization process. Reviewed engineering drawings that concerned crucial design elements of the demilitarization facilities. [4-02 to 9-02]

Construction/Environmental Remediation, Plattsburgh, NY, Plattsburgh Air Force Base, Construction Supervisor/Field Manager. Field Manager for multimillion dollar, multiphase construction and environmental remediation initiative at multiple sites on Plattsburgh AFB as part of BRAC. Construction tasks included coordination of subcontractors, landfill remediation and capping, sampling events, and soil remediation and disposal of hazardous waste. Developed final reports for various sites, including tables, figures, and photographic logs. [3-02 to 2-04]

Underground Storage Tank (UST) Database Project, Horsham, PA, U.S. Army Garrison, Fort Monmouth, Main Post, Assistant Engineer. Generated PDF files and a project database for over 1,500 documents cataloging the removal and remediation of USTs and any contamination. Reorganized and relabeled all paper files used in the database, entered all PDF documents into the database, and linked all documents to the database to create a functional, user-friendly method of organization. [5-03 to 8-03]

Remedial Action Progress Report (RAPR), Fort Monmouth, Main Post, M-2 Landfill, Horsham, PA, U.S. Army Garrison, Directorate of Public Works, Assistant Engineer. Prepared and developed a RAPR for the EEB/ORC Injection and Long Term Groundwater Monitoring Program at the site for submittal to the New Jersey Department of Environmental Protection (NJDEP). Maintained sample results database for the generation of tables for use in the RAPR. Developed contaminant maps, graphs of contaminant concentration over time, and conclusions regarding the success of the EEB/ORC injection program for use in the RAPR. Conducted data reviews and quality assurance checks on all data results. [5-03 to 12-03]

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Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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TRAINING MANAGER
Conrad W. Lehr, CET, CIT

INSTRUCTOR
Conrad W. Lehr CET

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HAS COMPLETED THE

8-Hour Site Manager and Supervisor Training Course (SHSC)

In accordance with 29 CFR 1910.120(e)(4) completed on 2/10/2005 in West Chester, PA

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Daniel Locurcio

has successfully completed requirements for

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American Red Cross

Date Completed: 06/08/2015
Instructors: Lawrence John Werts III

Certificate ID: GRUZAI

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DANIEL LOCURCIO

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 12/11/2015 in Westchester, PA

Herold S Hannah

TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III

INSTRUCTOR
Lawrence J. Werts III

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Robert W. Wagner

Qualifications Summary

- Over 16 years of professional experience.
- More than 11 years of experience as a Field Safety Officer.
- Experienced in coordination and execution of hazardous waste sampling and characterization, and remedial activities, including soil excavation and remediation, groundwater characterization, and high hazard operation.
- Experienced in ecological and human health risk assessments including computation of carcinogenic risks associated with toxicity exposure.
- Development of technical documents including: Health and Safety Plans, Accident Prevention Plans, Work Plans, Quality Control Plans, Sampling and Analysis Plans, RIs, RAs, and Interim and Final Reports.
- Experienced with environmental sampling techniques including forest surveys, habitat assessments, and wetland delineations.
- Developed/implemented sampling activities involving all sample media (air, water, soil, sediment, fish, and wastes).

Credentials

USCG Boat Captain's License (No. 2779465), USCG (2012)

Education

B.S., Environmental Science - Susquehanna University (1998)

Training, Memberships & Awards

- 40-Hour Hazardous Waste Site Training Course, OSHA 29 CFR 1910.120(e)(3), WESTON (1999)
- 8-Hour Hazardous Waste Refresher Course, OSHA 29 CFR 1910.120(e)(8), WESTON (2015)
- 30-Hour Construction Safety and Health Training Course, OSHA 29 CFR 1926, WESTON (2005)
- 8-Hour Managers and Supervisors Course (SHSC), OSHA 29 CFR 1910.120(e)(4), WESTON (1999)
- Site Manager/Field Safety Officer (FSO) Certification, WESTON (2009)
- First Aid/CPR/AED Training, WESTON (2016)

- Bloodborne Pathogens Training – Initial, OSHA 29 CFR 1910.1030, WESTON (2006)
- Bloodborne Pathogens Refresher Training, OSHA 29 CFR 1910.1030, WESTON (2015)
- Electrical Safety Training, NFPA 70E, WESTON (2014)
- Global Harmonization System Hazard Communication Training, OSHA 29 CFR 1910.1200, WESTON (2013)
- Hydrogen Sulfide Awareness Training, WESTON (2013)
- START Orientation Training, EPA START (2010)
- Air Monitoring Exercise, EPA START (2010)
- Assessment Scenario Exercise, EPA START (2010)
- Emergency Response Orientation, EPA START (2010)
- HAZCAT Training, EPA START (2010)
- Level A Team Overview, EPA START (2010)
- Minor Containment and Control of Discharges, Spills, and Release, EPA START (2010)
- Multimedia Sampling Basics, EPA START (2010)
- Recognition and Identification of Hazards, EPA START (2010)
- ICS-100 Introduction to Incident Command System, FEMA (2010)
- ICS-200 Basic Incident Command System, FEMA (2010)
- Behavior-Based Safety Training – Phase I, WESTON (2009)
- Defensive Driving Course, WESTON (2008)
- USCG Approved OUPV/Six Pack Captain's License Course, Mariners School (2007)
- Trenching/Excavation Competent Person Training Course, OSHA 29 CFR 1026 Subpart P, WESTON (2005)
- Fall Protection Competent Person Training Course – Initial, OSHA 29 CFR 1926 Subpart M, WESTON (2005)
- Function-Specific Dangerous Goods Shipping, WESTON (2005)
- Boater’s Safety Course, PA Fish and Boat Commission (2000)
- Electrofishing Safety, U.S. Fish and Wildlife Service (2014)
- Principles and Techniques of Electrofishing, U.S. Fish and Wildlife Service (2014)

Employment History

1998 to Present WESTON
1996 to 1998 Susquehanna University
1996 Chester Engineers

Key Projects

Site Characterization and Geophysical Survey, GN, U.S. Air Force Air Education and Training Command, Senior Project Scientist. Lead author for the UFP-QAPP/Work Plan for Thule Air Base, Greenland. Field Lead and Health and Safety Officer for site characterization sampling at six sites at Thule Air Base in Greenland. Sampling included a geophysical survey, test pitting, soil, sediment, and surface water sampling. Coordinated all transportation of personnel and materials to and from Greenland. Lead author for the post-sampling characterization reports. [9-14 to Present]

Health and Safety Oversight, Tobyhanna Army Depot (TYAD), Tobyhanna, PA, U.S. Army Corps of Engineers (USACE), Senior Project Scientist/Safety Officer. Provided oversight to daily construction activities involving barbed wire fence installation at both radar sites. Radar sites were located in potential ordnance area. An unexploded ordnance (UXO) sweep was performed before excavation. Conducted daily safety briefings with subcontractors and provided logbook and photo documentation. [8-11 to 9-13]

Health and Safety Oversight, Clements Landfill, Shoemakersville, PA, Pennsylvania Department of Environmental Protection (PADEP), Senior Project Scientist/Safety Officer. Provided oversight of installation of a residential water treatment system. Conducted daily safety briefings with subcontractors and provided logbook and photo documentation. [7-11 to 11-11]

Treatment Plant Operations and Maintenance (O&M), Berks Sand Pit, Huffs Church, PA, PADEP, Senior Project Scientist. Duties include routine monthly inspections of facilities and treatment plant operations. Provides maintenance and repair of any defective equipment. [6-11 to 6-12]

Site Investigation (SI), VanNoy Gas Well Pad, Granville, PA, Confidential Client, Senior Project Scientist/Boat Captain/Safety Officer. Conducted sediment, groundwater, and surface- water sampling at contaminated pad. Developed fish restocking plan based on findings. Conducted daily safety briefings and provided logbook and photo documentation. [5-11 to 10-12]

Vapor Intrusion Sampling, TYAD, Tobyhanna, PA, USACE, Senior Project Scientist. Conducted indoor air monitoring to establish background levels and to identify sampling locations. Installed sub-slab sampling ports and deployed Summa canisters for 24-hour air sampling. [4-11 to 9-13]

Health and Safety Oversight, Stoney Creek Facilities, Chester, PA, U.S. Environmental Protection Agency (EPA), Senior Project Scientist/Safety Officer. Conducted air monitoring of subcontractors entering into confined space tanks for cleanout. Tanks were formerly used in a chemical processing facility. Activities included conducting daily safety briefings, calibrating air-monitoring instruments, monitoring air levels at each tank cleanout, and logging air levels on confined space entry permit. [3-11 to 5-11]

Hazard Categorization, AGMET, Delano, PA, EPA, Senior Project Scientist. Provided hazard categorization (HAZCAT) of unknown chemicals in an on-site EPA mobile laboratory at a former chemical recycling facility. [2-11 to 4-11]

Health and Safety Oversight, Powhatan Mining Site, Baltimore, MD, EPA, Senior Project Scientist/Safety Officer. Provided health and safety oversight of daily removal activities at a former asbestos processing facility. Conducted daily safety briefings and provided logbook and photo documentation. [2-11 to 6-11]

Data Validation, Various Gas Well Locations in Ohio and Pennsylvania, Confidential Client, Senior Project Scientist. Provided laboratory data validation, with a 24-hour turnaround, for surface-water and groundwater grab samples from properties associated with natural gas wells. [12-10 to 7-11]

Vibracore Sediment Sampling, Delaware River, Philadelphia, PA, Confidential Client, Senior Project Scientist/Boat Captain. Operated sampling vessel along Delaware River and collected sediment cores using vibracore unit. Duties included navigation and positioning of boat at sampling locations and assisting in vibracore deployment and sample management. [10-10 to 3-15]

Soil Remediation and X-Ray Fluorescence (XRF) Analysis, Former Mohr Orchard Site, Schnecksville, PA, EPA, Senior Project Scientist/Field Team Lead/Safety Officer. Developed a Field Sampling Plan (FSP) and Site-Specific Health and Safety Plan to collect residential soil samples and analyze them on-site with an XRF unit. Conducted daily safety briefings, led field teams, and provided logbook and photo documentation. [7-10 to 11-10]

Health and Safety Oversight, Berks Sand Pit, Huffs Church, PA, PADEP, Senior Project Scientist/Safety Officer. Provided oversight to construction activities, which included trenching with excavator to install electrical conduit and water pipe from supply well to water treatment plant. Conducted daily safety briefings and provided logbook and photo documentation. [5-10 to 6-10]

Fish Collection, Delaware River, Philadelphia, PA, Southport, Senior Project Scientist/Boat Captain/Safety Officer. Conducted fish collection on Delaware River. Seining, trawling, and electrofishing were all used as fish collection methods as well as deploying trotlines. Fish were keyed and sampled. Conducted daily safety briefings and provided logbook and photo documentation. [4-10 to 11-10]

Plant Identification, Ricochet Area Munitions Response Site (MRS), Dauphin County, PA, Fort Indiantown Gap, Senior Project Scientist. Conducted vegetation survey for endangered and threatened plant species at munitions and explosives of concern (MEC) removal site. [4-10 to 5-10]

Vibracore Sediment Sampling, Delaware River, Philadelphia, PA, Southport, Senior Project Scientist/Boat Captain. Operated sampling vessel along Delaware River and collected sediment cores using vibracore unit. Duties included navigation and positioning of boat at sampling locations, and assisting in vibracore deployment and sample management. [3-10 to 3-15]

Air Sampling, TYAD, Tobyhanna, PA, USACE, Senior Project Scientist. Deployed Summa canisters for 24-hour period, after which the canisters were collected and sent for laboratory analysis. [6-08 to 9-13]

Energy Study, TYAD, Tobyhanna, PA, USACE, Senior Project Scientist. Using fall protection, installed weather stations on roof to monitor wind direction and speeds for potential wind energy system. Also installed monitors on garage doors to record each time doors were opened and shut, and duration between each to evaluate potential heat loss. Weather stations and door monitors were downloaded weekly. [4-08 to 6-08]

Soil and Sediment Sampling, Former Nansemond Ordnance Depot (FNOD), Suffolk, VA, USACE, Senior Project Scientist/Field Team Lead/Safety Officer. Collected soil and sediment samples in former ordnance area. Sample locations were cleared for UXO prior to sampling. Conducted daily safety briefings and provided logbook and photo documentation. [4-08 to 11-09]

Health and Safety Oversight, Inspections, and Maintenance, TYAD, Tobyhanna, PA, USACE, Senior Project Scientist/Safety Officer. Provided oversight of subcontractors who installed GreenGrid system on building roof. Conducted monthly assessments and inspections of GreenGrid, and provides maintenance including plant replacement as needed. Conducted daily safety briefings and provided logbook and photo documentation. [3-08 to 10-13]

Vibracore Sediment Sampling, Delaware River, Philadelphia, PA, Confidential Client, Senior Project Scientist/Boat Captain. Operated sampling vessel along Delaware River and collected sediment cores using vibracore unit. Duties included navigation and positioning of boat at sampling locations and assisting in vibracore deployment and sample management. [6-08 to 3-15]

Vibracore Sediment Sampling, Delaware River, Philadelphia, PA, Confidential Client, Senior Project Scientist/Boat Captain. Operated sampling vessel along Delaware River and collected sediment cores using vibracore unit. Duties included navigation and positioning of boat at sampling locations and assisting in vibracore deployment and sample management. [4-08 to 3-15]

Health and Safety Oversight, Blue Mountain Rock Stabilization and Reseeding, Palmerton, PA, National Park Service, Senior Project Scientist/Safety Officer. Provided oversight to construction activities that included installing rock catch fence and grouting loose boulders to keep them from rolling or sliding out onto nearby highway. Also provided oversight to aerial seed application using crop-duster planes to barren areas of Blue Mountain affected by zinc contamination. Conducted daily safety briefings and provided logbook and photo documentation. [3-08 to 11-12]

Surface-Water Sampling, Reheis Chemical Facility, Berkley Heights, NJ, Reheis Chemical, Senior Project Scientist/Boat Captain. Collected surface-water samples from small lagoon on Reheis property. Duties included navigation and positioning of boat at sampling locations and assisting in sampling and sample management. [3-08 to Present]

Stream Temperature Monitoring, Brodhead Creek, Stroudsburg, PA, Pocono Township, Senior Project Scientist/Field Team Lead/Safety Officer. Developed a Field Sampling Plan (FSP) and Health and Safety Plan (HASP) to assess stream temperature at Brodhead Creek. Installed HOBO probes at different locations in the stream and programmed them to record hourly temperature readings. Conducted daily safety briefings and provided logbook and photo documentation. Probes were retrieved and downloaded on a monthly basis. [3-08 to 1-10]

MEC Clearance, Fort Miles, Lewes, DE, USACE, Project Engineer. Conducted a MEC geophysical investigation of a former military firing range. Geophysical anomalies were reacquired using global positioning system (GPS) and handheld magnetometers and excavated by hand for identification. [1-08 to 2-08]

MEC Clearance, Tobyhanna Artillery Ranges (TOAR) Formerly Used Defense Site (FUDS), Tobyhanna, PA, PADEP, Project Engineer/Site Manager. Supervised and coordinated MEC clearance effort at AOC-1, MRS-R02D, MRS-R02B, and on base operations at Barstow and Seal Beach radar sites. Duties included tracking expenditures and production rates along with daily reporting to PADEP and USACE of field activities, and completion of final reports. Assisted UXO Safety Officer with preparation for daily safety briefings. [9-07 to 12-09]

Site Inspections, U.S. Army Reserve Centers (USARCs), VA, WV, and PA, 99th Regional Reserve Command (RRC), Project Scientist/Field Team Lead/Safety Officer. Conducted environmental facility inspections of multiple reserve centers in Mid-Atlantic region. Activities included historical records review, inspections of general environmental conditions, photo documentation, and health and safety oversight of sampling for suspected asbestos-containing material (ACM) and lead-based paint (LBP) by licensed asbestos/lead inspectors. Conducted daily safety briefings to subcontractors. All information was compiled into WESTON's SurveyFastSM software and later used for a final assessment report. [12-05 to 8-06]

