HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC

Main Office
77 Arkay Drive, Suite K
Hauppauge, New York 11788
T (631) 462-5866 ; F (631) 462-5877

WWW.HYDROTECHENVIRONMENTAL.COM

REMEDIAL INVESTIGATION WORK PLAN

152 Graham Avenue
Block 3062; Lot 2
Brooklyn, New York 11206

NYSDEC BCP Site Number: C224208

Prepared For: Reina Diaz & Belio Urena
152 Graham Avenue
Brooklyn, NY 11206

Prepared By: HydroTech Environmental Engineering and Geology, DPC
15 Ocean Avenue, 2nd Floor
Brooklyn, New York 11225

Hydro Tech Job No. 200040

CERTIFICATIONS

I, Mark E. Robbins, certify that I am a Qualified Environmental Professional (QEP) as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan was prepared for Reina Diaz and Belio Urena in Brooklyn, New York in accordance with all applicable statues and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Mark E. Robbins (PG# 000087)

Name

Signature

October 23, 2020

Date

LIST OF ACRONYMS

Acronym	Definition
AWQS	Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BGS	Below Grade Surface
BN	Base Neutral
CAMP	Community Air Monitoring Plan
C&D	Construction & Demolition
CGI	Combustible Gas Indicator
CPP	Citizen Participation Plan
DCE	Dichloroethene
DB	decibels
DUSR	Data Usability Summary Report
ESA	Environmental Site Assessment
ELAP	Environmental Laboratory Accreditation Program
FID	Flame Ionization Detector
EZ	Exclusion Zone
HASP	Health and Safety Plan
MDL	Method Detection Limit
NYC DEP	New York City Department of Environmental Protection
NYS DEC	New York State Department of Environmental Conservation
NYS DOH	New York State Department of Health
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PID	Photo Ionization Detector
PFOA	Perfluorooctanoic acid
PM	Particulate Matter
PPE	Personal Protective Equipment (PPE

QAO	Qualified Assurance Officer
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
QHHEA	Qualitative Human Health Exposure Assessment
QEP	Qualified Environmental Professional
REC	Recognized Environmental Condition
QA/QC	Quality Assurance/Quality Control
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
SCOs	Soil Cleanup Objectives
SCG	Standards, Criteria and Guidance
SCBA	Self-Contained Breathing Apparatus
SSO	Site Safety Officer
TAL	Full Target Analyte List
TCL	Full Target Compound List
TICs	Tentatively Identified Compounds
TOGS	Technical and Operational Guidance Series
SVOCs	Semi-Volatile Organic Compounds
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds

TABLE OF CONTENTS

Page Number

Figures

Tables

Appendices

A. HASP
B. CAMP
C. Sample Boring Log
D. Sample Groundwater Monitoring Well Construction Diagram
E. QAPP
F. Resumes

EXECUTIVE SUMMARY

This Remedial Investigation Work Plan (RIWP) has been prepared on behalf of Reina Diaz and Belio Urena (referred to herein as the "Owner") to document the details and protocols for the environmental investigation of the site located at Top Hat Cleaners 152 Graham Avenue in Brooklyn, New York (the "Site"). The purpose of this RIWP is to further investigate the environmental quality of on-site and off-site soil, groundwater and soil vapor to fully characterize the nature and extent of contamination across the Site and its off-site impacts.

This remedial investigation will complement the previous site characterization performed in March 2019 under an Order on Consent and Administrative Settlement, Index No. R2-20180226-42 (NYSDEC Site ID 224208). This remedial investigation will fill data gaps in order to better assess on-site and off-site subsurface conditions and to come up with a comprehensive remedy. All investigation work will be performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) requirements, NYSDEC Brownfield Cleanup Program requirements (BCP Site Number C224208) and in compliance with the New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006), NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010) and other acceptable industry standards.

The remedial investigation will be conducted via the installation and sampling of soil probes, monitoring wells, and soil vapor probes. All portions of the fieldwork will be conducted in accordance with a site-specific Health & Safety Plan.

The following sections provide the details and specific information pertaining to the various components of the RIWP.

1.0 INTRODUCTION

HydroTech Environmental Engineering and Geology, DPC ("HydroTech") has been retained by the Reina Diaz and Belio Urena to prepare this Remedial Investigation Work Plan (RIWP) for the site located at 152 Graham Avenue in Brooklyn, New York (the "Site"). Specifically, this RIWP provides the protocols and specifications for the proposed subsurface investigation to fully characterize the environmental quality of the soil, groundwater and soil vapor beneath the Site and off-site in anticipation of the Site remediation under the NYSDEC Brownfield Cleanup Program.

2.1 Site Description

The Site is located at 152 Graham Avenue in the East Williamsburg section of Brooklyn, New York and is identified as Block 3062 and Lot 2 on the New York City Tax Map. The Site occupies an area of approximately 2,500 square feet and is occupied by a three-story mixed-use commercial and residential building with a partial basement. The building is constructed of concrete, brick and mortar and occupies a majority of the footprint of the lot. The remaining area is occupied by a rear yard. The first floor of the building is occupied by a dry cleaner and the upper two floors contain residential apartments.

The Site is bordered to the north by Montrose Avenue and a three-story mixed commercial/residential building; to the east by residential structures and Humboldt Avenue; to the south by residential structures (four-story mixed residential/ commercial) and Johnson Avenue; and to the west by Graham Avenue. Historic database records indicate that the mixed-use adjacent property located south of the site at 183 Johnson Avenue was formerly utilized as a dry cleaner (Martinez French Cleaners). **Figure 1** provides a site plan.

Surrounding properties within one half mile radius of the Site consist of residential, commercial, and institutional, and light residential uses and open areas. A Receptor Survey was performed within a 2,640-foot radius of the Site. The results of the sensitive receptor database search indicate that the following sensitive receptors are located within a 2,640-foot radius to the Site including Public School 250 George H. Lindsay to the west, Graham Child Care Center to the northwest, The Baby Play Place Preschool and Daycare to the southwest, Small World Day Care Center to the northwest, The Brooklyn Latin School to the northwest, and Woodhull Hospital of Internal Medicine, La Salud Medical Center, Ahava Medical and Rehabilitation Urgent Care Center, and Health and Wellness Medical Center to the south. Newtown Creek is also located within 2,640 feet to the north of the Site. No other sensitive receptors including schools, day care, hospitals, rivers or streams were identified within the search distance of 2,640 feet from the Site.

2.2 Site History

The following environmental assessments and investigations were previously performed at the Site and surrounding properties:

- Phase I Environmental Site Assessment Report, 152 Graham Avenue, Brooklyn, NY, July 2017, HAKS Engineers, Architects, and Land Surveyors, DPC.
- Vapor Intrusion Investigation, 154 Graham Avenue, Brooklyn, NY, December 12, 2014, Merritt Environmental Consulting Corp.
- Site Characterization Report, Top Hat Dry Cleaners (152 Graham Avenue, Brooklyn, NY) (THDC), March 2016, Parsons.
- Site Characterization Report, Top Hat Dry Cleaners (152 Graham Avenue, Brooklyn, NY), March 2019, HydroTech Environmental Engineering and

Geology, DPC.

The Phase I ESA report identified as Recognized Environmental Conditions (RECs) at the Site, the historic and current use of the Site as a dry-cleaning facility, identified as Top Hat Cleaners at 152 Graham Avenue, since circa 1960, and the presence of above-ground storage tanks (ASTs) in the basement with known visible leaks and soil contamination. Additionally, the Phase I identified as an off-Site REC the vapor intrusion investigation performed at the adjacent property (154 Graham Avenue) which identified elevated concentrations of PCE, TCE, and cis-1,2-dichloroethylene in sub-slab vapor and indicated the possible source of the contamination was the dry cleaner located at 152 Graham Avenue; and the open NYSDEC spill (Spill No. 1505573) located 0.0852 miles north of the Site at 182 Montrose Avenue.

The vapor intrusion investigation performed by Merritt Environmental Consulting Corp. in 2014 at the adjacent property located at 154 Graham Avenue involved the collection of two (2) sub-slab vapor samples, one (1) basement indoor air sample, and one (1) ambient air sample. Elevated concentrations of tetrachloroethylene (PCE), trichloroethylene (TCE), and cis-1,2-dichloroethylene were detected in the sub-slab vapor samples. The concentration of PCE detected in the basement indoor air sample, 44.1 $\mu g/m^3$, was above the New York State Final Guidance Air Guideline Value (AGV) of 30 $\mu g/m^3$ and corrective action was determined to be necessary.

The Vapor Intrusion Report prepared by Merritt at 154 Graham Avenue identified Top Hat Cleaners as the most likely source of PCE contamination and states that “A clear impact to the Site indoor air quality by elevated concentration of PCE was identified by this study. The source of the condition (PCE contamination) is the adjoining (152 Graham Avenue) dry cleaner likely through historical subsurface releases of PCE in fluid form." The report then recommends additional investigation of indoor air quality. No soil or groundwater samples were collected during the vapor intrusion investigation at 154 Graham Avenue. The report indicates that groundwater depth is estimated to be 30 to 35 feet and the local direction of groundwater flow is estimated to be towards the east.