Fish Collection and Sediment Sampling, Cottage Grove, MN, Confidential Client, Project Scientist/Boat Operator/Safety Officer. Conducted fish and sediment sampling in the Mississippi River. Fishing methods used at the site involved the use of a boat-mounted electrofishing unit and trotlines. Fish were keyed, weighed, measured, and sampled for human health and ecological risk. Sediment samples were collected using a Wildco coring device. Conducted daily safety briefings and provided logbook and photo documentation. [6-05 to 12-05]

Fish Collection, Imperial Refining Site, Ardmore, OK, Oklahoma Department of Environmental Quality (ODEQ), Project Scientist/Boat Operator/Safety Officer. Conducted fish sampling at facility ponds. Fishing methods used at the site involved the use of a boat-mounted electrofishing unit. Fish were keyed, weighed, measured, and sampled for human health and ecological risk. Conducted daily safety briefings and provided logbook and photo documentation. [4-05 to 10-05]

Fish Collection, Wetland Delineation, Habitat Assessment, Sediment Sampling, Ward Transformer Site, Raleigh, NC, North Carolina Department of Environmental and Natural Resources (NCDENR), Project Scientist/Boat Operator/Safety Officer. Conducted fish and sediment sampling on Little Brier Creek, Brier Creek Reservoir, and Lake Crabtree. Fishing methods used at the site involved the use of a boat-mounted electrofishing unit. Fish were keyed, weighed, measured, and sampled for human health and ecological risk. Wetlands were delineated along the floodplain of Little Brier Creek and an unnamed tributary originating from the site. Habitat types and communities were also identified during field activities. Conducted daily safety briefings and provided logbook and photo documentation.
[5-04 to 8-05]

UXO Mapping, TYAD and Tobyhanna State Park, Tobyhanna, PA, PADEP, Project Scientist. Conducted a UXO geophysical investigation of a former military firing range. Mapping was done by walking grids and transects throughout the Depot and State Park with a geophysical magnetometer and GPS unit. [4-04 to 11-04]

Search and Recovery, Columbia Space Shuttle Recovery, Nacogdoches, TX, EPA, Associate Project Scientist/Field Team Leader. Conducted search and recovery expeditions in eastern Texas to find shuttle debris. Daily activities included searching 5-mile grids, photodocumenting and taking GPS coordinates of finds, and logging in all findings with National Aeronautics and Space Administration (NASA) officials each evening. [3-03 to 4-03]

Sediment Sampling, , Defense Distribution Depot Susquehanna Pennsylvania (DDSP), Harrisburg, PA, USACE, Associate Project Scientist/Boat Operator/Safety Officer. Collected sediment samples from a boat using a lexane coring device. Navigated to sample locations using a real-time GPS unit. Conducted daily safety briefings and provided logbook and photo documentation. [1-03 to 12-09]

Groundwater Sampling and Tidal Survey, FNOD, Suffolk, VA, USACE, Associate Project Scientist/Field Team Lead/Safety Officer. Purged and sampled monitoring wells using a low-flow peristaltic pump. Tidal survey was conducted by programming and installing data loggers into monitoring wells to examine tidal influence on groundwater. A single data logger was installed nearby in the Nansemond River to collect baseline data of actual tide movement. Conducted daily safety briefings and provided logbook and photo documentation. [11-02 to 12-02]

Groundwater Sampling, DDSP, Harrisburg, PA, USACE, Project Scientist/Field Team Leader/Safety Officer. Conducted quarterly groundwater monitoring and sampling using a Grunfos groundwater pump at various monitoring wells throughout the site. Samples were collected after all physical parameters had stabilized. Conducted daily safety briefings and calibrated health and safety monitoring instrumentation. Instructed and evaluated junior-level personnel on sampling specifics. [10-02 to 10-09]

Groundwater Sampling, TYAD, Tobyhanna, PA, USACE, Senior Project Scientist/Field Team Leader/Safety Officer. Conducted semiannual groundwater monitoring and sampling using a Grunfos groundwater pump at various monitoring wells throughout the site. Samples were collected after three times the well volume had been purged and all physical parameters had stabilized. Conducted daily safety briefings and calibrated health and safety monitoring instrumentation. Instructed and evaluated junior-level personnel on sampling specifics. Also responsible for producing semiannual reports of data results. [10-02 to 11-13]

Fish Collection and Sediment Sampling, Former Air Force Plant No. 51, Greece, NY, New York State Department of Environmental Conservation (NYSDEC), Associate Project Scientist/Boat Operator/Safety Officer. Conducted sampling on Round Pond and Round Pond Creek, which border the site. Nearby Bucks Pond was also sampled and used as the background area. Fishing methods used at the site involved the use of a boat-mounted electrofishing unit. Fish were keyed, weighed, measured, and sampled for human health and ecological risk. Sediment samples were collected using a ponar dredge to gather sediment from 0 to 6 inches. Assisted in creation of deliverable document that outlined human health and ecological risks and pathways. Conducted daily safety briefings and provided logbook and photo documentation. [10-02 to 4-03]

Sediment, Surface Water, and Groundwater Sampling, Raymark Industries Site, Manheim, PA, PADEP, Associate Project Scientist. Collected sediment and surface-water grab samples from nearby stream bordering the site. Groundwater was purged and collected by using a high-flow Grunfos groundwater pump. Assisted in creation of deliverable document that outlined human health and ecological risks and pathways. [10-02 to 7-03]

Habitat Assessment, Bucks Harbor, Machiasport, ME, U.S. Air Force, Associate Project Scientist. Delineated habitat boundaries along a stream and wetland running through the site. Identified site vegetation, birds, mammals, and aquatic organisms. Also characterized stream segments and ponded areas. Created a summary report that reported field investigation and observations. [3-02 to 8-02]

Fish Collection, Resolve Superfund Site, Massachusetts, EPA, Senior Project Scientist/Boat Captain/Safety Officer. Conducted yearly sampling on local stream and pond in close proximity to site. Fishing methods used in the stream involved the use of a portable electrofishing unit. In the pond, sampling was conducted by the use of a boat-mounted electrofishing unit and setting trotlines. Fish were keyed, weighed, measured, and sampled. Conducted daily safety briefings and provided logbook and photo documentation. [10-02 to Present]

Benthic Macroinvertebrate and Fish Collection, TOSCO Refinery, Delaware River, Chester, PA, Associate Project Scientist/Boat Operator/Safety Officer. Conducted seasonal sampling on Delaware River along refinery property. Gill netting, seining, trawling, and electrofishing were all used as fish collection methods as well as deploying hoop nets. Fish were keyed and sampled. Zooplankton and benthic macroinvertebrates were also collected. Assisted in creation of deliverable document that outlined human health and ecological risks and pathways. Conducted daily safety briefings and provided logbook and photo documentation. [4-01 to 4-02]

Surface-Water Sampling, , Wastewater Treatment Facility (WWTF), Chester, PA, Delaware County Regional Water Quality Control Authority (DELCORA), Associate Project Scientist/Boat Operator/Safety Officer. Conducted bi-weekly surface-water sampling of Delaware River and effluent from WWTF. Samples were collected and analyzed in situ for residual chlorine and chlorine demand. Conducted daily safety briefings and provided logbook and photo documentation. [3-01 to 3-02]

Screening-Level Risk Assessments (SLRAs), Letterkenny Army Depot (LEAD), Chambersburg, PA, USACE, Associate Project Scientist. Performed human health and ecological SLRAs for several sites located on the Depot. Managed data, developed human health and ecological benchmarks, calculated risk-based screening concentrations (RBSCs), and calculated soil screening levels (SSLs) using EPA (1996) guidance. Calculated cancer risk and noncancer hazard quotients (HQs) using risk ratio approach. [12-00 to 4-02]

Screening-Level Human Health and Ecological Risk Assessments(HHRAs/ERAs), FNOD, Suffolk, VA, USACE, Associate Project Scientist. Responsible for data validation and evaluation. Ran statistical analyses on data, set up summary tables, and compared concentrations to applicable or relevant and appropriate requirements (ARARs). Developed human health and ecological benchmarks, calculated RBSCs, and calculated SSLs using EPA (1996) guidance. Compiled table of physical/chemical properties. Contributed text. [9-00 to 4-01]

Health and Safety Noise Survey, Postal Facilities in Clifton, Elizabeth, Newark, Patterson, and Hackensack, NJ, U.S. Postal Service (USPS), Associate Project Scientist. Monitored decibel levels in postal facilities using portable audio-dosimeters. Recorded decibel levels for 8-hour periods and produced map of facilities that delineated noise patterns around machinery. [7-00 to 8-01]

Right-to-Know Surveys, Edison, NJ, Medicia Pharmaceuticals, Inc., Associate Project Scientist. Produced 1999 Community Right-to-Know surveys for chemicals stored at facility. Also prepared Material Safety Data Sheets (MSDSs) for new chemicals at facility. [6-00 to 6-01]

Phase I Site Assessment Update/SI, Former Vegetable Oil Manufacturing Facility, Staten Island, NY, USPS, Associate Project Scientist. Assisted in developing and implementing the Phase I/SI. Project involved a geophysical investigation on a portion of the site, an asbestos and lead-based paint evaluation, a wetlands evaluation, identifying soil and groundwater contamination, and investigating potential sources of the contaminants. [6-00 to 6-01]

Remedial Investigation (RI)/Feasibility Study (FS)), Kauffman and Minteer Site, Roseville, NJ, EPA, Response, Engineering, and Analytical Contract (REAC), Associate Project Scientist. Field tasks included groundwater sampling at this industrial-solvent-contaminated site. Assisted in preparation of RI/FS report on site and investigated remedial options. Evaluated geological/hydrogeological characteristics of site. [5-00 to 6-01]

RI, Camp Hero Property, Montauk, NY, USACE, Associate Project Scientist/Safety Officer. Planned, mobilized, and implemented the final phase of an RI for site close-out consideration from USACE at former military facility. Work included Work Plan preparation, Health and Safety Plan (HASP) preparation, subcontractor procurement, safety briefing, sample (soil, chip, groundwater, and surface water) collection, and field management of a 1-day field effort. Produced initial report summarizing field activities and initial results for client. [5-00 to 6-01]

Groundwater Monitoring, Green Brook Flood Control Site, Manville, NJ, USACE, Associate Project Scientist. Installed monitoring wells and performed weekly groundwater monitoring at a site designated for mitigated wetland construction for flood control. Prepared two bimonthly reports and a final report of results and figures to client. [12-99 to 7-00]

Risk Assessment, Nyanza Superfund Site, Sudbury, MA, EPA, Assistant Project Scientist. Assisted in the preparation of a baseline HHRA/ERA addressing potential risks to Sudbury River biota from organic compounds and metals present in groundwater. [12-99 to 6-01]

Management Action Plan (MAP), Former Schenectady Army Depot, Schenectady, NY, USACE, Assistant Project Scientist. Task Manager for development of Project Implementation Plan (PIP) and MAP for USACE at a former military facility. Compiled several documents and studies into summarized MAP report for USACE reference and to be made available to public. [11-99 to 12-99]

Phase V Field Investigation, Gibbsboro, NJ, Confidential Client, Associate Project Scientist. Aided in an ERA of two approximately 30-acre sites impacted by paint waste from a former manufacturing facility. Calculated HQs for various receptors. Created maps and drawings using ArcView 3.0. Conducted HHRA and ERA portions of the Phase I RI report. Field activities included Geoprobe® soil sampling. Assisted in production of the final report. [11-99 to 2-00]

RI, Former Raritan Arsenal, Edison, NJ, USACE, Associate Project Scientist. Assisted in mobilization and implementation of the final phase of an RI of a 3,200-acre former Army arsenal. Work included soil and chip sample collection and quarterly groundwater monitoring. Assisted in production of multiple reports. [9-99 to 12-99]

Environmental Impact Assessment (EIA), Meadowlands Mills Development, USACE, New York District, Assistant Project Scientist. Assisted in preparation of a draft environmental impact statement (EIS) evaluating impacts of a proposed 206-acre wetland fill project in the Hackensack Meadowlands. Critical technical issues evaluated included compliance with Section 404(b)1 guidelines and National Environmental Policy Act (NEPA); and the evaluation of wildlife habitat, including threatened and endangered species, avian studies, water quality, flood storage and hydrological and hydraulic modeling, management of contaminated sediment, and other wetland values under existing and proposed alternative conditions. [8-99 to 1-00]

Risk Assessment/Wetlands Mitigation, New Jersey, Precision Roll Products, Inc., Associate Project Scientist. Assisted in the preparation of an ERA and derivation of ecologically based site cleanup criteria for remediation of forested wetland soils contaminated with metals and polychlorinated biphenyls (PCBs). Responsible for preparation of necessary wetland and stream encroachment permit applications. Conducted quality assurance/quality control (QA/QC) tasks on data, calculated HQs for various receptors, and sampled soil in situ using Geoprobe®. [4-99 to 6-01]

RI, Housatonic River, Pittsfield, MA, USACE and EPA, Associate Project Scientist. Assisted in production of Comprehensive Work Plan. Created maps, drawings, and parsed data using ArcView 3.0. Responsible for leading field crews in delineating the extent of contamination in the soil and surface water. Field tasks included surface-water sampling, soil sampling, sediment sampling, sample management, and assisting animal studies. The global positioning system (GPS) was utilized in positioning sample locations. Aided in data analysis and crayfish and bullfrog study design. Conducted fish biomass study on river using electroshock equipment. Fish were keyed, weighed, and measured before being released. Collected and keyed out benthic macroinvertebrate samples. [1-99 to 7-00]

Groundwater Sampling, U.S. Steel, Clairton Works, Pittsburgh, PA, Environmental Intern. Purged and sampled monitoring wells at a coke storage and processing facility using Grunfos portable pumping equipment and bailers. Performed field pH and conductivity tests on samples. [7-96]

ROY F. WESTON, INC.

COPY

THIS CERTIFIES THAT

Robert W Wagner

HAS COMPLETED THE

40-Hour Hazardous Waste Site Training Course

in accordance with 29 CFR 1910.120 (e)(3)(i) completed on 1/11/1999 at West Chester, PA

Conrad W Lehr, CET
TRAINING MANAGER

WESTON®
MANAGERS DESIGNERS/CONSULTANTS

Conrad W Lehr, CET
INSTRUCTOR
Conrad W. Lehr CET

Cert. No. 19119991

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99P-1390

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Restoring Resource Efficiency

This Certifies That

ROBERT WAGNER

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 10/08/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_1165_10082015

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WESTON SOLUTIONS, INC.

THIS CERTIFIES THAT

ROBERT WAGNER

HAS COMPLETED THE

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 3/17/2005 in West Chester, PA

Conrad W Lehr, CET

TRAINING MANAGER
Conrad W. Lehr, CET

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INSTRUCTOR
Theodore Blackburn CSP, CET

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04P-0755

ROY F. WESTON, INC.

THIS CERTIFIES THAT

ROBERT W. WAGNER

HAS COMPLETED THE

Site Health and Safety Coordinators Training
in accordance with 29 CFR 1910.120 (e) (4)

Edison, NJ
February 3, 1999

TRAINING MANAGER

WESTON®
MANAGERS DESIGNERS/CONSULTANTS

INSTRUCTOR

ROY F. WESTON, INC · 1 WESTON WAY · WEST CHESTER, PA · 19380-1499

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This Certifies That

ROBERT WAGNER

Has Completed the

First Aid/ CPR/AED Initial

completed on 01/19/2016 in Westchester, PA

Lawrence J Werts III

INSTRUCTOR

Lawrence J. Werts III

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ROBERT WAGNER

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 10/08/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

2_1165_10082015

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CERTIFICATE OF TRAINING

To acknowledge the completion of

HAZWOPER 40 hour classroom training

Craig Anderman
Student's Name

Has completed this course on

May 21-25, 2007
Date

Instructors: Dr.Chuck Shorten, PE
& Dr. Maura Sheehan, CIH
Organization: West Chester University of PA

Instructor's Name/Signature
Dr. Maura Sheehan, CIH

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This Certifies That

CRAIG ANDERMAN

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 10/16/2014 in West Chester, PA

a m garrison

TRAINING MANAGER

Alanna Garrison- Kast, CSP, CHMM, CET

Christopher Baer CSP

INSTRUCTOR

Christopher M. Baer CSP

195_16922_10162014

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This Certifies That

CRAIG ANDERMAN

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 04/14/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_16922_04142016

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American Red Cross

Certificate of Completion

Craig Anderman
has successfully completed requirements for

Adult First Aid/CPR/AED - valid 2 Years

conducted by
American Red Cross

Date Completed: 12/01/2015
Instructors: Lawrence John Werts III

Certificate ID: GSJAZE

To verify, scan code or visit:
redcross.org/confirm

WESTON SOLUTIONS®
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This Certifies That

CRAIG ANDERMAN

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 04/14/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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Certificate of Completion

This is to certify that

Alexandra Balter

has satisfactorily completed

40 hours of training in

Hazardous Waste Operations

in compliance with 29 CFR 1910.120 and WAC 296-843

August 21, 2015

Edward B. Lawson

Instructor: Ed Lawson

RGA
ENVIRONMENTAL
A Terracon COMPANY

Certificate # 15-0841
Presented By:
RGA Environmental, Inc.

Exp. Date:August 20, 2016

3317 3rd Ave. S., Suite D • Seattle, Washington 98134 • (206) 281-8858

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This Certifies That

ALEXANDRA BALTER

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 01/28/2016 in Concord, NH

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Herold S Hannah
INSTRUCTOR
Herold S. Hannah Jr CIH, CSP

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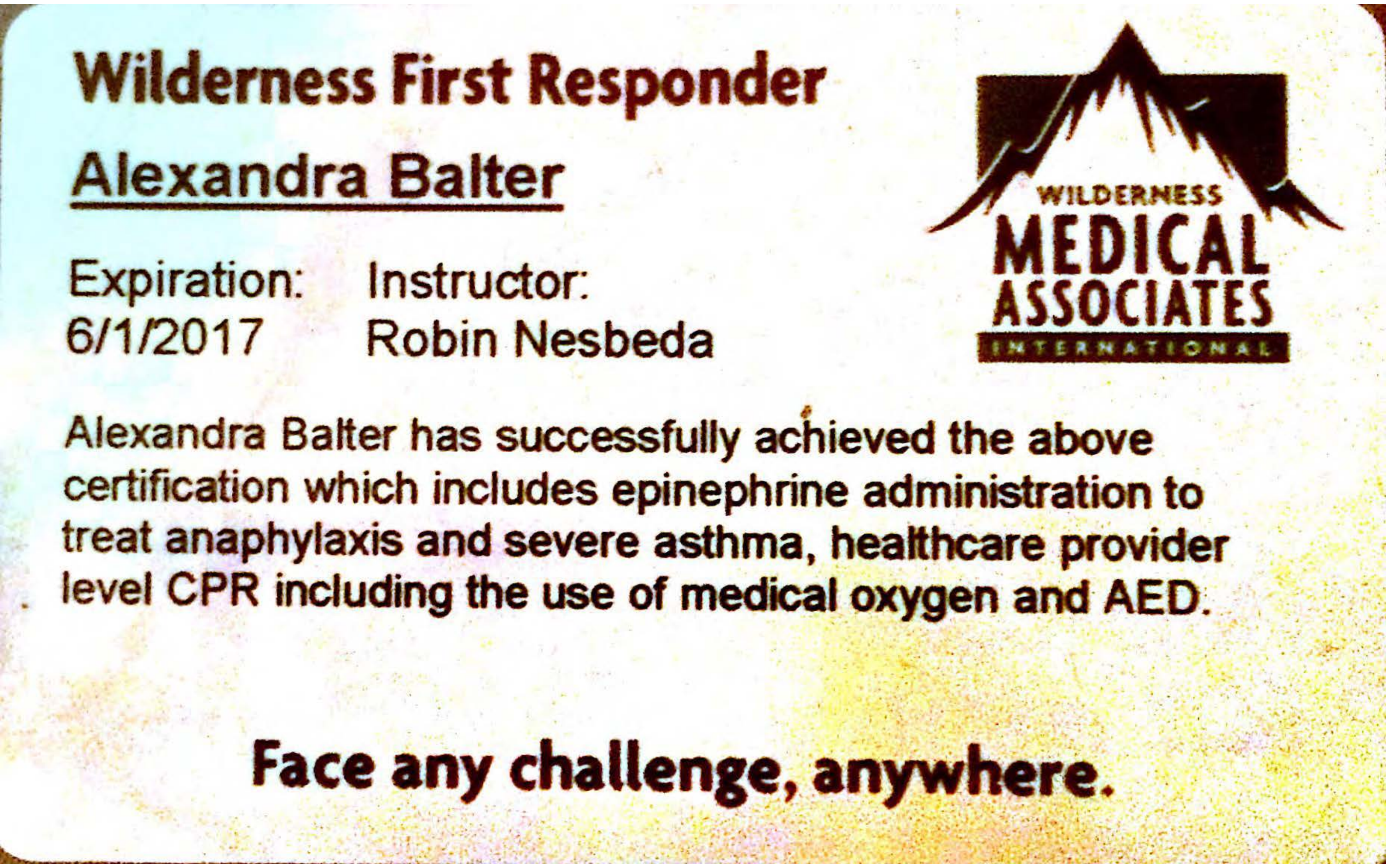


Wilderness First Responder

Alexandra Balter

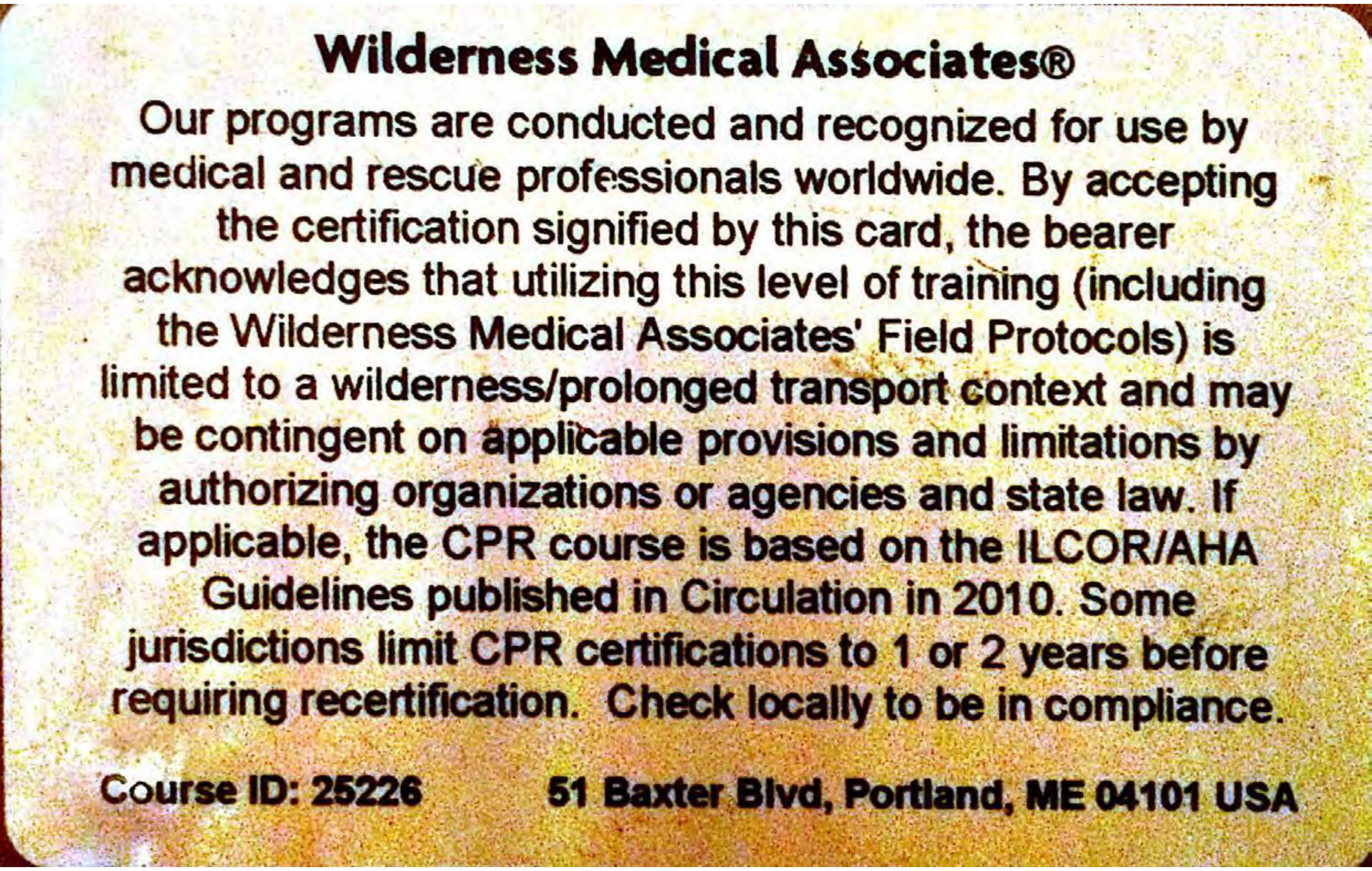
Expiration:
6/1/2017

Instructor:
Robin Nesbeda

WILDERNESS
MEDICAL
ASSOCIATES
INTERNATIONAL

Alexandra Balter has successfully achieved the above certification which includes epinephrine administration to treat anaphylaxis and severe asthma, healthcare provider level CPR including the use of medical oxygen and AED.

Face any challenge, anywhere.



Wilderness Medical Associates®

Our programs are conducted and recognized for use by medical and rescue professionals worldwide. By accepting the certification signified by this card, the bearer acknowledges that utilizing this level of training (including the Wilderness Medical Associates' Field Protocols) is limited to a wilderness/prolonged transport context and may be contingent on applicable provisions and limitations by authorizing organizations or agencies and state law. If applicable, the CPR course is based on the ILCOR/AHA Guidelines published in Circulation in 2010. Some jurisdictions limit CPR certifications to 1 or 2 years before requiring recertification. Check locally to be in compliance.

Course ID: 25226 **51 Baxter Blvd, Portland, ME 04101 USA**

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This Certifies That

ALEXANDRA BALTER

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 01/28/2016 in Concord, NH

Herold S Hannah

TRAINING MANAGER

Herold Hannah, CIH, CSP

Herold S Hannah

INSTRUCTOR

Herold S. Hannah Jr CIH, CSP

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06P-0910-2

Compliance Solutions

"Today's Training... Tomorrow's Solution"

10515 E 40th Ave, Suite 116, Denver Colorado 80239   800-711-2706

Student Affiliation:
Weston Solutions, Inc
31719

Certificate of Completion

This is to certify that

Mary Serdakowski

has successfully completed the training requirements for

40-Hour HAZWOPER

29 CFR 1910.120(e)

Presented

Friday, September 19, 2008

Compliance Solutions Occupational Trainers, Inc.

Certificate Number: *754785905*

Gupta

Neval Gupta
Vice President

Dane Wilcox

Dane Wilcox
Instructor

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This Certifies That

MARY BOGGS

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 08/21/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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This Certifies That

MARY BOGGS

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 04/05/2013 in West Chester, PA

Ted Blackburn CSP, CET
TRAINING MANAGER
Ted Blackburn, CSP, CET

Christopher Baer CSP
INSTRUCTOR
Christopher M. Baer CSP

195_15981_04052013 *Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380*

American
Red Cross

Mary Boggs

has successfully completed requirements for

Adult and Pediatric First Aid/CPR/AED: valid 2 Years

Date Completed: 07/24/2014

conducted by: American Red Cross

Instructor: Robin D Hassler

ID: 0VNOO7
Scan code or visit:
redcross.org/confirm

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MARY BOGGS

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 08/21/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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CERTIFICATE OF TRAINING

To acknowledge the completion of

HAZWOPER 40 hour classroom training

Jeffrey S. Broudy
Student's Name

Has completed this course on

May 21-25, 2007
Date

Instructors: Dr.Chuck Shorten, PE
& Dr. Maura Sheehan, CIH
Organization: West Chester University of PA

Instructor's Name/Signature
Dr. Maura Sheehan, CIH

WESTON
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This Certifies That

JEFFREY BROUDY

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 10/16/2014 in West Chester, PA

am garrison

TRAINING MANAGER

Alanna Garrison- Kast, CSP, CHMM, CET

Christopher Baer CSP

INSTRUCTOR

Christopher M. Baer CSP

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This Certifies That

JEFFREY BROUDY

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 12/11/2015 in Westchester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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JEFFREY BROUDY

Has Completed the

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In accordance with 29 CFR 1910.1030 completed on 12/11/2015 in Westchester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

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American Red Cross

Certificate of Completion

Jeffrey Brady

has successfully completed requirements for

CPR/AED for Professional Rescuers and Health Care Providers - valid 2 Years

conducted by
American Red Cross

Date Completed: 12/22/2014
Instructors: Lawrence John Werts III

Certificate ID: GR4RDQ

To verify, scan code or visit:
redcross.org/confirm

American Red Cross

Certificate of Completion

Jeffrey Brady

has successfully completed requirements for

First Aid - valid 2 Years

conducted by
American Red Cross

Date Completed: 12/22/2014
Instructors: Lawrence John Werts III

Certificate ID: GR4R81

To verify, scan code or visit:
redcross.org/confirm

This is to certify that

David Chapman

has completed

29 CFR 1910.120-40 Hour HAZWOPER

Instructor: R. Kip Score
Date: April 30, May 2, 21 & 22, 2005

Saratoga Safety Inc.
Gansevoort, New York

MACTEC Engineering and Consulting

Certificate of Training

This certifies that

David Chapman

has completed the annual 8-hour
Hazardous Waste Site Health and Safety Supervisory Course
as required by 29 CFR 1910.120(e)(4)
on

April 13, 2006

Cynthia Sundquist
Cynthia Sundquist, CIH, CSP
Division EH&S Manager

July 19, 2006
Date

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This Certifies That

DAVID CHAPMAN

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 01/28/2016 in Concord, NH

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Herold S Hannah
INSTRUCTOR
Herold S. Hannah Jr CIH, CSP

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This Certifies That

DAVID CHAPMAN

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 01/28/2016 in Concord, NH

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Herold S Hannah
INSTRUCTOR
Herold S. Hannah Jr CIH, CSP

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NSC First Aid Course

Name: **David Chapman**
Address:
Address:
City, State, Zip:

Security Control No.
045453

Course Completion Date: **February 17, 2015**
Expiration Date: **February 17, 2018**

Training Center: **National Safety Council of NNE**
Instructor Name: **Raymond Seddon**
Instructor Number: **177784**

David Chapman

has successfully completed the NSC First Aid Course.

The National Safety Council saves lives by preventing injuries and deaths at work, in homes and communities and on the roads through leadership, research, education and advocacy.

THIS DOCUMENT IS VOID IF REPRODUCED

More life-saving courses from NSC

- NSC First Aid, CPR & AED
- NSC CPR & AED
- NSC Bloodborne & Airborne Pathogens

NSC—in it for life™ nsc.org/fatraining

David Chapman

Security Control No.
045453

has completed the
NSC First Aid Course

Training Center: **National Safety Council of NNE**
Completion Date: **February 17, 2015**
Expires: **February 17, 2018**
Instructional Hours:

Instructor Signature: **Raymond Seddon**
Instructor No.: **177784**

Keep this card for your records. Void if reproduced.