A Site Characterization investigation was performed at 152 Graham Avenue by Parsons (for NYSDEC) in the fall of 2015 and the corresponding report was issued in March 2016. The site characterization included a geophysical survey to locate underground utilities and subsurface structures, a subsurface soil investigation consisting of four (4) soil borings and the collection of soil samples, the installation of three (3) monitoring wells and collection of groundwater samples, and a survey of final monitoring well locations and elevations. The subsurface soil investigation did not identify any soil impacts in exceedance of NYSDEC "Division of Environmental Remediation, 6 New York State Codes, Rules and Regulations (6 NYSCRR), Part 375, Environmental Remediation Programs Subparts 375-1 to 375-4 and 375-6, Effective December 14, 2006, Unrestricted Soil Criteria." However, the groundwater investigation did identify the presence of PCE in exceedance of the Class GA New York State Groundwater Quality Standards and Guidance Values (5 µg/L) in monitoring wells THPMW-01 (56 µg/L) and THPMW-03 (10 µg/L). The investigation also identified chloroform in groundwater in exceedance of the Class GA standard (7 µg/L) at monitoring well THPMW-02 (8.7 µg/L).

During the investigation performed by Parsons, groundwater was encountered at a depth of between 17.5 feet and 22.5 feet below ground surface (bgs) and groundwater flow was determined to be in the north to northwest direction under a hydraulic gradient of approximately 0.023 vertical feet per each horizontal foot.

NYSDOH conducted an environmental survey and air sampling in residential areas at 152 Graham Avenue in 2017 that identified PERC in the ambient air at levels of 65-80 $\mu g/m^3$ which are above the NYSDOH Air Guidance Values of 30 $\mu g/m^3$. As a result of this investigation, a commissioner order (Case #16-12-28-0292) was issued to abate the nuisance.

The site characterization performed by HydroTech in March 2019 consisted of the installation of two (2) soil borings (designated as SB-1 and SB-2), one permanent well (MW-1) installed in the sidewalk and two temporary wells (GW-1 and GW-2) installed inside the partial basement, and three (3) soil vapor implants (SV-1 through SV-3) to assess soil, groundwater, and soil vapor impacts at the Site. Two indoor air samples (IA-1 located in the partial basement and IA-2 located on the first floor) and one outdoor air sample (OA-1) were also collected.

The site characterization performed by HydroTech in March 2019 indicated that tetrachloroethylene (PCE) and trichloroethene (TCE) were detected in soil at an intermediate depth below the western portion of the basement at concentrations exceeding their respective NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives (UUSCOs) and NYSDEC Part 375 Protection of Groundwater Soil Cleanup Objectives (PGWSCOs). The concentration of PCE (max. 440 mg/kg) detected in soil also exceeded its NYSDEC Part 375 Restricted Residential Soil Cleanup Objective (RRSCO). The results further indicated that PCE was also present in soil in the eastern portion of the basement, at shallow and intermediate depths, at concentrations exceeding its RRSCO and PGWSCO. The detection of PCE in soil was indicative of a likely release of the chlorinated solvent as a result of historic dry-cleaning operations at 152 Graham Avenue.

During the March 2019 investigation performed by HydroTech, groundwater flow beneath the site was determined to be toward to the north in the direction of Newtown Creek. PCE was detected in the two on-site and one off-site groundwater samples at concentrations exceeding 6NYCRR Part 703.5 Class GA Groundwater Quality Standards (GQS) with the highest concentration of 29,000 μg/L detected in the western portion of the Site. Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS) were detected in the groundwater beneath the Site at a maximum concentration of 270 μg/L.

Volatile Organic Compounds (VOCs) associated with chlorinated compounds were identified in sub-slab and soil vapor beneath the Site and also in indoor air samples. PCE and TCE were most abundant in soil vapor beneath the western portion of the Site at SV-1 and at the northwestern portion of the Site along the Graham Avenue sidewalk at SV-3. Maximum concentrations of PCE and TCE detected in soil vapor and sub-slab samples were 929,000 μg/m^3 and 1,240 μg/m^3, respectively. PCE and TCE were also detected in the two indoor air samples at maximum concentrations of 396 μg/m3 and 6.87 μg/m3, respectively. The distribution and abundance of PCE and TCE in soil vapor/sub-slab and indoor air samples is consistent with the presence of these compounds in soil and in groundwater. According to the New York State Department of Health (NYSDOH) Decision Matrices, the levels of PCE and TCE in soil/sub-slab vapors and indoor air are indicative of soil vapor intrusion impact that would warrant the implementation vapor mitigation measures. **Figures 2** through **5** provide a summary of the historical soil, groundwater, soil vapor, and indoor and outdoor air data.

2.3 Environmental Setting

The Site is located in northeastern portion of Brooklyn, New York. The elevation of the Site is approximately 27 feet above mean sea level (USGS 7.5-Minute Brooklyn, New York Quadrangle, 2013).

Brooklyn, New York is located in the western portion of Long Island. Long Island consists of a wedge-shaped mass of unconsolidated deposits that overlie ancient basement rock. The thickness of these deposits ranges from approximately 100 feet on the Island's north shore to approximately 2,000 feet in some portions of the south shore. These deposits contain ground water that is the sole source of drinking water for the Island's over 3.1 million residents.

The major landforms of Long Island of importance to the hydrologic system are the moraines and outwash plains, which originated from glacial activity. The moraines represent the farthest extent of the glacial advances. The moraines consist of till, which is a poorly sorted mixture of sand, silt, clay, gravel and boulders. The till is poor to moderately permeable in most areas. Outwash plains are located to the south of the moraines. The outwash plains were formed by the action of glacial melt water streams, which eroded the headland material of the moraines and laid down deposits of well-sorted sands, silts and gravels. These outwash deposits have a moderate to high permeability.

The Upper Glacial Aquifer is the uppermost hydrogeologic unit. This aquifer encompasses the moraine and outwash deposits, in addition to some localized lacustrine, marine and reworked materials. A relatively high horizontal hydraulic conductivity and a low vertical hydraulic conductivity characterize the outwash plain portion of this unit. Since the water table is situated in the Upper Glacial Aquifer.

The Magothy Formation directly underlies the Upper Glacial Aquifer in the vicinity of the site. This formation is a Cretaceous coastal-shelf deposit, which consists principally of layers of sand and gravel with some interbedded clay. This formation ranges from moderate to highly permeable. A clay layer in some parts of Long Island confines the uppermost portion of the aquifer. The Magothy is Long Island's principal aquifer for public water supply. The United States Environmental Protection Agency (USEPA) has classified the Long Island aquifer system as a sole source aquifer.

The Raritan Formation is the deepest unit and rests directly above the bedrock units. This formation is comprised of a sand member (Lloyd Aquifer) and a clay member (Raritan Clay). The Lloyd sand extends southward from Flushing Bay to the Atlantic Ocean. The thickness of the sand member ranges in depth from 200 to 800 feet below sea level and increases in thickness to the southeast. The clay member acts as an aquitard confining the lower Lloyd aquifer between the clay and the underlying bedrock.

The depth to groundwater determined during the March 2019 site characterization performed by HydroTech ranges between 19.3 and 22.8 feet below grade surface. In addition, the regional groundwater flow direction in the vicinity of the Site was determined to be toward the north, in the direction of Newtown Creek, which is located approximately 0.7 miles from the Site. This is consistent with the topographic relief of the site vicinity presented by the USGS Groundwater Conditions on Long Island, NY (2010).

2.4 Objective & Project Goals

The objective of the RIWP is to set forth the details and protocols for the characterization of the environmental quality beneath the Site and off-site by further delineating the extent of VOC impacts specifically, PCE and TCE, in soil and groundwater and further assessing the extent of VOC impacts in soil vapor.

All the fieldwork will be performed in accordance with 6NYCRR Part 375-3.8, along with NYSDEC DER-10 and applicable NYSDOH Guidance for Evaluating Soil Vapor Intrusion.

3.0 INVESTIGATION SPECIFICATIONS

3.1 Introduction

The purpose of this section is to document the details and protocols intended to be utilized in the delineation of the contamination present on-site, off-site or emanating from adjacent properties, the determination of the site-specific groundwater flow direction and the general characterization of those portions of the Site that have yet not been investigated. To accomplish this, HydroTech will install and sample a series additional soil probes, monitoring wells and soil vapor probes utilizing direct-push technology. Select soil, groundwater and soil vapor samples will be analyzed via approved analytical methods, and all laboratory results will be evaluated and documented in a Remedial Investigation Report. All these activities will be implemented consistent with a NYSDEC BCP Citizen Participation Plan (CPP) and in accordance to a site-specific Health and Safety Plan (HASP) and a Community Air Monitoring Plan (CAMP). Contaminated soil and water generated during an investigation will be containerized in DOT-approved 55-gallon drums and will be subject to waste characterization sampling consistent with disposal facilities requirements. **Appendix A** provides a Site-specific HASP. **Appendix B** provides a Site-specific CAMP.

Prior to the performance of the fieldwork, a public utility mark-out will be requested from the New York City-Long Island One-Call Center. All work will be coordinated with representatives of the NYSDEC.

3.2 Soil Borings

A total of two (2) additional soil borings designated SB-3 and SB-4 will be in the northeast portion of the Site which was not previously investigated due to access restrictions.

The purpose of these soil borings is to characterize the potential source area and delineate the horizontal extent of VOC contaminants in soil and also vertically from grade to the interface with groundwater.