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NSC CPR Course

Name: **David Chapman**
Address:
Address:
City, State, Zip:

Security Control No.
422448

Course Completion Date: **February 17, 2015**
Expiration Date: **February 17, 2017**

Training Center: **National Safety Council of NNE**
Instructor Name: **Raymond Seddon**
Instructor Number: **177784**

David Chapman

has successfully completed the NSC CPR Course based on the current Guidelines for CPR and ECC.

The National Safety Council saves lives by preventing injuries and deaths at work, in homes and communities and on the roads through leadership, research, education and advocacy.

THIS DOCUMENT IS VOID IF REPRODUCED

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- NSC First Aid, CPR & AED
- NSC First Aid
- NSC Bloodborne & Airborne Pathogens

NSC—in it for life™ nsc.org/fatraining

Security Control No.
422448

David Chapman

has completed the

NSC CPR Course

Training Center: **National Safety Council of NNE**
Completion Date: **February 17, 2015**
Expires: **February 17, 2017**
Instructional Hours:

Raymond Seddon 177784

Instructor Signature Instructor No.

Keep this card for your records. Void if reproduced.

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CERTIFICATION OF TRAINING

This is to certify that

Robin Dermigny

Has successfully completed the 40-hour training requirements for Hazardous Waste Operations and Emergency Response under OSHA's 1910.120 Standard.

PTP Consulting, Inc.
1531 Kings Highway
Swedesboro, NJ 08085

Course Date: October 18 – 21, 2004

Carol Brozosky

Carol Brozosky, CHMM, Instructor
President

ptp
CONSULTING, INC.
Progress Through Performance

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This Certifies That

ROBIN DERMIGNY

Has Completed the

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 03/11/2011 in West Chester, PA

TRAINING MANAGER

Owen B. Douglass, Jr., PhD, CIH

INSTRUCTOR

Theodore L. Blackburn

82_15135_03112011

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Restoring Resource Efficiency

This Certifies That

ROBIN DERMIGNY

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 05/18/2009 in West Chester, PA

TRAINING MANAGER
Conrad W. Lehr, CET, CIT

INSTRUCTOR
Conrad W. Lehr

195_15135_05182009 *Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380*

06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

ROBIN DERMIGNY

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 03/28/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_15135_03282016

Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

ROBIN DERMIGNY

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 03/28/2016 in Westchester, PA

Herold S Hannah

TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III

INSTRUCTOR
Lawrence J. Werts III

2_15135_03282016

Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

06P-0910-2

American
Red Cross

Certificate of Completion

Robin Dermigny
has successfully completed requirements for

Adult First Aid/CPR/AED - valid 2 Years

conducted by
American Red Cross

Date Completed: 01/26/2015
Instructors: Lawrence John Werts III

Certificate ID: GR80MO

To verify, scan code or visit:
redcross.org/confirm

CERTIFICATE OF TRAINING

To acknowledge the completion of

HAZWOPER 40 hour classroom training

Dane H. Kormos

Has completed this course on

May 11-15, 2009

Date

Instructors: Dr. Charles Shorten, P.E. &
Dr. Maura Sheehan, C.I.H.
Organization: West Chester University of PA
West Chester, PA 19383

Instructors' Names/Signatures

Dr. Charles Shorten, P.E.

Dr. Maura Sheehan, C.I.H.

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DANE KORMOS

Has Completed the

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 03/22/2012 in West Chester, PA

TRAINING MANAGER
Owen B. Douglass, Jr., PhD, CIH

INSTRUCTOR
Theodore L. Blackburn

82_16863_03222012

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06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DANE KORMOS

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 11/10/2011 in West Chester, PA

Owen B Douglass Jr PhD, CIH
TRAINING MANAGER
Owen B. Douglass, Jr., PhD, CIH

George M Crawford Jr CIH
INSTRUCTOR
George M. Crawford Jr CIH

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WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DANE KORMOS

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 02/29/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_16863_02292016

Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

WESTON
SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DANE KORMOS

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 02/29/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

2_16863_02292016

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American Red Cross

Certificate of Completion

Dane Kormos
has successfully completed requirements for

Adult First Aid/CPR/AED - valid 2 Years

conducted by
American Red Cross

Date Completed: 12/01/2015
Instructors: Lawrence John Werts III

Certificate ID: GSJAZK

To verify, scan code or visit:
redcross.org/confirm

5103

Roy F. Weston, Inc.

This certifies that

PAUL LANDRY

has completed the

SITE HEALTH AND SAFETY COORDINATORS COURSE
(RFW 1180.9)

WEST CHESTER, PENNSYLVANIA
MARCH 18 & 19, 1988

Corporate Health & Safety Director

3/19/88
Date

The Continuing Education Unit

0852

Roy F. Weston, Inc.

This certifies that

PAUL LANDRY

has completed the

REMEDIAL RESPONSE HEALTH AND SAFETY
TRAINING COURSE (RFW 1180.8)

Lionville, Pennsylvania
April 13, 14, 15, 16, and 17, 1987

3.0 CONTINUING EDUCATION UNITS (CEUs) AWARDED

Corporate Health & Safety Director

04/17/87
Date

The Continuing

WESTON
SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

PAUL LANDRY

Has Completed the

30-Hour Construction Safety and Health Training Course

In accordance with OSHA Outreach Training Program (Includes Competent Person Instruction as indicated in 29 CFR 1926 Subparts C, E, M, P, & X) completed on 03/11/2011 in West Chester, PA

TRAINING MANAGER
Owen B. Douglass, Jr., PhD, CIH

INSTRUCTOR
Theodore L. Blackburn

82_1100_03112011

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06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

PAUL LANDRY

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 10/08/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_1100_10082015

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06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

PAUL LANDRY

Has Completed the

First Aid/ CPR/AED Initial

completed on 01/19/2016 in Westchester, PA

Lawrence J Werts III

INSTRUCTOR
Lawrence J. Werts III

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06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

PAUL LANDRY

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 10/08/2015 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

2_1100_10082015

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Compliance Solutions

"Today's Training... Tomorrow's Solution"

3980 Quebec St, 2nd Floor Denver, CO 80207-1633 800-711-2706

Student Affiliation:
Weston Solutions, Inc
9808494

Certificate of Completion

This is to certify that

David Sena

has been tested and successfully meets the training requirements for

40-Hour HAZWOPER

29 CFR 1910.120(e)

Presented

Monday, May 10, 2010

Compliance Solutions Occupational Trainers, Inc.

Certificate Number: 754808997

Neval Gupta
Vice President

Jeffrey Kline
President/CEO

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DAVID SENA

Has Completed the

8-Hour Site Manager and Supervisor Training Course

In accordance with 29 CFR 1910.120(e)(4) completed on 05/21/2010 in Norcross, GA

TRAINING MANAGER
Owen B. Douglass, Jr., PhD, CIH

INSTRUCTOR
James E. Davis

195_16491_05212010

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06P-0910-2

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DAVID SENA

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 04/14/2016 in West Chester, PA

Herold S Hannah
TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III
INSTRUCTOR
Lawrence J. Werts III

1_16491_04142016

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WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DAVID SENA

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 04/14/2016 in West Chester, PA

Herold S Hannah

TRAINING MANAGER
Herold Hannah, CIH, CSP

Lawrence J Werts III

INSTRUCTOR
Lawrence J. Werts III

2_16491_04142016

Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

DAVID SENA

Has Completed the

First Aid/ CPR/AED Initial

completed on 01/19/2016 in Westchester, PA

Lawrence J Werts III

INSTRUCTOR

Lawrence J. Werts III

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CERTIFICATE OF ACHIEVEMENT

40 HOUR: HAZARDOUS WASTE OPERATIONS & EMERGENCY RESPONSE

THIS IS TO CERTIFY THAT

Zach Taylor

HAS SUCCESSFULLY COMPLETED 40 HOUR HAZWOPER CERTIFICATION TRAINING IN IN ACCORDANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS 29 CFR 1910.120 AND 1926.65

Location: Burlington, MA

Date: January 31, 2014

EBI Training Services
21 B Street
Burlington, MA 01803
(781) 273-2500

EBI Consulting
environmental | engineering | due diligence

Jordan A. Hall
EBI Training Services
January 31, 2013

Association of
Bay Area Governments

ABAG Training Center
www.hazmatschool.com

CERTIFICATE OF COMPLETION

Zachary Taylor

has successfully completed the course titled

OSHA 8-hr Annual HAZWOPER Refresher

Satisfies 29 CFR 1910.120(e)(8)

on

July 8, 2015

and has earned

0.8 CEUs (Continuing Education Units) (8Course hours) from the program

OSHA Requires recertification every year

Certificate No. 120927
(verify at www.hazmatschool.com)

Brian Kirking, Training Director
Michelle McDaniels, Training Coordinator
ABAG Training Center, 101 8th St., Oakland CA 94607; (510) 464-7964

Paul W Gantt

Paul W. Gantt, CSP, CET
Safety Compliance Management, Inc.

ACTIVE

American
Heart
Association.
life is why™

Zachary Taylor

has successfully completed

Heartsaver® First Aid CPR AED

Additional Optional Modules:

Infant CPR, Child CPR AED

eCard Code: 153502354301

Course Date:
03/28/2016

Recommended Renewal Date:
03/2018

Exeter Hospital

Training Center ID: NH00050

5 Alumni Dr, Exeter NH 03833-2128

Instructor: Kourtney Auger

Instructor ID: 12140295596

Scan this code from your mobile device to view your eCard.

Students may view their AHA eCards profile at www.heart.org/cpr/mycards.
Employers, visit www.heart.org/cpr/mycards to validate AHA eCards.

Lewis Environmental

Certificate of Completion

Presented to

Brian Tolton

In recognition of completing the Initial 40-hour Training Requirements of 29 CFR 1910.120(e)(3)(i) for Hazardous Waste Operations and Emergency Response including: Health & Safety, PPE, Hazardous Material Identification, Chemistry, Containers, Hazard and Risk Assessment, Mitigation, PPE, Air Monitoring, Bonding & Grounding, Decon, Scene Management, ICS, Debriefing & Critiquing, MSDS/SDS, HAZCOM, GHS, CSE, LOTO, BBP, Shoring, Benzene, Silica, Lead, Asbestos, Safe Driving, Fall Protection, and Trenching & Excavation Review

May 1, 2015

Stephen Pelna, MS
Health & Safety Director

LEWIS ENVIRONMENTAL 455 RAILROAD PLAZA, P.O. BOX 639 ROYERSFORD, PA 19468 (610) 495-6695 WWW.LEWISENVIRONMENTAL.COM

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

BRIAN TOLTON

Has Completed the

8-Hour HAZWOPER Refresher Training Course

In accordance with 29 CFR 1910.120(e)(8) completed on 02/11/2016 in Plano, TX

Herold S Hannah

TRAINING MANAGER
Herold Hannah, CIH, CSP

INSTRUCTOR
Samuel Cheek

1_18242_02112016

Weston Solutions, Inc • 1400 Weston Way • West Chester, PA • 19380

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

BRIAN TOLTON

Has Completed the

First Aid/ CPR/AED Initial

completed on 01/19/2016 in Westchester, PA

Lawrence J Werts III

INSTRUCTOR

Lawrence J. Werts III

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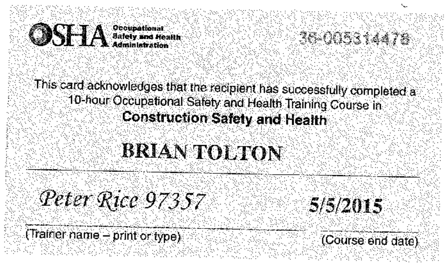

OSHA Occupational Safety and Health Administration

36-005314478

This card acknowledges that the recipient has successfully completed a 10-hour Occupational Safety and Health Training Course in

Construction Safety and Health

BRIAN TOLTON

Peter Rice 97357

(Trainer name – print or type)

5/5/2015

(Course end date)

WESTON SOLUTIONS®
Restoring Resource Efficiency

This Certifies That

BRIAN TOLTON

Has Completed the

Bloodborne Pathogens Training Course Refresher

In accordance with 29 CFR 1910.1030 completed on 02/11/2016 in Plano, TX

Herold S Hannah

TRAINING MANAGER
Herold Hannah, CIH, CSP

INSTRUCTOR
Samuel Cheek

2_18242_02112016

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ATTACHMENT C

ENVIRONMENTAL HEALTH AND SAFETY INSPECTION CHECKLIST

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ENVIRONMENTAL HEALTH AND SAFETY INSPECTION CHECKLIST

Project Name: ______________________________

Inspector: ______________________________

Submit to: ______________________________

Date: ______________

THE WESTON SITE APPEARANCE

YES	NO		COMMENT
		Is the site secured to prevent inadvertent, unnecessary, or unauthorized access? Are gates closed and locked at any time that the access point is not occupied or visible to site workers?	
		Are access points posted with signs to indicate client and end-user client name, WESTON's name and logo, names of other contractors and sub-contractors, project name and location, and appropriate safety messages?	
		Are required postings in place (e.g., Labor Poster, Emergency Phone Numbers, Site Map, etc.)?	
		Are site trailers tied down per local code and provided with stairs that have a landing platform with guard and stair railings?	
		Is a Site Safety file system established in the office to maintain records required by applicable safety regulations	
		Is the Health and Safety Plan (HASP) or Accident Prevention Plan (APP) amended as scope of work changes, hazards are discovered or eliminated or if risk change?	
		Is the Site Safety Plan and the Safety Officers Field Manual on site?	
		Is new employee indoctrination provided?	
		Have site Rules been provided, discussed and signed off on by all employees	
		Incident Reporting procedure explained to all?	
		Is site management trained in the WESTON (and client as applicable) Incident Reporting system?	
		Are NOI and Supplemental Report forms and OSHA 300 Log available on site?	
		Is Site Management aware of the Case Management and Incident Investigation Procedures?	
		Is there a list of preferred provider medical facilities available?	
		Has the "Inspection By A Regulatory Agency" procedure been reviewed by all site management?	
		Will Competent Persons be required because of activities to be performed, equipment to be used or hazards to be encountered?	

POLICIES

YES	NO		COMMENT
		Each individual employee is aware that he or she responsible for complying with applicable safety requirements, wearing prescribed safety equipment and preventing avoidable accidents.	
		Do employees understand that they will wear clothing suitable for existing weather and work conditions and the minimum work uniform will include long pants, sleeved work shirts, protective footwear, hard hat, and safety glasses unless otherwise specified via the HASP.	
		Are employees provided safety and health training to enable them to perform their work safely ? Is all training documented to indicate the date of the session, topics covered, and names of participants?	
		Safety meetings are conducted daily. The purpose of the meetings are to review past activities, review pertinent tailgate safety topics and establish safe working procedures for anticipated hazards encountered during the day.	
		Training has been provided to all personnel regarding handling of emergency situations that may arise from the activity or use of equipment on the project.	
		Employees/contractors are informed and understand that they may not be under the influence of alcohol, narcotics, intoxicants or similar mind-altering substances at any time. Employees found under the influence of or consuming such substances will be immediately removed from the job site.	
		Site workers and operators of any equipment or vehicles are able to read and understand the signs, signals and operating instructions of their use.	
		Have contractors performing work provided copies of relevant documentation (such as medical fit-for-duty, training certificates, fit-tests, etc.) prior to initiation of the project?	

SANITATION
29 CFR 1926 Subparts C, D. EM 385-1-1, Section 2

YES	NO		COMMENT
		Is an adequate supply of drinking water provided. Is potable/drinking water labeled as such? Are there sufficient drinking cups provided?	
		Is there a sufficient number of toilets?	
		Are washing facilities readily available and appropriate for the cleaning needs?	
		Are washing facilities kept sanitary with adequate cleansing and drying materials?	
		Waste is secured so as not to attract rodents, insects or other vermin?	
		Is an effective housekeeping program established and implemented?	