Specifically, soil boring SB-3 will be installed in the northeast portion of the building where there is a slab-on-grade. SB-4 will be installed in the rear yard area.

All soil probes at grade levels will be installed utilizing a hand-held probe machine fitted with Geoprobe® tooling and sampling equipment. **Figure 6** provides the proposed locations of the soil borings.

Soil sampling will comply with NYSDEC DER-10 3.5.2. Soil samples will be collected in all probes at 2-foot intervals utilizing a 4-foot long Macro Core sampler fitted with dedicated acetate liners. The Macro sampler allows for the collection of discrete soil samples. Each sampler will be installed with 1 ¾ - inch diameter drill rods.

The borings will be extended to groundwater, which was determined to be located between 19.3 and 22.8 feet below grade surface. The soil samples will be placed in clean zip-lock storage bags and characterized in the field by a HydroTech geologist. The characterization will consist of field screening for evidence of organic vapors utilizing a Photoionization Detector (PID) with an 11.7eV bulb and soil classification.

Headspace analyses will be conducted on each soil sample by partially filling a zip lock bag and sealing it, thereby creating a void. This void is referred to as the sample headspace. To facilitate the detection of any hydrocarbons contained within the headspace, the container will be agitated for a period of thirty (30) seconds. The probe of the PID will then be placed within the headspace to measure the hydrocarbon concentrations present.

The soil classification will be based upon the Unified Soil Classification System (USCS). The USCS identifies common soil details such as grain size, shape, sorting and color. In addition, any visual or olfactory evidence of hydrocarbons will be identified. Soil probe logs will be generated based upon the soil characterization, along with the PID field screening. **Appendix C** provides a sample boring log.

Since no evidence of historic fill was identified during the site characterization performed in March 2019, three (3) soil samples will be collected for lab analysis from each of the soil probes which will consist of the 2-foot interval with the highest PID reading, from the 2-foot interval just above groundwater and from the 2-foot clean interval.

All soil samples will be containerized in laboratory supplied soil jars and appropriately labeled.

Table 1 - Summary of Proposed Soil Sampling Locations and Analyses

Soil Probe (SP)	Location	Soil Characterization Depth	Analytical Methods
SB-3	Eastern Portion of the Site underneath the Slab-on-grade	* Sample at the 2-foot interval with the highest PID reading *Sample at the 2-foot interval just above groundwater *Sample at the 2-foot clean interval	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury Emerging Contaminants (1 sample only): - 1,4-Dioxine via Method 8270 - 21 target Perfluorooctanoic acid (PFOA) via Method 537
SB-4	Eastern Portion of the Site in the Rear Yard		

3.3 Groundwater Monitoring Wells

Three (3) permanent groundwater monitoring wells, designated MW-2 and MW-3, and MW-4 will be installed and to further investigate groundwater quality. Monitoring wells MW-2 and MW-3 will be installed at the same locations of soil probes SB-3 and SB-4, respectively. MW-4 will be installed on the sidewalk to the south along Johnson Avenue. The wells will be installed to a depth of between 27.5 to 32.5 feet below grade surface.

The wells will be installed utilizing similar technology as the soil probes (i.e. direct push). The wells will be constructed using two-inch diameter Schedule 40 PVC with American Society of Testing (ASTM) F-480 pipe threading and 10 feet of two-inch diameter, 0.020-inch (20-slot) PVC well screen. The water level in the borehole will be measured immediately prior to the construction of the well. The screened interval of the wells will consist of 0.020-inch slots and will be situated approximately 5 feet above the level of groundwater and 10 feet below. Once the well is inserted into the boreholes, the annular space will be completed with sand pack, a bentonite seal, and backfilled to grade. The sand pack will be emplaced so that it extends to a minimum depth of six inches below the bottom of the screen and a minimum of two feet above the top of the well screen. The bentonite seal will be emplaced, a minimum of two feet, above the sand pack. A plug will be installed at the top of the well as a protective cover and a manhole cover will be installed for future access. **Appendix D** provides a sample groundwater monitoring well construction diagram.

Once installed, the monitoring wells will then be monitored and gauged for separate phase product. The monitoring will be performed utilizing a Solinst® 122 Oil/Water Interface Probe (Interface Probe). The Interface Probe can measure depths to water to 0.01 inch. The static depth to water will be measured in each well from the northern portion of the top of casing.

The four (4) existing wells designated MW-1, THPMW-01, THPMW-02 and THPMW-03 in the sidewalk will also be developed and sampled utilizing the same procedure outlined above. The two historic wells GW-1, GW-2, located in the basement will be capped and made accessible for future sampling via the installation of flush mounted manhole covers.

Additionally, as part of the investigation, the casings elevation of all the wells will be surveyed. The determination of the casings' elevations will allow for an updated calculation of the groundwater elevation, which therefore allows for the determination of the groundwater flow direction. A licensed surveyor will perform the wells survey.

The monitoring wells will be purged and sampled in accordance to the USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (EQASOP #GW4, Rev. September 19, 2017) and following the stabilization of water quality indicator parameters. Sampling of groundwater will occur following the stabilization of aquifer parameters including pH, dissolved Oxygen, redox potential or ORP, temperature, specific conductance and turbidity within specified confidence limits in the Quality Assurance Project Plan (QAPP) presented in **Appendix E** If it is determined that there is not enough water in the well to perform purging, then a grab sample will be collected for analysis.

As per the USEPA's Low Stress/Flow Groundwater Sampling Protocol, static depth to water will also be gauged during the purging and sampling exercise.

Each groundwater sample will then be placed into laboratory supplied containers and appropriately labeled.

Table 2 - Summary of Existing and Proposed Groundwater Monitoring Well Sampling Locations and Analyses

Monitoring Well (MW)	Location	Analysis
MW-2	Eastern portion of the Site Underneath the Slab-on-grade	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury * Emerging Contaminants (1 sample only): - 1,4-dioxane via EPA Method 8270D SIM and
MW-3	Eastern portion of the Site in the Rear Yard	
MW-4	Southern sidewalk along Johnson Avenue	
GW-1	Western Central Portion of the basement	

GW-2	Northeastern Portion of the basement	- 21 target Perfluorooctanoic acid (PFOA) via Modified EPA Method 537m
MW-1	Graham Avenue Sidewalk outside Northwestern Site Boundary	
THPMW-01	Graham Avenue Sidewalk near 158 Graham Avenue Site	
THPMW-02	Intersection of Graham Avenue and Johnson Avenue Sidewalk near 150 Graham Avenue Site	
THPMW-03	Johnson Avenue Sidewalk near 185 Johnson Avenue Site	

3.4 Soil Vapor Sampling

Five (5) soil vapor sampling points, designated SV-4 through SV-8 and five indoor air samples, designated IA-3 through IA-7 will be installed at the Site and adjacent properties to the north, south, east and west of the Site in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006). The purpose of the soil vapor and indoor air sampling will be to further delineate soil vapor impacts on-site and in the off-site adjacent properties. **Figure 6** provides the location of soil vapor sampling locations.

The soil vapor sampling point will be installed utilizing similar technology to the soil probes (i.e. direct push). The soil vapor sampling point will consist of a stainless-steel screen or implant fitted with inert tubing (e.g., polyethylene) of ¼ inch diameter and of laboratory quality to the surface. The soil vapor implants will be installed in the subsurface soil, at approximately 5 feet below the slab-on-grade or below basement slab since most of the buildings have basements.

Porous inert backfill material (e.g. glass beads) will be used to create a sampling zone around the stainless-steel screen or implant. The soil vapor sampling point will then be sealed above the sampling zone with a bentonite slurry to prevent outdoor air infiltration and the remainder of the borehole will be backfilled with clean material. The soil vapor probe will be finished to grade with a concrete at surface.

A soil vapor sample will be collected utilizing 6 liter pre-cleaned, passivated, evacuated whole air Summa® Canister. A 60-cm^3 plastic syringe will be used to purge approximately 1 to 3 implant volumes (i.e. the volume of the sample probe and tube) prior to collecting the soil vapor sample. The air sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 8 hours at a rate of less than 0.2 liter per minute. In order to ensure the integrity of the borehole seal and to verify that ambient air is not inadvertently drawn into the sample, a tracer gas, such as Helium, will be applied to enrich the atmosphere in the immediate vicinity of the sampling location. A portable monitoring device MGD-2002 Helium-Hydrogen Lead Detector; Model 83-219, will be utilized to analyze a real time sample of soil vapor from each soil vapor sampling point for the tracer prior to purging and after sampling. Plastic sheeting will be used to keep the tracer gas in contact with the soil vapor point during the sampling.

Table 3 – Summary of Proposed Soil Vapor Sampling Locations and Analyses

Soil Vapor Samples (SV)	Location	Analysis
SV-4/IA-3	Central Portion of the basement	VOCs and via EPA Method TO-15
SV-5/IA-4	Inside the adjacent 4-story residential building to the west of the Site at 147 Graham Avenue	
SV-6/IA-5	Inside the adjacent 3-story residential and commercial building to the north of the Site at 156 Graham Avenue	
SV-7/IA-6	Inside the adjacent 4-story residential building to the east of the Site at 185 Johnson Avenue	
SV-8/IA-7	Inside the adjacent 4-story residential and commercial building to the south of the Site at 150 Graham Avenue	

3.5 Field Management of Investigation Derived Waste

Soil and Groundwater Sampling

- Soil cuttings generated during soil probe installation and sampling will be placed into 55-gallon drum(s) and properly disposed of.
- Fluids generated during groundwater sampling and equipment decontamination will be contained in the 55-gallons drums and properly disposed of as hazardous waste.
- Fine grade sand will be applied immediately around the boreholes to

prevent any runoff of storm water from discharging unknown surface contaminants into the subsurface soil and groundwater. The sand will be disposed of into 55-gallons drum(s) along the soil cuttings.