ACCIDENT PREVENTION SIGNS, TAGS, LABELS, SIGNALS, AND PIPING SYSTEM IDENTIFICATION
29 CFR 1926 Subpart G. EM 385-1-1, Section 8

YES	NO		COMMENT
		Are signs, tags, and labels provided to give adequate warning and caution of hazards and instruction/directions to workers and the public?	
		Are all employees informed as to the meaning of the various signs, tags and labels used in the workplace and what special precautions are required?.	
		Are construction areas posted with legible traffic signs at points of hazard?	
		Are signs required to be seen at night lighted or reflectorized?	
		Tags contain a signal word (“danger” or “caution”) and a major message to indicate the specific hazardous condition or the instruction to be communicated to the employee. Tags follow requirements as outlined in 29 CFR 1926.200.	

MEDICAL SERVICES AND FIRST AID
29 CFR 1926 Subparts C, D. EM 385-1-1, Section 3

YES	NO		COMMENT
		Is a local medical emergency facility (LMEF) identified in the HASP or APP?	
		Has the LMEF been visited to verify the directions and establish contacts?	
		Has site management reviewed WESTON’s incident management procedures?	
		Have clinics and specialists that will help WESTON manage injuries and illnesses been identified?	
		Is there at least two (2) people certified in First Aid and CPR?	
		Are first aid kits available at the command post and appropriate remote locations?	
		Are first Aid Kits and Eyewash/Safety Showers inspected weekly?	
		Are 15 minute eyewash/safety showers in place if required.	

FIRE PREVENTION AND PROTECTION
29 CFR 1926 Subpart F. EM 385-1-1, Section 9

YES	NO		COMMENT
		Is an Emergency Response and Contingency Plan in place?	
		Are emergency phone numbers posted?	
		Are fire extinguishers selected and provided based on the types of materials and potential fire classes in each area.	
		Are fire extinguishers provided in each administrative and storage trailer, within 50 ft but no closer than 25 ft of any fuel or flammable liquids storage, on welding and cutting equipment, on mechanical equipment?	
		Are fire extinguishers checked daily and inspected monthly?	
		Do site personnel know the location of fire extinguishers and how to use them?	
		Are flammable and combustible liquids stored in approved containers?	
		Safety cans are used for dispensing flammable or combustible liquids in 5 gallon or less volumes.	
		Are flammable and combustible liquids stored in flammable storage cabinets or appropriate storage areas?	
		Are flammable materials separated from oxidizers by at least 20 feet (or 5 foot tall, ½ -hour rated fire wall) when in storage?	
		Are fuel storage tanks double walled or placed in a lined berm?	
		Spills are cleaned up immediately and wastes are disposed of properly.	
		Combustible scrap, debris and waste material (oily rags) are stored in closed metal containers and disposed of promptly.	
		Vehicle fueling tanks are grounded and bonding between the tank and vehicle being fueled is provided?	
		LPG is stored, handled and used according to OSHA regulations 29 CFR 1926.	
		LPG cylinders are not stored indoors.	
		Is a hot work permit program in place? See WESTON FLD-36	
		Is smoking limited to specific areas, prohibited in flammable storage areas and are signs posted to this effect?	

HAZARDOUS SUBSTANCES, AGENTS AND ENVIRONMENTS
29 CFR 1926 Subparts D, Z. EM 385-1-1, Sections 6, 28

YES	NO		COMMENT
		Are operations, materials and equipment evaluated to determine the presence of hazardous contaminants or if hazardous agents could be released in the work environment?	
		Are MSDS for substances made available at the work-site when any hazardous substance is procured, used, or stored?.	
		Are all containers and piping containing hazardous substances labeled appropriately?	
		Is there an inventory of hazardous substances?	
		Is there a site Specific Hazard Communication Program?	
		Spill kits appropriate for the hazardous materials present are on site and their location is known to spill responders.	
		Is disposal of excess hazardous chemicals performed according to WESTON's guidelines and RCRA regulations.	
		Before initiation of activities where there is an identified asbestos or lead hazard, is there a written plan detailing compliance with OSHA and EPA asbestos or lead abatement requirements? Does the plan comply with state and local authority, and USACE requirements, as applicable?	
		Are personnel trained and provided with protection against hazards from animals, poisonous plants and insects?	

PERSONAL PROTECTIVE AND SAFETY EQUIPMENT, RESPIRATORY AND FALL PROTECTION
29 CFR 1926 Subparts D, E, M. EM 385-1-1, Section 5

YES	NO		COMMENT
		Do employees understand that the minimum PPE is hard hat, safety glasses with side shields and safety shoes or boots and that long pants and a sleeved shirt are required?	
		Has the SSHC reviewed the PPE requirements in the HASP against actual site conditions and certified that the PPE is appropriate? (see Field Manual, PPE Program)	
		PPE is inspected, tested and maintained in serviceable and sanitary condition as recommended by the manufacturer. Is defective or damaged equipment taken out of service and repaired or replaced?	
		Are workers trained in the use of the PPE required?	
		Are personnel exposed to vehicular or equipment traffic, including signal persons, spotters or inspectors required to vests or apparel marked with a reflective or high visibility material?	
		Is there a noise hazard? If yes, hearing protection will be required.	
		Is there a splash or splatter hazard? Face shields or goggles will be required.	
		Will personnel be working in or over water? Personnel Floatation devices will be required.	
		Is there a welding hazard? Welding helmet and leathers will be required. Is there a cutting torch hazard? Goggles and protective clothing will be required.	
		Is each person on a walking/working surface with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level protected from falling by the use of guardrail systems, safety net systems or personal fall arrest systems? See WESTON FLD 25 (Note General Industry standard is four feet).	
		Guardrail systems are used as primary protection whenever feasible. Guardrail construction meets criteria in 29 CFR 1926.502(b).	
		Personal fall arrest systems (PFAS) are inspected and appropriate for use.	
		Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body belts and body harnesses are from synthetic fibers.	
		Safety nets and safety net installations are constructed, tested and used according to 29 CFR 1926.502.c	
		Is respirator use required? See WESTON Respiratory Protection Program	
		Persons using respiratory protection have been successfully medically cleared, trained and fit tested.	
		Respirators are used according to the manufacturer’s instructions, regulatory requirements, selection criteria and health and safety plan provisions.	
		For Level C operations with organic vapor contamination, is the cartridge change-out schedule documented?	
		Is breathing certified as Grade D, or better, and certification available on-site?	

MACHINERY AND MECHANIZED EQUIPMENT
29 CFR 1926 Subparts N, O. EM 385-1-1, Sections 16, 17, 18

YES	NO		COMMENT
		Are inspections of machinery by a competent person established?	
		Is equipment inspected daily before its next use?	
		Equipment inspection reports are reviewed, followed-up on negative findings and records of inspections are maintained?	
		Machinery or equipment found to be unsafe is taken out of service until the unsafe condition has been corrected.	
		Is there a preventive maintenance program established?	
		Are operators of equipment qualified and authorized to operate?	
		Is all self-propelled construction and industrial equipment equipped with a reverse signal alarm?	
		Are seats or equal protection provided for each person required to ride on equipment. Are seatbelts installed and worn on motor vehicles, as appropriate.	
		All equipment with windshields is equipped with powered wipers. If fogging or frosting is possible, operable defogging or defrosting devices are required.	
		Internal combustion engines are not operated in enclosed areas unless adequate ventilation are made. Air monitoring is conducted to assure safe working conditions.	
		Is each bulldozer, scraper, dragline, crane, motor grader, front-end loader, mechanical shovel, backhoe, or similar equipment equipped with at least one dry chemical or carbon dioxide fire extinguisher with a minimum rating of 5-B:C?	
		Will cranes or other lifting devices be used? If so, are the following documents available on site: 1) a copy of the operating manual, 2) load rating chart, 3) log book, 4) a copy of the last annual inspection and 5) the initial on-site inspection?	
		Do operators have certificates of training to operate the type of crane(s) to be used?	
		Is a signal person provided when the point of operation is not in full view of the vehicle, machine or equipment operator? When manual (hand) signals are used, is only one person designated to give signals to the operator?	
		Signal persons back one vehicle at a time. While under the control of a signal person, drivers do not back or maneuver until directed. Drivers stop if contact with the signal person is lost.	
		Is a critical lift plan prepared by a competent person whenever: a lift is not routine, or a lift exceeds 75% of a crane's capacity, a lift results in the load being out of the operator's line of sight, or a lift involves more than one crane, a man basket is used, or the operator believes there is a need for a critical lift plan.	
		Fork Lifts (Powered Industrial Trucks) - Will forklifts be used on site?	
		All fork lifts meet the requirements of design, construction, stability, inspection, testing, maintenance and operation as indicated in ANSI/ASME B56.1 Safety Standards for Low Lift and High Lift Trucks.	
		Do forklift operators have certificates of training?	
		Are pile driving operations conducted according to EM 385-1-1, Section 16.L?	
		Is drilling equipment operated, inspected, and maintained as specified in the manufacturer's operating manual? Is a copy of the manual available at the work-site? See also the Drilling Safety Guide in the Safety Officers Field Manual.	
		Are flag persons provided when operations or equipment on or near a highway expose workers to traffic hazards? Do flag persons and persons working in proximity to a road wear high visibility vests? Are persons exposed to highway vehicle traffic protected by signs in all directions warning of the presence of the flag persons and the work? Do signs and distances from the work zone conform to federal and local regulations?	

MOTOR VEHICLES
29 CFR 1926 Subpart O. EM 385-1-1, Section 18

YES	NO		COMMENT
		Motor vehicle operators have a valid permit, license, or certification of ability for the equipment being operated.	
		Inspection, maintenance and repair is according to manufacturer's requirements by qualified persons.	
		Vehicles are inspected on a scheduled maintenance program.	
		Vehicles not in safe operating condition are removed from service until defects are corrected.	
		Glass in windshields, windows, and doors is safety glass. Any cracked or broken glass is replaced.	
		Seatbelts are installed and worn.	
		The number of passengers in passenger-type vehicles does not exceed the number which can be seated.	
		Trucks used to transport personnel have securely anchored seating, a rear endgate, and a guardrail.	
		No person is permitted to ride with arms or legs outside of a vehicle body; in a standing position on the body; on running boards; seated on side fenders, cabs, cab shields, rear of the truck or on the load.	
		ATV operators possess valid state drivers license, have completed an ATV training course prior to operation of the vehicle, and wear appropriate protective equipment such as helmets, boots, and gloves.	

EXCAVATING AND TRENCHING
29 CFR 1926 Subpart P. EM 385-1-1, Section 25

YES	NO		COMMENT
		Has the known or estimated location of utility installations such as sewer, telephone, fuel, electric, water lines, or any other underground installations that may be expected to be encountered during excavation been determined before excavation? Have utility locations been verified by designated state services according to state regulations? Has the client provided clearance where state jurisdiction doesn't apply?	
		Have overhead utilities in excavation areas been identified and either de-energized, shielded or barricaded so excavating equipment will not come within 10 feet?	
		Are inspections of the excavation, the adjacent areas, and protective systems made daily and as necessary by a competent person?	
		Are Protective systems in place as prescribed by the competent person?	
		Is material removed from excavations managed so it will not overwhelm the protective systems?	
		Are barriers provided between excavations and walkways?	
		Are excavations by roadways barricaded to warn vehicles of presence or to prevent them from falling in?	
		Is there a means of exit from the excavation every 25 feet?	
		Is air monitoring required? If yes, Is it performed?	

CONFINED SPACES
29 CFR 1910 Subpart J. EM 385-1-1, Section 6

YES	NO		COMMENT
		Is there a Confined Space Entry Program in place?	
		Are the confined Spaces identified and labeled?	
		Will the Confined Spaces be entered?	
		Is appropriate entry documentation used and on-file?	

ELECTRICAL
29 CFR 1926 Subpart K. EM 385-1-1, Section 11

YES	NO		COMMENT
		Are electrical installations made according to the National Electrical Code and applicable local codes?	
		Qualified electricians make all connections and perform all work within 10 feet of live electric equipment.	
		Location of underground, overhead, under floor, behind wall electrical lines is known and communicated. Lines are documented by qualified person as de-energized where necessary.	
		Workers understand they must not work near live parts of electric circuits, unless they are qualified as required by OSHA or are protected by de-energizing and grounding the parts, guarding the parts by insulation, or other effective means?	
		Employees who regularly work on or around energized electrical equipment or lines are instructed in the cardiopulmonary resuscitation (CPR) methods.	
		Workers are prohibited from working alone on energized lines or equipment over 600 volts.	
		Are Ground-fault circuit interrupters (GFCI's) or is ground fault circuit protection provided to protect employees from ground-fault hazards for all 115 – 120 Volt, 15 and 20 amp receptacle outlets which are not a part of the permanent wiring of a building or structure at construction sites?	
		Circuit breakers are labeled.	
		Circuit breaker and all cabinets with exposed electric conductors are kept tightly closed.	
		Unused openings (including conduit knockouts) in electrical enclosures and fittings are closed with appropriate covers, plugs or plates.	
		Sufficient access and working space is provided and maintained about all electrical equipment to permit ready and safe operations and maintenance.	
		Motors are located within sight of their controllers or controller disconnecting means are capable of being locked in the pen position or is a separate disconnecting means installed in the circuit within sight of the motor.	
		Are visual inspections of extension cords and cord-and plug-connected equipment conducted daily? Is equipment found damaged or defective tagged and removed from service, and not used until repaired?	
		Wet Areas - Is portable lighting used in wet or conductive locations, such as tanks or boilers operated at no more than 12 volts and protected by GFCIs.	
		Are electrical installations in hazardous areas to NEC?	
		Metal ladders and tools including tape measures or fabric with metal thread are prohibited where contact with energized electrically parts is possible.	
		All extension cords are the three-wire type, designed and rated for hard or extra hard usage?	
		Worn or frayed electrical cords or cables are taken out of service. Fastening with staples, hanging from nails or suspending extension cords by wire is prohibited.	
		Electric wire/flexible cord passing through work areas is protected from damage such as foot traffic, vehicles, sharp corners, projections and pinching? Flexible cords and cables passing through holes are protected by bushings or fittings?	
		Before an employee or contractor performs any service or maintenance on a system where the unexpected energizing, start up, or release of kinetic or stored energy could occur and cause injury or damage, the system is to be isolated. Only authorized persons may apply and remove lockouts and tags.	
		Contractors planning to use hazardous energy control procedures submit their hazardous energy control plan to the WESTON site safety officer or designee before implementing lockout/tagout procedures.	
		There is a site specific hazardous energy control plan that clearly and specifically outlines the scope, purpose, authorization, rules and techniques to be used for the control of hazardous energy.	
		Workers possess the knowledge and skills required for the safe application, usage and removal of energy controls.	

WELDING AND CUTTING
29 CFR 1926 Subpart J. EM 385-1-1, Section 10

YES	NO		COMMENT
		Prior to performing welding, cutting or any other heat or spark producing activity, an assessment of the area is made by a competent person to identify combustible materials and potential sources of flammable atmospheres.	
		Welders, cutters and their supervisors are trained in the safe operation of their equipment, safe welding and cutting practices, hot work permit requirements, and fire protection.	
		Welding and cutting equipment is inspected daily before use. Unsafe equipment is taken out of use, replaced or repaired.	
		Workers and the public is shielded from welding rays, flashes, sparks, molten metal and slag.	
		Employees performing welding, cutting or heating are protected by PPE appropriate for the hazards (e.g., respiratory, vision and skin protection).	
		Compatible fire extinguishing equipment is provided in the immediate vicinity of welding or cutting operations.	
		Drums, tanks, or other containers and equipment which have contained hazardous materials shall be thoroughly cleaned before welding or cutting. Cleaning shall be performed in accordance with NFPA 327, Cleaning or Safeguarding Small Tanks and Containers, ANSI/AWS F4.1, Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, and applicable health and safety plan requirements.	