- The 55-gallon drum containing IDW will be temporarily staged in a secure area on-site at grade level and beneath the unfinished building until waste characterization sampling is complete and arrangements with permitted disposal facility are finalized for.
- All boreholes will be back filled with fine grade sand and properly sealed in surface with a layer of slurry and native shallow dirt.

3.6 Laboratory Analytical Methods

As indicated in **Table 1** and **Table 2** the soil and groundwater samples will be analyzed for volatile organic compounds (VOCs) via EPA Method 8260, semi-volatile organic compounds (SVOCs) via EPA Method 8270, Pesticides via EPA Method 8081, Herbicides via EPA Method 8151, Polychlorinated biphenyls via EPA Method 8082 and TAL Metals via EPA Method 6010 and EPA Method 7471 for Mercury. Groundwater sample analyses for TAL Metals will be performed for both filtered and unfiltered samples. Groundwater samples will also be analyzed for Emerging Contaminants, i.e. 1,4-Dioxine via EPA Method 8270D SIM and the 21 target Perfluorooctanoic acid (PFAS) compounds via Modified EPA Method 537. If water supply in the wells is limited, sample analysis will depend on the volume of water that could be sampled. VOC analysis will be performed, at a minimum. As indicated in **Table 3** soil vapor samples will be analyzed for VOCs via EPA Method TO-15. **Table 4** includes all the historical data tables.

HASP

This remedial investigation will be performed in accordance with the HASP provided in **Appendix A**. Health and safety procedures will be carried out at all times during field activities. All personnel will wear appropriate levels of personal protective equipment. The investigation will be performed during normal business hours. In the occupied spaces, additional measures such as the use of an emission venting system in the immediate vicinity of the remedial investigation in the basement to prevent exposure to toxic vapors or dust, will be implemented as needed to protect the receptors (operator and visitors). During off-site soil vapor implant installation and off-site monitoring well installation, development and sampling, sections of the sidewalks around the Site will be closed using caution tape to direct pedestrians away from the work zone and machinery. Sections of sidewalk will be kept open without causing safety hazards to nearby pedestrians or residents.

CAMP

Air monitoring will be performed during the remedial investigation in accordance with a Community Air Monitoring Plan presented in **Appendix B**. Air quality monitoring will include monitoring the air Volatile Organic Compounds (VOCs) using a PID and the presence of elevated levels of dust using Particulate Dust Track Real-time Particle Counter.

3.7 Quality Assurance/Quality Control

A HydroTech Quality Assurance Officer (QAO) (Anusha Agnoor) will adopt a Quality Assurance Project Plan (QAPP) during the collection of soil, groundwater and soil vapor samples in order to ensure that proper procedures are performed and subsequently followed during sample collection and analysis. The QAPP for this investigation is provided in **Appendix E**.

Instrument Calibration

Field instruments will be calibrated daily per manufacturer's recommendations prior to the start of screening or sampling activities.

Decontamination

In order to reduce the risk of cross-contamination, all sampling equipment will be decontaminated before and after each use using a detergent and water solution followed by a potable water rinse. All disposable sampling equipment will be discarded after a single use.

Chain of Custody

All samples collected during the site characterization field work will be recorded on a chain-of-custody form which includes information such as the site location, sample date, time of sample collection, analyses required, and the name of the sampling technician. The chain-of-custody will be signed by the sampling technician and the laboratory representative to who samples were relinquished. Copies of the forms will be included in the laboratory data package submitted to NYSDEC.

Data Usability Summary Report (DUSR)

The Remedial Investigation Report will provide a Data Usability Summary Report (DUSR). The DUSR will compare all sampling results to the QAPP provided under **Appendix E**. Resumes for all key personnel are provided in **Appendix F**.

4.0 REPORT OF FINDINGS

A Remedial Investigation Report (RIR) will be prepared following the completion of the fieldwork and the laboratory analyses in accordance with DER-10 Section 3.14. This report will be certified by a QEP as per DER-10 Table 1.5 and will contain the findings and conclusions of the investigation and will include appropriate maps and diagrams, tabulations of all analytical data, written narratives, a Fish and Wildlife Analysis; Qualitative Human Health Exposure Assessment and Conceptual Site Model; boring logs, well construction diagrams, well purging and sampling logs, and appendices.

The soil quality results will be compared to the 6 NYCRR Part 375 Unrestricted Use, Protection of Groundwater SCOs and Restricted Residential Use. The groundwater quality results will be compared to the AWQS documented in NYSDEC's Technical and Operational Guidance Series (TOGS) 1.1.1. All soil samples that exceed their respective soil cleanup objectives (SCOs) and groundwater samples that exceed the Ambient Water Quality Standards (AWQS) will be highlighted in tables and shown on spider diagrams. The RIR will include the Data Usability Summary Report. Based on the results of this phase of remedial investigation, further delineation of the groundwater and soil vapor contamination may be required.

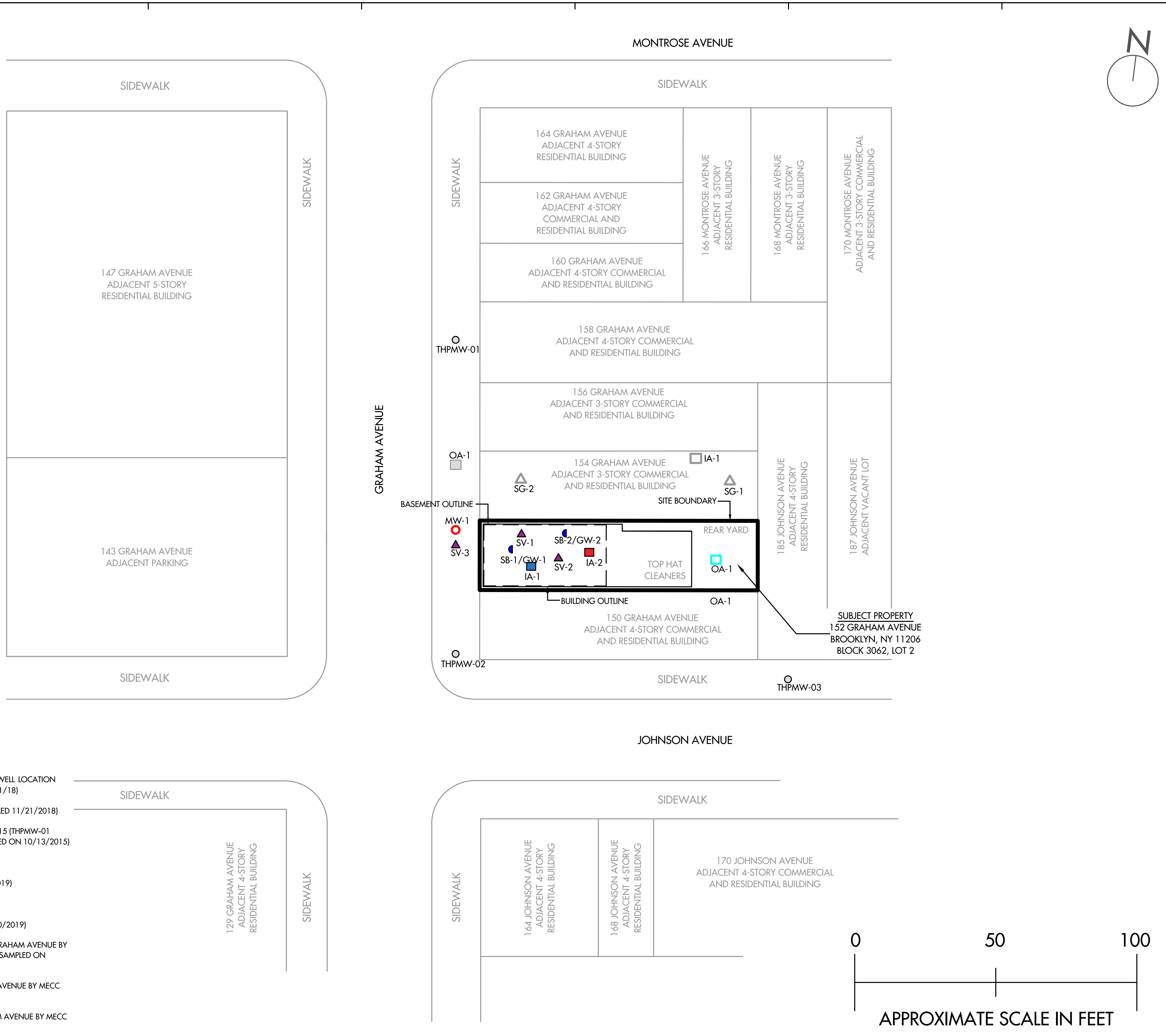
All data will also be submitted electronically to NYSDEC through the Environmental Information Management System, using the standardized electronic data deliverable (EDD) format.

4.1 Anticipated Project Schedule

The table below provides a tentative schedule for the performance of the remedial investigation and other major tasks leading to the date of issuance of a Certificate of Complete (COC). This schedule is tentative based upon the approvals of documents by the NYSDEC.

Schedule Milestone	Anticipated Date
Brownfield Cleanup Agreement Signed	March 2020
Submit Citizen Participation Plan (CPP)	June 2020
Approval of RIWP	November 2020
Implementation RIWP	December 2020/January 2021
Submit RIR/RAWP	January/February 2021
Fact Sheet Announcing 45-day Public Comment Period for RAWP	February 2021
NYSDEC RAWP Approval/Issuance of Decision Document	March 2021
Begin Implementation of RAWP	April 2021
Submittal of FER and SMP	September 2021
Issuance of COC	December 2021

FIGURES



LEGEND

◖	HISTORICAL SOIL BORING AND GROUNDWATER MONITORING WELL LOCATION (SOIL SAMPLED 11/19/18 AND GROUNDWATER SAMPLED 11/21/18)
○	HISTORICAL PERMANENT MONITORING WELL LOCATION (SAMPLED 11/21/2018)
◍	HISTORICAL MONITORING WELLS INSTALLED BY PARSONS IN 2015 (THPMW-01 SAMPLED ON 10/12/2015, THPMW-02 AND THPMW-03 SAMPLED ON 10/13/2015)
🟦	HISTORICAL INDOOR AIR SAMPLE (SAMPLED 11/20/2019)
▲	HISTORICAL SOIL/SUB-SLAB VAPOR PROBES (SAMPLED 11/20/2019)
□	HISTORICAL OUTDOOR AIR SAMPLE (SAMPLED 11/20/2019)
🟥	HISTORICAL INDOOR AIR SAMPLE (FIRST FLOOR) (SAMPLED 11/20/2019)
△	HISTORICAL SUB-SLAB SOIL VAPOR PROBES INSTALLED AT 154 GRAHAM AVENUE BY MERRITT ENVIRONMENTAL GROUP CONSULTING CORP (MECC) (SAMPLED ON 12/03/2014)
□	HISTORICAL INDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)
⬜	HISTORICAL OUTDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

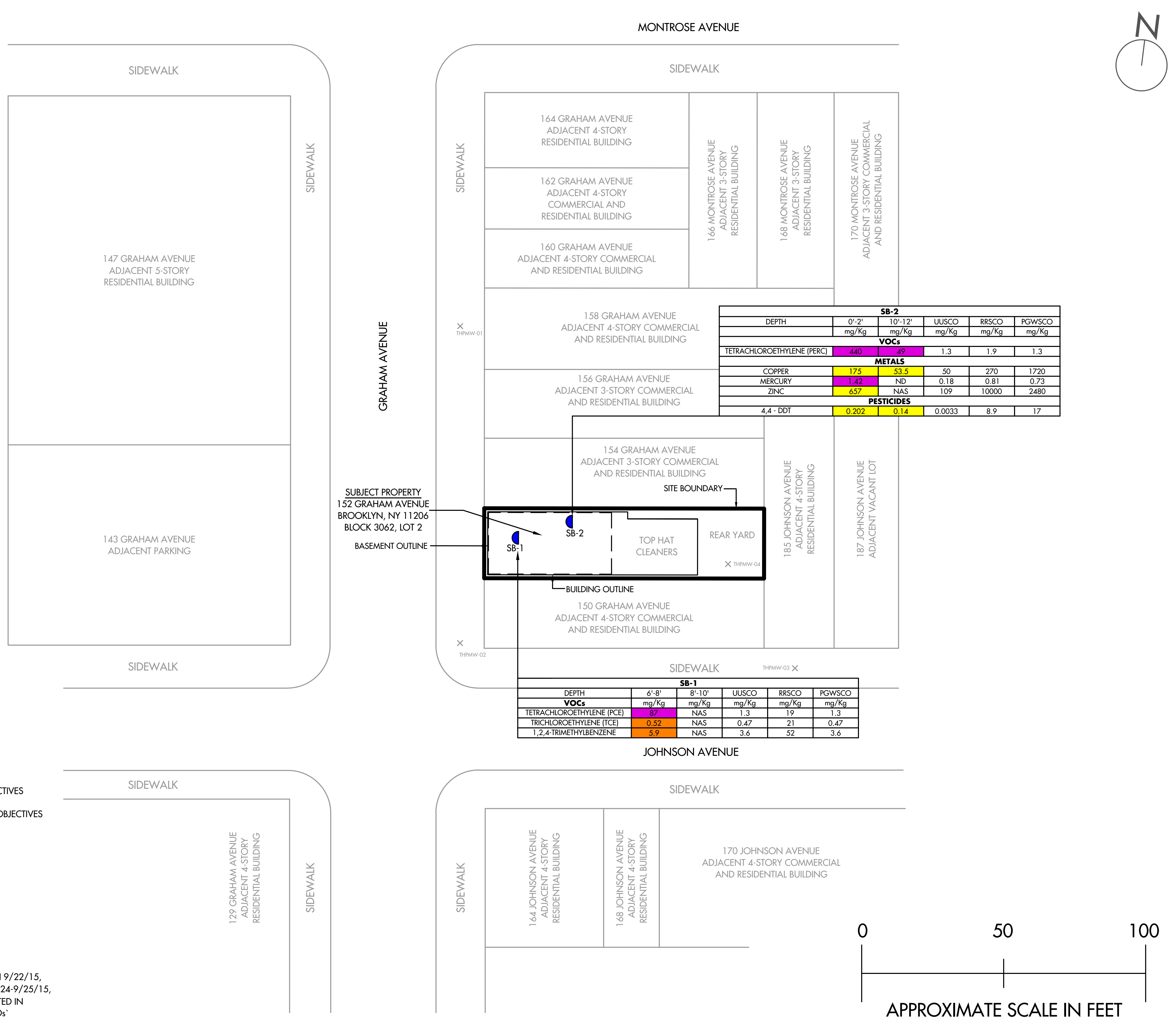
PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 1: SITE PLAN

PROJECT NO. 200040	DATE 09/02/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.



SB-2					
DEPTH	0'-2'	10'-12'	UUSCO	RRSCO	PGWSCO
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
VOCs					
TETRACHLOROETHYLENE (PERC)	440	49	1.3	1.9	1.3
METALS					
COPPER	175	53.5	50	270	1720
MERCURY	1.42	ND	0.18	0.81	0.73
ZINC	657	NAS	109	10000	2480
PESTICIDES					
4,4 - DDT	0.202	0.14	0.0033	8.9	17

SB-1					
DEPTH	6'-8'	8'-10'	UUSCO	RRSCO	PGWSCO
VOCs	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
TETRACHLOROETHYLENE (PCE)	87	NAS	1.3	19	1.3
TRICHLOROETHYLENE (TCE)	0.52	NAS	0.47	21	0.47
1,2,4-TRIMETHYLBENZENE	5.9	NAS	3.6	52	3.6

LEGEND:

◖	SOIL BORING LOCATION (SAMPLED 11/19/18)
DEPTH	FEET BELOW GRADE SURFACE
mg/Kg	MILLIGRAMS PER KILOGRAM
UUSCO	UNRESTRICTED USE SOIL CLEANUP OBJECTIVES
RRSCO	RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES
PGWSCO	PROTECTION OF GROUNDWATER SOIL CLEANUP OBJECTIVES
🟨	CONCENTRATION EXCEEDS UUSCO
🟧	CONCENTRATION EXCEEDS UUSCO AND PGWSCO
🟪	CONCENTRATION EXCEEDS RRSCO AND PGWSCO
NAS	NOT ABOVE STANDARD
ND	NOT DETECTED
×	SOIL PROBE LOCATIONS (THPMW-01 SAMPLED ON 9/22/15, THPMW-02 ON 9/23-9/24/15, THPMW-03 ON 9/24-9/25/15, AND THPMW-04 ON 9/29/15) - NO VOCs DETECTED IN EXCEEDANCE OF NYSDEC UNRESTRICTED USE SCOs`