HAND AND POWER TOOL SAFETY
29 CFR 1926 Subpart I. EM 385-1-1, Section 13

YES	NO		COMMENT
		Power tools are from a manufacturer listed by a nationally recognized testing laboratory for the specific application for which they are to be used.	
		Hand & power tools are inspected, maintained, tested and determined to be in safe operating condition before use.	
		Tools found to be unsafe are not used, tagged and repaired or destroyed.	
		Users of tools are trained in safe use.	
		Electrical tools have cords and plug connections in good repair.	
		Electrical tools are effectively grounded or approved double insulated.	
		Reciprocating, rotating, and moving parts of equipment are guarded if they may be accessed by employees or they otherwise create a hazard.	
		Safety clips/retainers are installed and maintained on pneumatic impact tool connections.	
		Chain saws have an automatic chain brake or anti-kickback device.	
		Pneumatic and hydraulic hoses and fittings are inspected regularly.	
		Employees who operate powder actuated tools are trained and carry valid operators cards.	
		Powder activated tools are stored in individual locked containers, when not in use and are not loaded until ready to use.	
		Powder actuated tools are inspected for obstructions or defects daily before use.	
		Powder actuated tool operators have appropriate PPE.	

RIGGING
29 CFR 1926 Subpart H. EM 385-1-1, Section 15

YES	NO		COMMENT
		Rigging equipment is inspected as specified by the manufacturer, by a qualified person, before use on each shift and as necessary to assure that it is safe.	
		Defective equipment is removed from service.	
		Rigging not in use is removed from the work area, properly stored, and maintained in good condition.	
		Wire rope removed from service for defects is cut up or plainly marked as unfit for use as rigging.	
		The number of saddle clips used to form eyes in wire rope conforms with Table H-20, are spaced evenly and the saddles are on the live side.	
		Chain rigging has a tag clearly indicating load limits, is inspected before initial use, then weekly, and is of alloyed metal.	
		Fiber rope rigging is not used if it is frozen or has been subject to acids or excessive heat.	
		Slings and their fittings and fastenings are inspected before use on each shift and as needed during use.	
		Drums, sheaves, and pulleys on rigging hardware are smooth and free of surface defects that can damage rigging.	

MATERIAL HANDLING, STORAGE, AND DISPOSAL
29 CFR 1926 Subpart H. EM 385-1-1, Section 14

YES	NO		COMMENT
		Employees are trained in and use safe lifting techniques.	
		Materials are not moved or suspended over workers unless positive precautions have been taken to protect workers.	
		Conveyors are constructed, inspected, & maintained by qualified persons according to manufacturer’s recommendations.	
		All conveyors are to be equipped with emergency stopping devices.	
		Hazardous exposed moving machine parts are guarded mechanically, electrically or by location.	
		Controls are clearly marked and/or labeled to indicate the function controlled.	
		Taglines are used for suspended loads where the movement may be hazardous to persons.	
		Material in storage is protected from falling or collapse by effective stacking, blocking, cribbing, etc.	
		Walkways and aisles are to be kept clear.	
		Materials are not stored on scaffolds or runways in excess of normal placement or in excess of safe load limits.	
		Work areas and means of access are maintained safe and orderly.	
		Tools, materials, extension cords, hoses or debris do not cause tripping or other hazards.	
		Storage and construction sites are kept free from the accumulation of combustible materials.	
		Waste materials and rubbish are placed in containers or, if appropriate, in piles. Waste materials are disposed of in accord with applicable local, state, or federal requirements.	

FLOATING PLANT AND MARINE ACTIVITIES
29 CFR 1926 Subpart O. EM 385-1-1 Section 19

YES	NO		COMMENT
		Floating plants that are regulated by the USCG have current inspections and certificates.	
		Before any floating plant is brought to the job site and placed in service it is inspected and determined to be in safe operating condition	
		Periodic inspections are made such that safe operating conditions are maintained. Strict compliance with EM 385-1-1, Section 19 is expected.	
		Plans are in place for removing or securing the plant and evacuation of personnel endangered by severe weather and other marine emergencies such as; fire, flooding, man overboard, hazardous materials incidents, etc..	
		Means of access are properly secured, guarded, and maintained free of slipping and tripping hazards.	
		Dredging operations follow guidelines as established in EM 385-1-1, Section 19.D.	

PRESSURIZED EQUIPMENT AND SYSTEMS
29 CFR 1926 Subparts I, F. EM 385-1-1, Section 20

YES	NO		COMMENT
		Pressurized equipment and systems are inspected before being placed into service.	
		Pressurized equipment or systems found to be unsafe are tagged “Out of Service-Do Not Use”.	
		Systems and equipment are operated, inspected and maintained by qualified, designated personnel.	
		Safe clearance, lockout/tagout procedures are followed as appropriate during maintenance or repair.	
		Air hose, pipes, fittings are pressure-rated for the activity. Defective hoses are removed from service.	
		Hoses aren’t laid over ladders, steps, scaffolds, or walkways in a manner that creates a tripping hazard.	
		The use of compressed air for personal cleaning is prohibited. The use of compressed air for other cleaning is restricted to less than 30 psig.	
		Compressed gas cylinders are stored in well-ventilated locations.	
		Cylinders in storage are separated from flammable or combustible liquids and from easily ignitable materials by at least 40 feet or by a minimum five feet tall, ½ -hour fire resistive partition.	
		Stored cylinders containing oxidizing gases are separated from fuel gas cylinders by at least 20 feet or by a minimum five feet tall, ½ -hour fire resistive partition.	
		Cylinder valve caps are in place when cylinders are in storage, in transit, or a regulator is not in place.	
		Compressed gas cylinders in service are secured in substantial fixed or portable racks or hand trucks.	
		Oxygen cylinders and fittings are kept away from, and free from oil and grease.	
		Cylinder Storage areas are posted with the names of the gases in storage and with signs indicating "No Smoking or Open Flame".	
		Cylinders are to be stored such that mechanical and corriosion damage is avoided. Cylinders are not to be stored in areas required as an egress path.	
		Cylinders may be stored in the open outdoors, however, they must be protected from the ground to prevent corrosion and must be protected from temperatures that may exceed 125 degrees F.	

WORK PLATFORMS/SCAFFOLDS
29 CFR 1926 Subparts L, M, N. EM 385-1-1 Sections 21, 22

YES	NO		COMMENT
		Work platforms are erected, used, inspected, tested, maintained and repaired according to manufacturer's requirements.	
		Construction, inspection, and disassembly of scaffolds is under the direction of a competent person.	
		Workers on scaffolding have been trained by a qualified person.	
		Scaffolds are erected on a firm and level surface and are square and plumb.	
		Scaffolds are not loaded in excess of rated capacity.	
		Working levels of work platforms are fully planked or decked.	
		Planks are in good condition and free from obvious defects.	
		Fabricated frame scaffolding four times higher than the base width is secured to building/structure according to manufacturer's instruction and/or OSHA requirements.	
		Working platforms of scaffolding over ten feet in height have guard rails meeting OSHA specifications. Fall protection is suggested at four feet or greater.	
		Scaffolding/work platforms are accessed by means of a properly secured ladder or equivalent. Built on ladders conform to scaffold ladder requirements. Climbing of braces is not allowed.	
		Crane supported work platforms are designed and used in accordance with OSHA standards.	
		Elevating work platforms are operated, inspected and maintained according to the equipment operations manual.	
		Employees working in aerial lifts remain firmly on the floor of the basket. Employees use fall protection while in an aerial lift basket.	

WALKING AND WORKING SURFACES AND STAIRS
29 CFR 1926 Subparts L, M, X. EM 385-1-1, Sections 21, 22, 24

YES	NO		COMMENT
		Work areas are clean, sanitary, and orderly	
		Work surfaces are kept dry or appropriate means are taken to assure the surfaces are slip-resistant	
		Accumulations of combustible dust are routinely removed.	
		Aisles and passageways are kept clear and marked as appropriate.	
		There is safe clearance for walking in aisles where motorized or mechanical handling equipment is operating.	
		Materials or equipment is stored in such a way that sharp projections will not interfere with the walkway.	
		Changes of direction or elevation are readily identifiable.	
		Aisles or walkways that pass near moving or operating machinery, welding operations or similar operations are arranged so employees will not be subjected to potential hazards.	
		Standard guardrails are provided wherever aisle or walkway surfaces are elevated more than 30 inches above any adjacent floor or the ground and bridges provided where workers must cross over conveyors and similar hazards.	
		There are standard stair rails or handrails on all stairways having four or more risers or with an elevation of 30 or more inches.	
		Stairways are at least 22 inches wide. (General Industry Standard)	
		Stairs angle no more than 50 and no less than 30 degrees, risers are uniform from top to bottom (plus or minus 1/4 inch) and are provided with a surface that renders them slip resistant.	
		Stairway handrails are not less than 36 inches above the leading edge of stair treads and have at least 3 inches of clearance between the handrails and the wall or surface they are mounted on.	
		Where doors or gates open directly on a stairway, there is a platform provided so the swing of the door does not reduce the width of the platform to less than 20 inches.	
		Where stairs or stairways exit directly into any area where vehicles may be operated, there are adequate barriers and warnings provided to prevent employees stepping into the path of traffic.	
		Signs are posted showing the load capacity of elevated storage areas.	
		An appropriate means of access and egress is provided for surfaces with 19 or more inches of elevation change.	
		Material on elevated surfaces is minimized, with that necessary for immediate work requriements piled, stacked or racked in a manner to prevent it from tipping, falling, collapsing, rolling or spreading.	

FLOOR AND WALL HOLES AND OPENINGS
29 CFR 1926 Subpart M. EM 385-1-1, Section 24

YES	NO		COMMENT
		Floor and roof openings that persons can walk into or fall through are guarded by a physical barrier or covered.	
		Holes (defined as equal to or greater than 2 inches in least dimension) where person could trip must be covered/protected.	
		Unprotected sides and edges on a walking/working surface six feet or more (note four feet in General Industry) are protected by guardrail system, safety net or Personal Fall Arrest System (PFAS).	
		Unused portions of service pits and pits not actually in use are either covered or protected by guardrails or equivalent.	
		Coverings for holes or other openings must be constructed of sufficient strength to support any anticipated load, must be secured in place to prevent accidental removal or displacement and must be marked indicating purpose (e.g., stenciled "Hole" or painted contrasting color to surroundings).	

LADDERS
29 CFR 1926 Subpart X. EM 385-1-1, Section 21

YES	NO		COMMENT
		Portable ladders are used for their designed purpose only.	
		Portable ladders are examined for defects prior to, and after use.	
		Ladders found to be defective are clearly tagged to indicate "DO NOT USE" if repairable, or destroyed immediately if no repair is possible.	
		Workers are trained in hazards associated with ladder use and how to inspect ladders.	
		Ladders have secure footing provided by a combination of safety feet, top of ladder tie-offs and mud cills or a person holding the ladder to prevent slipping.	
		The handrails of a straight ladder used to get from one level to another extend at least 36 inches above the landing.	
		Ladders conform to construction criteria of ANSI Standards A-14.1 and A-14.2.	
		Wooden ladders are not painted with an opaque covering such that signs of flaws, cracks or drying are obscured.	
		Fixed ladders are constructed and used according to OSHA Standards, 29 CFR 1910.27 and ANSI A-14.3.	
		Rungs, cleats or steps, and side rails that may be used for handholds when climbing, offer adequate gripping surface and are free of splinters, slivers or burrs, and substances that could cause slipping.	
		Fixed ladders of greater than 24 feet have cages or other approved fall protection devices. (note General Industry is 20 feet).	
		Where fall protection is provided by ladder safety systems (body belts or harnesses, lanyards and braking devices with safety lines or rails), systems meet the requirements of and are used in accordance with WESTON Fall Protection Standard Practices and are compatible with construction of the ladder system.	

DEMOLITION
29 CFR 1926 Subpart T. EM 385-1-1, Section 23

YES	NO		COMMENT
		Prior to initiating demolition activities an engineering survey (by a competent person) and a demolition plan (by a competent person) is completed.	
		All employees engaged in demolition activities are instructed in the demolition plan.	
		It has been determined through the engineering survey and outlined in the plan, if any hazardous materials, or conditions (e.g., asbestos, lead, utility connections, etc.) exist. Such hazards are controlled or eliminated before demolition is started.	
		Continued inspections, by a competent person, are conducted to ensure safe employee working conditions.	

TREE MAINTENANCE AND REMOVAL
29 CFR 1910 Subpart R. EM 385-1-1, Section 31

YES	NO		COMMENT
		Tree maintenance or removal is done is under the direction of a qualified person.	
		Tree work, in the vicinity of charged electric lines, is by trained persons qualified to work with electricity and tree work. Appropriate distances are maintained for all workers who are not qualified.	
		Equipment is inspected, maintained, repaired and used in accordance with the manufacture’s directions.	
		Prior to felling actions are planned to include clearing of the area to permit safe working conditions and escape.	
		Employees must be trained in the safe operation of all equipment.	
		All equipment and machinery is inspected and determined safe prior to use.	
		Work is performed under requirements of FLD 43.	

BLASTING
29 CFR 1926 Subpart U. EM 385-1-1, Section 29

YES	NO		COMMENT
		A blasting safety plan is developed prior to bringing explosives on-site.	
		The transportation, handling, storage, and use of explosives, blasting agents, and blasting equipment must be directed and supervised by a person with proven experience and ability in blasting operations. Licensing of person is verified.	
		Blasting operations in or adjacent to cofferdams, piers, underwater structures, buildings, structures, or other facilities must be carefully planned with full consideration to potential vibration and damage.	

HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE AND UNDERGROUND STORAGE TANK (UST) ACTIVITIES
29 CFR 1926 Subpart D. EM 385-1-1, Section 28

YES	NO		COMMENT
		All construction activities performed with known or potential exposure to hazardous waste are conducted in accordance with Hazardous Waste Operations and Emergency Response requirements.	

CONCRETE and MASONRY CONSTRUCTION
29 CFR 1926 Subpart Q. EM 385-1-1, Section 27

YES	NO		COMMENT
		Construction loads are not placed on a concrete or masonry structure or portion of a concrete or masonry structure unless the employer determines, based on information from a person who is qualified in structural design, that the structure or portion of the structure is capable of supporting the loads.	
		Employees are not permitted to work above or in positions exposed to protruding reinforcing steel or other impalement hazards unless provisions have been made to control the hazard.	
		Sections of concrete conveyances and airlines under pressure are secured with wire rope (or equivalent material) in addition to the regular couplings or connections.	
		Structural and reinforcing steel for walls, piers, columns, and similar vertical structures is supported and/or guyed to prevent overturning or collapse	
		All form-work, shoring, and bracing is designed, fabricated, erected, supported, braced, and maintained so it will safely support all vertical and lateral loads that may be applied until the loads can be supported by the structure.	
		Shoring equipment is inspected prior to erection to determine that it is specified in the shoring design. Any equipment found to be damaged is not used.	
		Erected shoring equipment is inspected immediately prior to, during, and immediately after the placement of concrete. Any shoring equipment that is found to be damaged, displaced, or weakened is immediately reinforced or re-shored.	
		Shoring, vertical slip forms and jacks conform with requirements of Section 27.B.08-13 of USACE EM 385-1-1.	
		Forms and shores (except those on slab or grade and slip forms) are not removed until the individual responsible for forming and/or shoring determines that the concrete has gained sufficient strength to support its weight and all superimposed loads.	
		Precast concrete members are adequately supported to prevent overturning or collapse until permanent connections are complete	
		No one is permitted under pre-cast concrete members being lifted or tilted into position except employees required for the erection of those members.	
		Lift slab operations are planned and designed by a registered engineer or architect.	
		Hydraulic jacks used in lift slab construction have a safety device that causes the jacks to support the load in any position if the jack malfunctions	
		No one is permitted under the slab during jacking operations.	
		A limited access zone is established whenever a masonry wall is being constructed.	
		Fall protection is provided to masonry workers exposed to falls of 6 feet or more.	