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

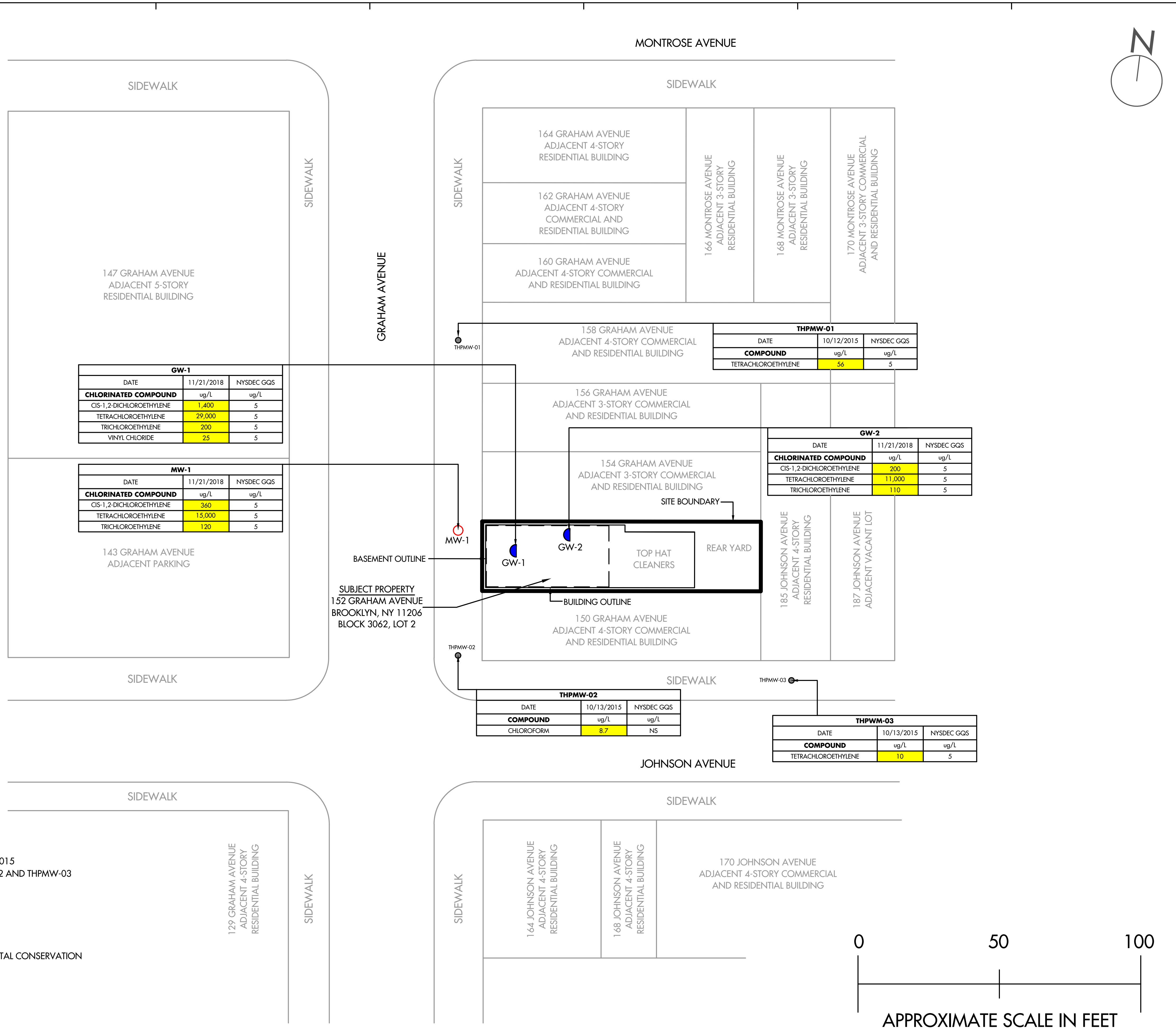
PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 2: HISTORICAL VOCs, METALS, AND PESTICIDES IN SOIL

PROJECT NO. 200040	DATE 09/02/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.



GW-1		
DATE	11/21/2018	NYSDEC GQS
CHLORINATED COMPOUND	ug/L	ug/L
CIS-1,2-DICHLOROETHYLENE	1,400	5
TETRACHLOROETHYLENE	29,000	5
TRICHLOROETHYLENE	200	5
VINYL CHLORIDE	25	5

MW-1		
DATE	11/21/2018	NYSDEC GQS
CHLORINATED COMPOUND	ug/L	ug/L
CIS-1,2-DICHLOROETHYLENE	360	5
TETRACHLOROETHYLENE	15,000	5
TRICHLOROETHYLENE	120	5

THPMW-01		
DATE	10/12/2015	NYSDEC GQS
COMPOUND	ug/L	ug/L
TETRACHLOROETHYLENE	56	5

GW-2		
DATE	11/21/2018	NYSDEC GQS
CHLORINATED COMPOUND	ug/L	ug/L
CIS-1,2-DICHLOROETHYLENE	200	5
TETRACHLOROETHYLENE	11,000	5
TRICHLOROETHYLENE	110	5

THPMW-02		
DATE	10/13/2015	NYSDEC GQS
COMPOUND	ug/L	ug/L
CHLOROFORM	8.7	NS

THPWM-03		
DATE	10/13/2015	NYSDEC GQS
COMPOUND	ug/L	ug/L
TETRACHLOROETHYLENE	10	5

LEGEND:

◖	GROUNDWATER MONITORING WELL LOCATION (SAMPLED 11/21/2018)
○	PERMANENT MONITORING WELL LOCATION (SAMPLED 11/21/2018)
●	MONITORING WELLS INSTALLED BY PARSONS IN 2015 (THPMW-01 SAMPLED ON 10/12/2015, THPMW-02 AND THPMW-03 SAMPLED ON 10/13/2015)
DEPTH	FEET BELOW GRADE SURFACE
ug/L	MICROGRAMS PER LITER
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GQS	GROUNDWATER QUALITY STANDARDS
🟨	CONCENTRATION EXCEEDS NYSDEC GQS
NS	NO STANDARD

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

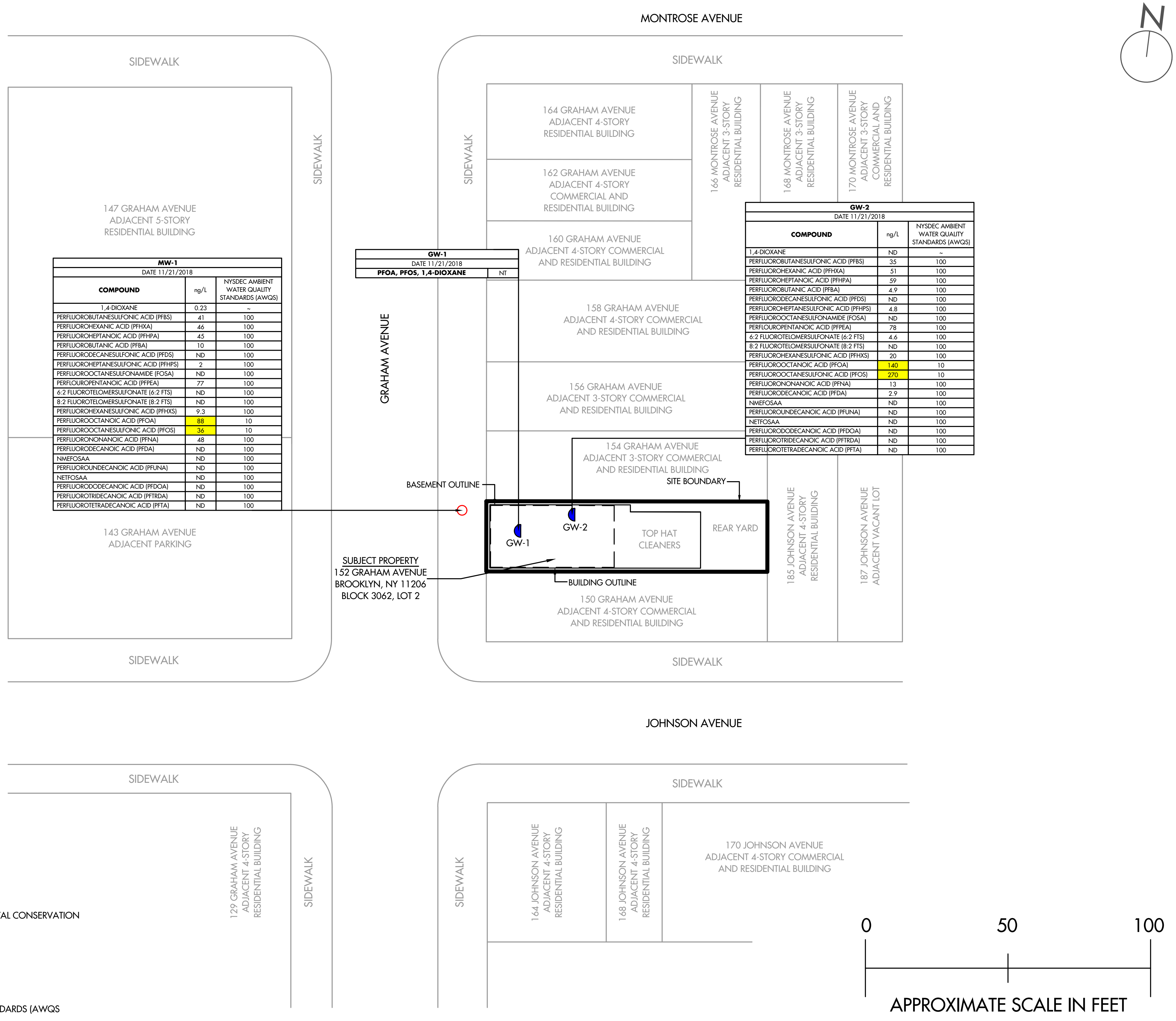
PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 3: HISTORICAL VOCs IN GROUNDWATER

PROJECT NO. 200040	DATE 09/09/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.