STEEL ERECTION
29 CFR 1926 Subpart R. EM 385-1-1, Section 27

YES	NO		COMMENT
		Impact wrenches have a locking device for retaining the socket. Containers shall be provided for storing or carrying rivets, bolts, and drift pins, and secured against accidental displacement when aloft.	
		Structural and reinforcing steel for walls, piers, columns, and similar vertical structures shall be guyed and supported to prevent collapse	
		No loading is placed upon steel joists until all bridging is completely and permanently installed.	
		Workers are provided fall protection whenever they are exposed to falls of 1.8 m (6 ft) or more (EM 385-1-1).	
		Temporary flooring in skeleton steel erection conforms with Section 27.F of USACE 385-1-1	

ROOFING
29 CFR 1926 Subpart M. EM 385-1-1, Sections 21, 22, 24, 27

Yes	No		Comments
		In the construction, maintenance, repair, and demolition, of roofs, fall protection systems is provided that will prevent personnel from slipping and failing from the roof and prevent personnel on lower levels from being struck by falling objects	
		On all roofs greater than 4.8 m (16 ft) in height, a hoisting device, stairways, or progressive platforms are furnished for supplying materials and equipment.	
		Roofing materials and accessories that could be moved by the wind, including metal roofing panels, that are on the roof and unattached are secured when wind speeds are greater than, or are anticipated to exceed, 10 mph.	
		Level, guarded platforms are provided at the landing area on the roof.	
		When their use is permitted, warning line systems comply with USACE Section 27.07 of EM 385-1-1.	
		Workers involved in roof-edge materials handling or working in a storage area located on a roof with a slope -/= to four vertical to twelve horizontal and with edges 6 ft or more above lower levels are protected by the use of a guardrail, safety net, or personal fall arrest system along all unprotected roof sides and edges of the area.	

ENVIRONMENTAL COMPLIANCE

Yes	No		Comments
		Environmental Compliance and Waste Management Plan on file.	
		Waste Determination Made.	
		Manifest and/or Shipping Papers prepared and filed.	
		Manifest Exception Reports Prepared, as necessary. Procedures to track manifests in place.	
		State Annual and EPA Biennial Reporting Information Available.	
		RCRA Personnel Training Records on file.	
		CAA Permits on file.	
		CWA Permits on file.	
		RCRA Permits on file.	
		State and/or Local Permits on file.	
		RCRA Inspections conducted and Documentation on file.	
		Transporter and TSD compliance information on file.	
		Waste Accumulation Areas Managed Properly.	
		Wetlands Areas Identified and Protected.	
		Endangered, Threatened or Special Concern Species or Areas Identified and Protective Methods Determined.	
		Runon and Runoff Concerns Identified and Managed.	
		Adjacent Land Areas Protected as Necessary.	
		Non-Hazardous Solid Wastes Managed Properly.	

MISCELLANEOUS REGULATORY and POLICY COMPLIANCE

Yes	No		Comments
		Personnel Training Records for DOT Materials Handling on file.	
		Noise Control Issues Addressed and Managed.	
		Site Security Issues Identified and Managed.	
		Known Historical, Archeological and Cultural Resources Identified and Managed.	
		WESTON EHS Analysis Checklist In Use.	
		Safety Observation and Recognition Program in place.	
		Weekly EHS Report Card System in place.	
		Federal, State and Local Required Postings in place.	
		Site specific Lockout/Tagout Program is in place.	
		Site-specific Confined Space Program is in place.	
		Site Safety Officer filing system is in place and up to date.	

ATTACHMENT D

DEFICIENCY TRACKING FORM

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SAMPLE DEFICIENCY TRACKING FORM
Site Information and Date

No.	Description	Risk Rating	Date Identified	Status/Date	Reference	Comments	Corrective Action/ Date to be Completed	Responsible Party
EX	PPE	IV	1/2010		EM385-1-1.05.B	Several individuals not using glasses - forgotten, left on hardhat, or dangling from neck strap	Develop program to ensure PPE items specified are worn. Have supervisors lead by example.	
1								
2								
3								
4								
5								
6								
7								
8								

Notes:
Risk Ratings:
I – Catastrophic
II – Serious
III – Severe
IV – Moderate
V – Minor

BMP – Best Management Practice

Requirement of EM 385-1-1, Section 01.A.06 (e)

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ATTACHMENT E

PRELIMINARY ACCIDENT NOTIFICATION (PAN) FORM AND USACE ENG FORM 3394 ACCIDENT INVESTIGATION REPORT

WORK SHEET FOR PRELIMINARY ACCIDENT NOTIFICATION

This work sheet is a field tool to assist the collection of information about an accident and facilitate the completion of a Preliminary Accident Notification. For Member of the Public Recreation Visitor accidents use the Initial Notification of Public Recreation Accident Work Sheet

Project Name: ________________________________ Project Office Symbol: _______ Date Worksheet Completed: _________
Date of Accident: _______ Time of Accident: ______ Person Completing Worksheet: _______________ Phone #: ____________

<u>Location and Incident Information</u>
Exact Location of Accident: ____
Number of Persons Involved: ____ Number of Properties Involved: ____
<u>Personnel Classification</u>
Government: Civilian [ ] Military [ ] Government Direct Contractor [ ] Foreign National [ ] Volunteer [ ]
Contractor [ ] Member of the Public [ ]
<u>Type of Accident</u> <u>(Mark all that are applicable)</u>
Injury/Illness [ ] Fatality [ ] Motor Vehicle [ ] Property Damage [ ] Fire [ ] Diving [ ]
<u>Personal Data</u> <u>(If more than 2 persons involved provide their personal data on a separate sheet)</u>
Person 1 - Name: Last __________________ First ____________ Middle Initial ___ Age: ___Gender: Male [ ] Female [ ]
Date of Birth: ________ Address: ____
Job Series/Title: ____________________ Grade: ___ Duty Status: On Duty [ ] Off Duty [ ] TDY [ ] Time Began Work _______
Unit and Station Assignment: ______________________________ Office Symbol: _________ Date Hired: _________
Nature of Injury: __________________________ Body Part(s) Affected Primary ________________ Secondary ______________________
Type of Injury ____Source of Injury ____
Severity of Injury: (See definitions on reverse side) Fatality: **Yes/No** Permanent Total Disability: **Yes/No**
Permanent Partial Disability: **Yes/No** Other Serious Injury: **Yes/No**
Estimated Days away from Work: ______ Estimated Days Restricted Duty/Job Transfer: _______
Primary Language Spoken: ___________________________________ English Literate: **Yes/No**
Does this person wish to remain anonymous **Yes/No**
What was employee worker doing before the accident occurred? ____
Name of Physician/Health Care Professional: _____________________________________
Medical Treatment Facility: ____
Address: ____ Phone # ______________________
Person 2 - Name: Last __________________ First ____________ Middle Initial ___ Age: ___Gender: Male [ ] Female [ ]
Date of Birth: ________ Address: ____
Job Series/Title: ____________________ Grade: ___ Duty Status: On Duty [ ] Off Duty [ ] TDY [ ] Time Began Work _______
Unit and Station Assignment: _________________________________ Office Symbol: _________ Date Hired: _________
Nature of Injury: __________________________ Body Part(s) Affected Primary ________________ Secondary ______________________
Type of Injury ____Source of Injury ____
Severity of Injury: (See definitions on reverse side) Fatality: **Yes/No** Permanent Total Disability: **Yes/No**
Permanent Partial Disability: **Yes/No** Other Serious Injury: **Yes/No**
Estimated Days away from Work: ______ Estimated Days Restricted Duty/Job Transfer: _______
Primary Language Spoken: ___________________________________ English Literate: **Yes/No**
Does this person wish to remain anonymous **Yes/No**
What was employee worker doing before the accident occurred? ____

Name of Physician/Health Care Professional: _____________________________________
Medical Treatment Facility: ____
Address: ____ Phone # ______________________

Summary of Accident: (Use additional sheet if needed)

Remarks:

Describe Any Information Released to the Public:

Nature of Injury

- Amputation
- Abrasion
- Back Strain
- Burn
- Contusion/Bruise
- Concussion
- Dislocation of joint
- Drowning
- Fracture
- Hearing Loss
- Hernia
- Laceration/Cut
- Puncture
- Strain
- Stroke
- Traumatic Food Poisoning
- Traumatic Heart Condition
- Traumatic Mental Disorder
- Traumatic Respiratory (Carbon Monoxide)
- Traumatic Skin Disease
- Tuberculosis
- Traumatic Virological/Infective Parasitic Disease
- Traumatic Injury Other (list)

Type of Injury

- Struck by/against
- Fell/slipped/tripped
- Caught on/in/between
- Punctured/lacerated
- Stung/bit by
- Contact with/by
- Exerted
- Exposed
- Inhaled
- Ingested
- Absorbed
- Traveling In

Severity of Injury

- Injury
- Illness
- Fatality
- Permanent Disability

Source of Injury

- Environmental Condition
- Building or other Area
- Walking surface
- Electricity
- Temperature Extreme
- Weather
- Fire
- Water
- Mechanical Equipment
- Guard/Shield
- Video Display Terminal
- Heating
- Motor Vehicle/Cycle
- Boat
- Bicycle/Other non-motorized vehicle
- Noise
- Radiation
- Light
- Ventilation
- Smoke
- Stress
- Confined Space
- Carbon Monoxide
- Inanimate Object
- Animal Insect
- Human (Violence)
- Diving Equipment
- Parachute

Body Parts

- Arm or Wrist
- Breast
- Testicle
- Abdomen
- Chest
- Lower Back
- Penis
- Side
- Upper Back
- Waist
- Trunk Other
- Ear
- Eye
- Brain
- Cranial Bones
- Teeth
- Jaw
- Throat/Larynx
- Mouth
- Nose
- Tongue
- Head Other External
- Elbow
- Finger
- Thumb
- Toe
- Face
- Scalp
- Knee
- Leg
- Hip
- Ankle
- Buttock
- Hand
- Feet
- Collar Bone
- Shoulder Blade
- Rib
- Sternum
- Vertebrae
- Trunk Bones other
- Shoulder
- Lung
- Kidney
- Heart
- Liver
- Reproductive Organs
- Stomach
- Intestines
- Trunk/internal

(For safety staff only)	REPORT NO.	EROC CODE	**UNITED STATES ARMY CORPS OF ENGINEERS** **ACCIDENT INVESTIGATION REPORT** For use of this form, see Help Menu and USACE Supplement to AR 385-40 The proponent agency is CESO	REQUIREMENT CONTROL SYMBOL: CEEC-S-8 *(R2)*

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE		MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED	☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED	☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER			☐	

2. PERSONAL DATA

a. NAME *(Last, First MI.)*

b. AGE

c. SEX ☐ MALE ☐ FEMALE

d. SOCIAL SECURITY NUMBER

e. GRADE

f. JOB SERIES/TITLE

g. DUTY STATUS AT TIME OF ACCIDENT

☐ ON DUTY ☐ TDY

☐ OFF DUTY

h. EMPLOYMENT STATUS AT TIME OF ACCIDENT

☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER

☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL

☐ TEMPORARY ☐ STUDENT

☐ OTHER *(Specify)* ____________

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(YYYYMMDD)*

b. TIME OF ACCIDENT *(Military Time)* hrs.

c. EXACT LOCATION OF ACCIDENT

d. CONTRACTOR'S NAME

(1) PRIME

(2) SUBCONTRACTOR

e. CONTRACT NUMBER ____________

☐ CIVIL WORKS ☐ MILITARY

☐ OTHER *(Specify)* ____________

f. TYPE OF CONTRACT

☐ CONSTRUCTION ☐ SERVICE

☐ A/E ☐ DREDGE

☐ OTHER *(Specify)* ____________

g. HAZARDOUS/TOXIC WASTE ACTIVITY

☐ SUPERFUND ☐ DERP

☐ IRP ☐ OTHER *(Specify)*

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY ____________ # ☐ (CODE)

b. TYPE OF CONSTRUCTION EQUIPMENT ____________ # ☐ (CODE)

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY ____________ # ☐ (CODE)

b. ESTIMATED DAYS LOST

c. ESTIMATED DAYS HOSPITALIZED

d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED

PRIMARY ____________ # ☐ (CODE)

SECONDARY ____________ # ☐ (CODE)

f. NATURE OF ILLNESS / INJURY ____________ # ☐ (CODE)

g. TYPE AND SOURCE OF INJURY/ILLNESS

TYPE ____________ # ☐ (CODE)

SOURCE ____________ # ☐ (CODE)

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT ____________ # ☐ (CODE)

b. PERSONAL FLOTATION DEVICE USED?

☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT APPLICABLE
☐☐ PICKUP/VAN ☐☐ AUTOMOBILE ☐☐ TRUCK ☐☐ OTHER *(Specify)* ____________________	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END ☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)* ____________	(1) FRONT SEAT	☐	☐	☐
		(2) REAR SEAT	☐	☐	☐

8. PROPERTY MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT (CODE) ____________________ # ☐	a. ACTIVITY AT TIME OF ACCIDENT (CODE) ____________________ # ☐

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary, see attached page 4.)*

11. CAUSAL FACTOR*(s) (Read instructions before completing)*

a. *(Explain YES answers in item 13)*	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident?	☐	☐
b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT? *(If yes, attach a copy.)*	☐	☐

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK? ☐ YES ☐ NO	b. TYPE OF TRAINING ☐ CLASSROOM ☐ ON JOB	c. DATE OF MOST RECENT FORMAL TRAINING *(YYYYMMDD)*

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE*(s) (Attach additional sheets as needed, See page 4)*

b. INDIRECT CAUSE*(s) (Attach additional sheets as needed, See page 5)*

14. ACTION*(s)* TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE*(s)*		
DESCRIBE FULLY *(Attach additional sheets as necessary, See page 5)*		
15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.		
a. BEGINNING *(YYYYMMDD)*	b. ANTICIPATED COMPLETION *(YYYYMMDD)*	
c. DATE SIGNED *(YYYYMMDD)*	d. TITLE OF SUPERVISOR COMPLETING REPORT	e. CORPS SIGNATURE, SUPERVISOR COMPLETING REPORT
c. DATE SIGNED *(YYYYMMDD)*	d. TITLE OF SUPERVISOR COMPLETING REPORT	e. CONTRACTOR SIGNATURE, SUPERVISOR COMPLETING REPORT
f. ORGANIZATION IDENTIFIER *(Division, Branch, Section, etc.,)*		g. OFFICE SYMBOL
16. MANAGEMENT REVIEW *(1st)*		
a. ☐ CONCUR b. ☐ NONCONCUR c. COMMENTS		
DATE *(YYYYMMDD)*	TITLE	SIGNATURE
17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.,)*		
a. ☐ CONCUR b. ☐ NONCONCUR c. COMMENTS		
DATE *(YYYYMMDD)*	TITLE	SIGNATURE
18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW		
a. ☐ CONCUR b. ☐ NONCONCUR c. ADDITIONAL ACTIONS/COMMENTS		
DATE *(YYYYMMDD)*	TITLE	SIGNATURE
19. COMMAND APPROVAL		
COMMENTS		
DATE *(YYYYMMDD)*	COMMANDER SIGNATURE	

10. ACCIDENT DESCRIPTION *(Continuation)*

13a. DIRECT CAUSE*(s) (Continuation)*

13b.	INDIRECT CAUSE*(s) (Continuation)*
14.	ACTION*(s)* TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE*(s) (Continuation)*

GENERAL. Complete a separate report for each person who was injured, caused, or contributed to the accident *(excluding uninjured personnel and witnesses).* Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs *(OWCP)* shall be at the discretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16 and 17.