MW-1

DATE 11/21/2018

COMPOUND	ng/L	NYSDEC AMBIENT WATER QUALITY STANDARDS (AWQS)
1,4-DIOXANE	0.23	~
PERFLUOROBUTANESULFONIC ACID (PFBS)	41	100
PERFLUOROHEXANIC ACID (PFHXA)	46	100
PERFLUOROHEPTANOIC ACID (PFHPA)	45	100
PERFLUOROBUTANIC ACID (PFBA)	10	100
PERFLUORODECANESULFONIC ACID (PFDS)	ND	100
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	2	100
PERFLUOROOCTANESULFONAMIDE (FOSA)	ND	100
PERFLOUROPENTANOIC ACID (PFPEA)	77	100
6:2 FLUOROTELOMERSULFONATE (6:2 FTS)	ND	100
8:2 FLUOROTELOMERSULFONATE (8:2 FTS)	ND	100
PERFLUOROHEXANESULFONIC ACID (PFHXS)	9.3	100
PERFLUOROOCTANOIC ACID (PFOA)	88	10
PERFLUOROOCTANESULFONIC ACID (PFOS)	36	10
PERFLUORONONANOIC ACID (PFNA)	48	100
PERFLUORODECANOIC ACID (PFDA)	ND	100
NMEFOSAA	ND	100
PERFLUOROUNDECANOIC ACID (PFUNA)	ND	100
NETFOSAA	ND	100
PERFLUORODODECANOIC ACID (PFDOA)	ND	100
PERFLUOROTRIDECANOIC ACID (PFTRDA)	ND	100
PERFLUOROTETRADECANOIC ACID (PFTA)	ND	100

GW-1

DATE 11/21/2018

PFOA, PFOS, 1,4-DIOXANE	NT

GW-2

DATE 11/21/2018

COMPOUND	ng/L	NYSDEC AMBIENT WATER QUALITY STANDARDS (AWQS)
1,4-DIOXANE	ND	~
PERFLUOROBUTANESULFONIC ACID (PFBS)	35	100
PERFLUOROHEXANIC ACID (PFHXA)	51	100
PERFLUOROHEPTANOIC ACID (PFHPA)	59	100
PERFLUOROBUTANIC ACID (PFBA)	4.9	100
PERFLUORODECANESULFONIC ACID (PFDS)	ND	100
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.8	100
PERFLUOROOCTANESULFONAMIDE (FOSA)	ND	100
PERFLOUROPENTANOIC ACID (PFPEA)	78	100
6:2 FLUOROTELOMERSULFONATE (6:2 FTS)	4.6	100
8:2 FLUOROTELOMERSULFONATE (8:2 FTS)	ND	100
PERFLUOROHEXANESULFONIC ACID (PFHXS)	20	100
PERFLUOROOCTANOIC ACID (PFOA)	140	10
PERFLUOROOCTANESULFONIC ACID (PFOS)	270	10
PERFLUORONONANOIC ACID (PFNA)	13	100
PERFLUORODECANOIC ACID (PFDA)	2.9	100
NMEFOSAA	ND	100
PERFLUOROUNDECANOIC ACID (PFUNA)	ND	100
NETFOSAA	ND	100
PERFLUORODODECANOIC ACID (PFDOA)	ND	100
PERFLUOROTRIDECANOIC ACID (PFTRDA)	ND	100
PERFLUOROTETRADECANOIC ACID (PFTA)	ND	100

LEGEND:

◖	GROUNDWATER MONITORING WELL LOCATION (SAMPLED 11/21/2018)
○	PERMANENT MONITORING WELL LOCATION (SAMPLED 11/21/2018)
PFAS	PERFLUOROALKYL SUBSTANCES
ng/L	NANOGRAMS PER LITER
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
TOGS	TECHNICAL AND OPERATIONAL GUIDANCE SERIES
NS	NO STANDARD
NT	NOT TESTED
🟨	SAMPLE EXCEEDS NYSDEC AMBIENT QUALITY STANDARDS (AWQS

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

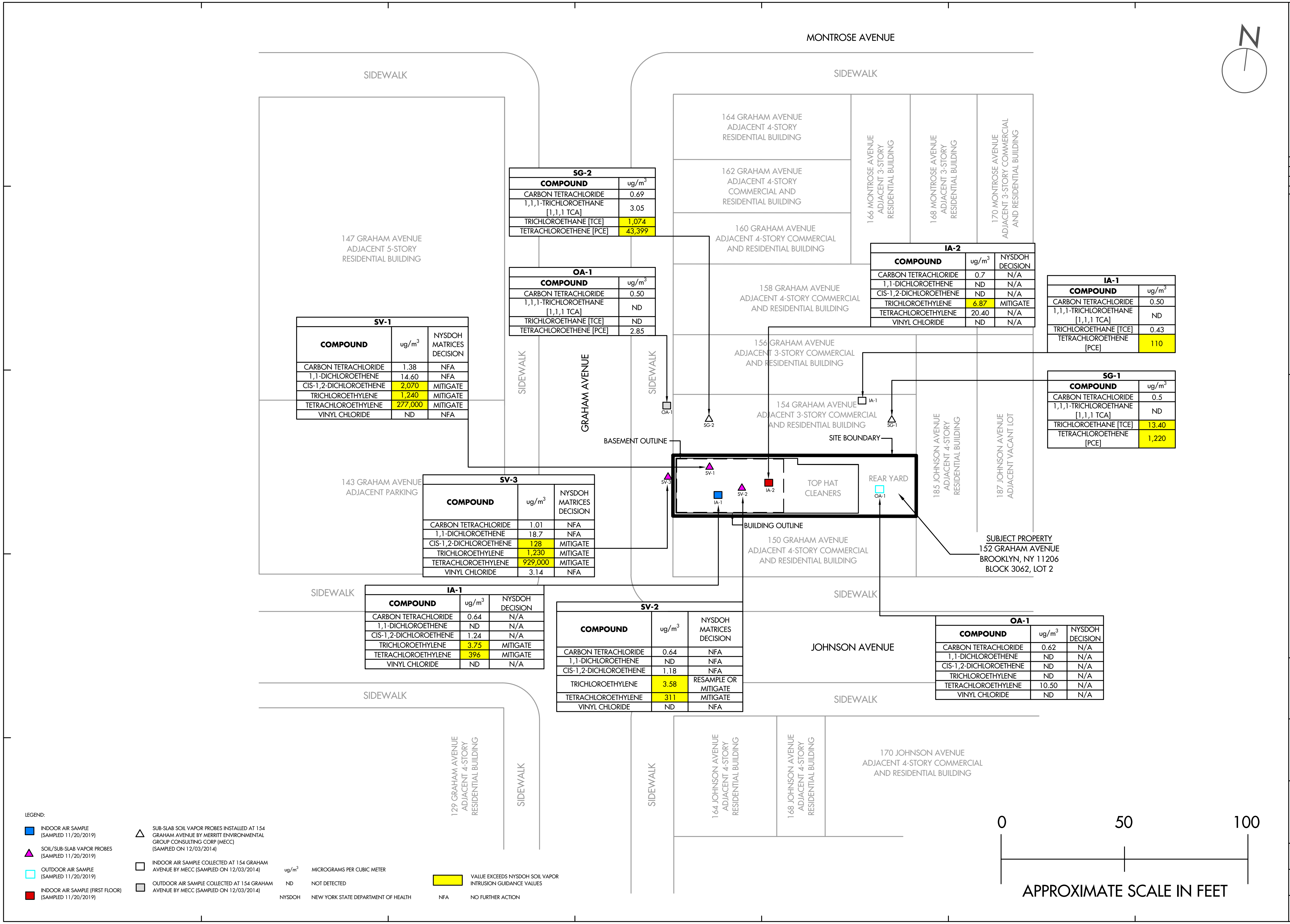
PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 4: HISTORICAL EMERGING CONTAMINANTS IN GROUNDWATER

PROJECT NO. 200040	DATE 09/02/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.



SG-2

COMPOUND	ug/m^3
CARBON TETRACHLORIDE	0.69
1,1,1-TRICHLOROETHANE [1,1,1 TCA]	3.05
TRICHLOROETHANE [TCE]	1,074
TETRACHLOROETHENE [PCE]	43,399

OA-1

COMPOUND	ug/m^3
CARBON TETRACHLORIDE	0.50
1,1,1-TRICHLOROETHANE [1,1,1 TCA]	ND
TRICHLOROETHANE [TCE]	ND
TETRACHLOROETHENE [PCE]	2.85

IA-2

COMPOUND	ug/m^3	NYSDOH DECISION
CARBON TETRACHLORIDE	0.7	N/A
1,1-DICHLOROETHENE	ND	N/A
CIS-1,2-DICHLOROETHENE	ND	N/A
TRICHLOROETHYLENE	6.87	MITIGATE
TETRACHLOROETHYLENE	20.40	N/A
VINYL CHLORIDE	ND	N/A

IA-1

COMPOUND	ug/m^3
CARBON TETRACHLORIDE	0.50
1,1,1-TRICHLOROETHANE [1,1,1 TCA]	ND
TRICHLOROETHANE [TCE]	0.43
TETRACHLOROETHENE [PCE]	110

SV-1

COMPOUND	ug/m^3	NYSDOH MATRICES DECISION
CARBON TETRACHLORIDE	1.38	NFA
1,1-DICHLOROETHENE	14.60	NFA
CIS-1,2-DICHLOROETHENE	2,070	MITIGATE
TRICHLOROETHYLENE	1,240	MITIGATE
TETRACHLOROETHYLENE	277,000	MITIGATE
VINYL CHLORIDE	ND	NFA

SG-1

COMPOUND	ug/m^3
CARBON TETRACHLORIDE	0.5
1,1,1-TRICHLOROETHANE [1,1,1 TCA]	ND
TRICHLOROETHANE [TCE]	13.40
TETRACHLOROETHENE [PCE]	1,220