INSTRUCTIONS FOR SECTION 1 - ACCIDENT CLASSIFICATION

(Mark All Boxes That Are Applicable)

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 *(injury)*, CA-2 *(illness)* or CA-6 *(fatality)* to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of $1000 or more to government property *(including motor vehicles).*

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any contractor lost-time injury/illness or fatality.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of $1000 or more to contractor property *(including motor vehicles).*

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in public fatality or permanent total disability. *(The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).*

(2) VOID SPACE - Make no entry.

(3) VEHICLE INVOLVED - Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, regardless of whether "INJURY/ILLNESS/ FATALITY" is marked.

(4) VOID SPACE - Make no entry.

INSTRUCTIONS FOR SECTION 2 - PERSONAL DATA

a. NAME - *(MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS).* Enter last name, first name, middle initial of person involved.

b. AGE - Enter age.

c. SEX - Mark appropriate box.

d. SOCIAL SECURITY NUMBER - *(FOR GOVERNMENT PERSONNEL ONLY)* Enter the social security number *(or other personal identification number if no social security number issued).*

e. GRADE - *(FOR GOVERNMENT PERSONNEL ONLY)* Enter pay grade. Example: 0-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE - For government civilian employees enter the pay plan, full series number, and job title, e.g., GS-O810/Civil Engineer. For military personnel enter the primary military occupational specialty *(PMOS)*, e.g., 15A30 or 11G50. For contractor employees enter the job title assigned to the injured person, e.g., carpenter, laborer, surveyor, etc.

g. DUTY STATUS - Mark the appropriate box.

(1) ON DUTY - Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident.

h. EMPLOYMENT STATUS - *(FOR GOVERNMENT PERSONNEL ONLY)* Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 - GENERAL INFORMATION

a. DATE OF ACCIDENT - Enter the month, day, and year of accident.

b. TIME OF ACCIDENT - Enter the local time of accident in military time. Example: 1430 hrs *(not 2:30 p.m.)*.

c. EXACT LOCATION OF ACCIDENT - Enter facts needed to locate the accident scene, *(installation/project name, building number, street, direction and distance from closest landmark, etc.)*.

d. CONTRACTOR NAME

(1) PRIME - Enter the exact name *(title of firm)* of the prime contractor.

(2) SUBCONTRACTOR - Enter the name of any subcontractor involved in the accident.

e. CONTRACT NUMBER - Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT - Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY *(HTW)* - Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program *(IRP)* HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site *(FUDS)* activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 - CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY - Select the most appropriate construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION
2. SITE PREPARATION
3. EXCAVATION/TRENCHING
4. GRADING (EARTHWORK)
5. PIPING/UTILITIES
6. FOUNDATION
7. FORMING
8. CONCRETE PLACEMENT
9. STEEL ERECTION
10. ROOFING
11. FRAMING
12. MASONRY
13. CARPENTRY
14. ELECTRICAL
15. SCAFFOLDING/ACCESS
16. MECHANICAL
17. PAINTING
18. EQUIPMENT/MAINTENANCE
19. TUNNELING
20. WAREHOUSING/STORAGE
21. PAVING
22. FENCING
23. SIGNING
24. LANDSCAPING/IRRIGATION
25. INSULATION
26. DEMOLITION

b. TYPE OF CONSTRUCTION EQUIPMENT - Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER
2. DRAGLINE
3. CRANE *(ON VESSEL/BARGE)*
4. CRANE *(TRACKED)*
5. CRANE *(RUBBER TIRE)*
6. CRANE *(VEHICLE MOUNTED)*
7. CRANE *(TOWER)*
8. SHOVEL
9. SCRAPER
10. PUMP TRUCK *(CONCRETE)*
11. TRUCK *(CONCRETE/TRANSIT MIXER)*
12. DUMP TRUCK *(HIGHWAY)*
13. DUMP TRUCK *(OFF HIGHWAY)*
14. TRUCK *(OTHER)*
15. FORKLIFT
16. BACKHOE
17. FRONT-END LOADER
18. PILE DRIVER
19. TRACTOR *(UTILITY)*
20. MANLIFT
21. DOZER
22. DRILL RIG
23. COMPACTOR/VIBRATORY ROLLER
24. OTHER

INSTRUCTIONS FOR SECTION 5 - INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY/ILLNESS - Reference paragraph 2-10 of USACE Supplement 1 to AR 385-40 and enter code and description from list below.

NOI	NO INJURY
FAT	FATALITY
PTL	PERMANENT TOTAL DISABILITY
PPR	PERMANENT PARTIAL DISABILITY
LWD	LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW	RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA	RECORDABLE FIRST AID CASE
NRI	NON-RECORDABLE INJURY

b. ESTIMATED DAYS LOST - Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED - Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY - Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED - Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	**CODE**	**BODY PART NAME**
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS/ ANKLES/ BUTTOCKS
	LS	SINGLE LEG/HIP/ ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM *(BREAST BONE)*
	RV	VERTEBRAE *(SPINE; DISC)*
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury/illness from the list below. This nature of injury/illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury/illness name on the line and place the corresponding CODE letters in the box provided.
* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	**CODE**	**NATURE OF INJURY NAME**
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN
	TC	CONTUSION; BRUISE; ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/INFECTIVE/ PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER, STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY - OTHER *(EXCEPT DISEASE, ILLNESS)*

** A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	**CODE**	**NATURE OF INJURY NAME**
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES		
	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC - OTHER
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE
	DD	ENDEMIC DISEASE *(OTHER THAN CODE TYPES R&S)*
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS, NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER
SKIN DISEASE OR CONDITION		
	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS *(CAUSE)* - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident *(see example 1, below)*. Examples:

(1) An employee tripped on carpet and struck his head on a desk. TYPE: 210 *(fell on same level)* SOURCE: 0110 *(walking/working surface)*.

NOTE: This example would NOT be coded 120 *(struck against)* and 0140 *(furniture)*.

(2) A Park Ranger contracted dermatitis from contact with poison ivy/oak.

TYPE: 510 *(contact)* SOURCE: 0920 *(plant)*

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.

TYPE: 410 *(punctured by)* SOURCE: 0830 *(metal)*

(4) An employee was driving a government vehicle when it was struck by another vehicle.

TYPE: 800 *(traveling in)* SOURCE: 0421 *(government-owned vehicle, as driver)*

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	**TYPE OF INJURY NAME**
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED *(NO FALL)*
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH *(INJURED PERSON MOVING)*
0520	CONTACTED BY *(OBJECT WAS MOVING)*
	EXERTED
0610	LIFTED, STRAINED BY *(SINGLE ACTION)*
0620	STRESSED BY *(REPEATED ACTION)*
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	**SOURCE OF INJURY NAME**
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE *(FLOOR, STREET, SIDEWALKS, ETC.)*
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT *(ERGONOMIC)*
0170	WINDOWS, DOORS
0180	ELECTRICITY

0200	ENVIRONMENTAL CONDITION	0631	CARBON MONOXIDE
0210	TEMPERATURE EXTREME *(INDOOR)*	0640	MIST, STEAM, VAPOR, FUME
0220	WEATHER *(ICE, RAIN, HEAT, ETC.)*	0641	WELDING FUMES
0230	FIRE, FLAME, SMOKE *(NOT TOBACCO)*	0650	PARTICLES *(UNIDENTIFIED)*
0240	NOISE	0700	CHEMICAL, PLASTIC, ETC.
0250	RADIATION	0711	DRY CHEMICAL - CORROSIVE
0260	LIGHT	0712	DRY CHEMICAL - TOXIC
0270	VENTILATION	0713	DRY CHEMICAL - EXPLOSIVE
0271	TOBACCO SMOKE	0714	DRY CHEMICAL FLAMMABLE
0280	STRESS *(EMOTIONAL)*	0721	LIQUID CHEMICAL - CORROSIVE
0290	CONFINED SPACE	0722	LIQUID CHEMICAL - TOXIC
0300	MACHINE OR TOOL	0723	LIQUID CHEMICAL - EXPLOSIVE
0310	HAND TOOL *(POWERED; SAW, GRINDER, ETC.)*	0724	LIQUID CHEMICAL - FLAMMABLE
0320	HAND TOOL *(NONPOWERED)*	0730	PLASTIC
0330	MECHANICAL POWER TRANSMISSION APPARATUS	0740	WATER
0340	GUARD, SHIELD *(FIXED, MOVEABLE, INTERLOCK)*	0750	MEDICINE
0350	VIDEO DISPLAY TERMINAL	0800	INAMINATE OBJECT
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL	0810	BOX, BARREL, ETC.
0370	HEATING EQUIPMENT	0820	PAPER
0380	WELDING EQUIPMENT	0830	METAL ITEM, MINERAL
0400	VEHICLE	0831	NEEDLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE	0840	GLASS
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE	0850	SCRAP, TRASH
0421	DRIVER OF GOVERNMENT VEHICLE	0860	WOOD
0422	PASSENGER OF GOVERNMENT VEHICLE	0870	FOOD
0430	COMMON CARRIER *(AIRLINE, BUS, ETC.)*	0880	CLOTHING, APPAREL, SHOES
0440	AIRCRAFT *(NOT COMMERCIAL)*	0900	ANIMATE OBJECT
0450	BOAT, SHIP, BARGE	0911	DOG
0500	MATERIAL HANDLING EQUIPMENT	0912	OTHER ANIMAL
0510	EARTHMOVER *(TRACTOR, BACKHOE, ETC.)*	0920	PLANT
0520	CONVEYOR *(FOR MATERIAL AND EQUIPMENT)*	0930	INSECT
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST	0940	HUMAN *(VIOLENCE)*
0540	HOIST, SLING CHAIN, JACK	0950	HUMAN *(COMMUNICABLE DISEASE)*
0550	CRANE	0960	BACTERIA, VIRUS *(NOT HUMAN CONTACT)*
0551	FORKLIFT	1000	PERSONAL PROTECTIVE EQUIPMENT
0560	HANDTRUCK, DOLLY	1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
0600	DUST, VAPOR, ETC.		
0610	DUST *(SILICA, COAL, ETC.)*	1020	RESPIRATOR, MASK
0620	FIBERS	1021	DIVING EQUIPMENT
0621	ASBESTOS	1030	SAFETY BELT, HARNESS
0630	GASES	1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 - PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT - Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the most appropriate primary activity area *(water related, non-water related or other activity)*, the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating-powered
3. Boating-unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities *(skin diving, scuba, etc.)*
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing *(general)*
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer *(baseball, football, etc.)*
24. Sports/winter *(skiing, sledding, snowmobiling etc.)*
25. Cycling *(bicycle, motorcycle, scooter)*
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts *(fights, riots, vandalism, etc.)*
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED - If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7 - MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE - Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION - Mark appropriate box.

c. SEAT BELT - Mark appropriate box.

INSTRUCTIONS FOR SECTION 8 - PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM - Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number *(NSN)* whenever applicable.

b. OWNERSHIP - Enter ownership for each item listed. *(Enter one of the following: USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE)*

c. $ AMOUNT OF DAMAGE - Enter the total estimated dollar amount of damage *(parts and labor)*, if any.

INSTRUCTIONS FOR SECTION 9 - VESSEL/FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT - Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT
2. SAIL BOAT
3. MOTOR BOAT
4. BARGE
5. DREDGE/HOPPER
6. DREDGE/SIDE CASTING
7. DREDGE/DIPPER
8. DREDGE/CLAMSHELL, BUCKET
9. DREDGE/PIPE LINE
10. DREDGE/DUST PAN
11. TUG BOAT
12. OTHER

b. COLLISION/MISHAP - Select from the list below the object*(s)* that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL
2. UPPER GUIDE WALL
3. UPPER LOCK GATES
4. LOCK WALL
5. LOWER LOCK GATES
6. LOWER GUIDE WALL
7. HAULAGE UNIT
8. BREAKING TOW
9. TOW BREAKING UP
10. SWEPT DOWN 0N DAM
11. BUOY/DOLPHIN/CELL
12. WHARF OR DOCK
13. OTHER

INSTRUCTIONS FOR SECTION 10 - ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT - Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role*(s)* in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11 - CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN - Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE - Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) PERSON'S PHYSICAL CONDITION - Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES - Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES - Were any of the provisions of the Safety and Health Requirements Manual *(EM 385-1-1)* violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice *(including EM 385-1-1)* fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS - Was the person under undue stress *(either internal or external to the job)*? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS - Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS - Did exposure to chemical agents *(either single shift exposure or long-term exposure)* such as dusts, fibers *(asbestos, etc.)*, silica, gases *(carbon monoxide, chlorine, etc.,)*, mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation *(UV radiation created during welding, etc.)* contribute to the accident/incident?

(9) OFFICE FACTORS - Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) SUPPORT FACTORS - Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources *(in terms of employee skills, number of workers, and adequate supervision)* available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc.?

(11) PERSONAL PROTECTIVE EQUIPMENT - Did the person fail to use appropriate personal protective equipment *(gloves, eye protection, hard-toed shoes, respirator, etc.)* for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard*(s)*? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) DRUGS/ALCOHOL - Is there any reason to believe the person's mental or physical capabilities, judgment, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS - Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.

INSTRUCTIONS FOR SECTION 12 - TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK? - For the purpose of this section "trained" means the person has been provided the necessary information *(either formal and/or on-the-job (OJT) training)* to competently perform the activity/task in a safe and healthful manner.

b. TYPE OF TRAINING - Mark the appropriate box that best indicates the type of training; *(classroom or on-the-job)* that the injured person received, before the accident happened.

c. DATE OF MOST RECENT TRAINING - Enter YYYYMMDD of the last formal training completed that covered the activity task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13 - CAUSES

a. DIRECT CAUSES - The direct cause is that single factor, which most directly lead to the accident. See examples below.

b. INDIRECT CAUSES - Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.

Direct cause: failure to provide fall protection at elevation. Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee *(possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety)*; failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. *(Note: USACE vehicle was in proper/safe working condition).*

Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.

Indirect cause: failure of employee to pay attention to driving *(defensive driving).*

INSTRUCTIONS FOR SECTION 14 - ACTION TO ELIMINATE CAUSE*(s)*

DESCRIPTION - Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/ illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15 - DATES FOR ACTION

a. **BEGIN DATE** - Enter the date YYYYMMDD when the corrective action(s) identified in section 14 will begin.

b. **COMPLETE DATE** - Enter the date YYYYMMDD when the corrective action(s) identified in section 14 will be completed.

c. **DATE SIGNED** - Enter YYYYMMDD that the report was signed by the responsible supervisor.

d.e.. **TITLE AND SIGNATURE** - Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE supervisor shall also sign the report. Upon entering the information required in 15c., 15d., 15e., 15f. and 15g. below, the responsible USACE supervisor shall forward the report for management review as indicated in section 16.

f. **ORGANIZATION NAME** - For GOVERNMENT employee accidents enter the USACE organization name *(Division, Branch, Section, etc.)* of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15d. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

g. **OFFICE SYMBOL** - Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15f.

INSTRUCTIONS FOR SECTION 16 - MANAGEMENT REVIEW (1st)

1ST REVIEW - Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15d. shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief *(2nd review)* for review and comment.

INSTRUCTIONS FOR SECTION 17 - MANAGEMENT REVIEW (2nd)

2ND REVIEW - The FOA Staff Chief *(i .e., FOA Chief of Construction, Operations, Engineering, Planning, etc.)* shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18 - SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW - The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19 - COMMAND APPROVAL

4TH REVIEW - The FOA Commander shall *(to include the person designated Acting Commander in his absence)* review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.