SV-3

COMPOUND	ug/m^3	NYSDOH MATRICES DECISION
CARBON TETRACHLORIDE	1.01	NFA
1,1-DICHLOROETHENE	18.7	NFA
CIS-1,2-DICHLOROETHENE	128	MITIGATE
TRICHLOROETHYLENE	1,230	MITIGATE
TETRACHLOROETHYLENE	929,000	MITIGATE
VINYL CHLORIDE	3.14	NFA

IA-1

COMPOUND	ug/m^3	NYSDOH DECISION
CARBON TETRACHLORIDE	0.64	N/A
1,1-DICHLOROETHENE	ND	N/A
CIS-1,2-DICHLOROETHENE	1.24	N/A
TRICHLOROETHYLENE	3.75	MITIGATE
TETRACHLOROETHYLENE	396	MITIGATE
VINYL CHLORIDE	ND	N/A

SV-2

COMPOUND	ug/m^3	NYSDOH MATRICES DECISION
CARBON TETRACHLORIDE	0.64	NFA
1,1-DICHLOROETHENE	ND	NFA
CIS-1,2-DICHLOROETHENE	1.18	NFA
TRICHLOROETHYLENE	3.58	RESAMPLE OR MITIGATE
TETRACHLOROETHYLENE	311	MITIGATE
VINYL CHLORIDE	ND	NFA

OA-1

COMPOUND	ug/m^3	NYSDOH DECISION
CARBON TETRACHLORIDE	0.62	N/A
1,1-DICHLOROETHENE	ND	N/A
CIS-1,2-DICHLOROETHENE	ND	N/A
TRICHLOROETHYLENE	ND	N/A
TETRACHLOROETHYLENE	10.50	N/A
VINYL CHLORIDE	ND	N/A

LEGEND:

🟦	INDOOR AIR SAMPLE (SAMPLED 11/20/2019)
▲	SOIL/SUB-SLAB VAPOR PROBES (SAMPLED 11/20/2019)
□	OUTDOOR AIR SAMPLE (SAMPLED 11/20/2019)
🟥	INDOOR AIR SAMPLE (FIRST FLOOR) (SAMPLED 11/20/2019)
△	SUB-SLAB SOIL VAPOR PROBES INSTALLED AT 154 GRAHAM AVENUE BY MERRITT ENVIRONMENTAL GROUP CONSULTING CORP (MECC) (SAMPLED ON 12/03/2014)
□	INDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)
▨	OUTDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)
ug/m^3	MICROGRAMS PER CUBIC METER
ND	NOT DETECTED
NYSDOH	NEW YORK STATE DEPARTMENT OF HEALTH
🟨	VALUE EXCEEDS NYSDOH SOIL VAPOR INTRUSION GUIDANCE VALUES
NFA	NO FURTHER ACTION

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

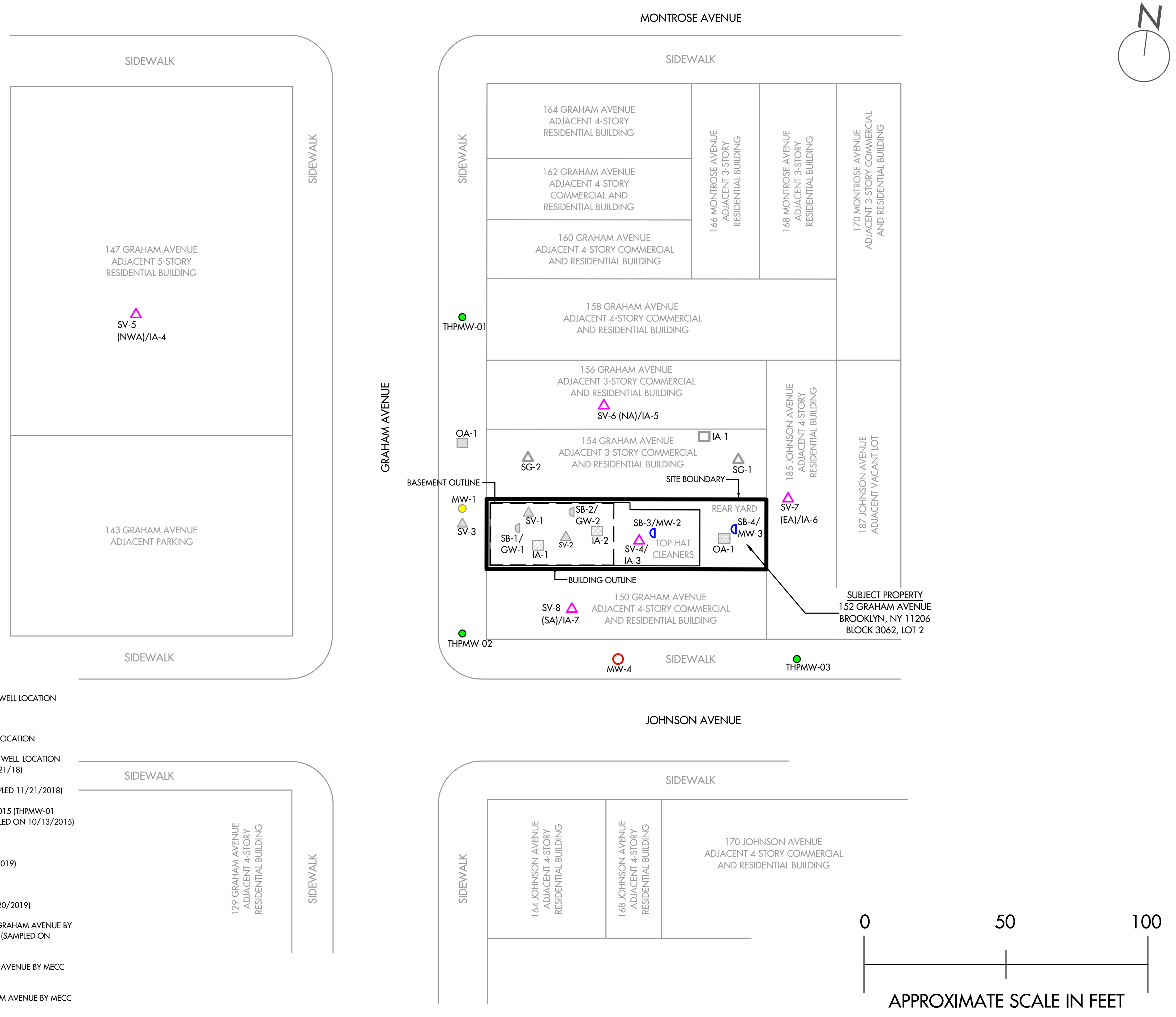
PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 5: HISTORICAL VOCs IN SUB-SLAB/SOIL VAPOR AND INDOOR/OUTDOOR AIR SAMPLES

PROJECT NO. 200040	DATE 09/09/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.



LEGEND

◗	PROPOSED SOIL BORING AND GROUNDWATER MONITORING WELL LOCATION
△	PROPOSED SOIL VAPOR PROBE LOCATION
○	PROPOSED PERMANENT GROUNDWATER MONITORING WELL LOCATION
◖	HISTORICAL SOIL BORING AND GROUNDWATER MONITORING WELL LOCATION (SOIL SAMPLED 11/19/18 AND GROUNDWATER SAMPLED 11/21/18)
●	HISTORICAL PERMANENT MONITORING WELL LOCATION (SAMPLED 11/21/2018)
●	HISTORICAL MONITORING WELLS INSTALLED BY PARSONS IN 2015 (THPMW-01 SAMPLED ON 10/12/2015, THPMW-02 AND THPMW-03 SAMPLED ON 10/13/2015)
▨	HISTORICAL INDOOR AIR SAMPLE (SAMPLED 11/20/2019)
▲	HISTORICAL SOIL/SUB-SLAB VAPOR PROBES (SAMPLED 11/20/2019)
▦	HISTORICAL OUTDOOR AIR SAMPLE (SAMPLED 11/20/2019)
⊠	HISTORICAL INDOOR AIR SAMPLE (FIRST FLOOR) (SAMPLED 11/20/2019)
△	HISTORICAL SUB-SLAB SOIL VAPOR PROBES INSTALLED AT 154 GRAHAM AVENUE BY MERRITT ENVIRONMENTAL GROUP CONSULTING CORP (MECC) (SAMPLED ON 12/03/2014)
☐	HISTORICAL INDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)
■	HISTORICAL OUTDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 6: PROPOSED SAMPLING PLAN

PROJECT NO. 200040	DATE 10/19/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.

TABLES

Table 1 - Summary of Proposed Soil Sampling Locations and Analyses

Soil Probe (SP)	Location	Soil Characterization Depth	Analytical Methods
SB-3	Eastern Portion of the Site underneath the Slab-on-grade	* Sample at the 2-foot interval with the highest PID reading *Sample at the 2-foot interval just above groundwater	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury Emerging Contaminants (1 sample only): - 1,4-Dioxine via Method 8270 - 21 target Perfluorooctanoic acid (PFOA) via Method 537
SB-4	Eastern Portion of the Site in the Rear Yard		

Table 2 - Summary of Existing and Proposed Groundwater Monitoring Well Sampling Locations and Analyses

Monitoring Well (MW)	Location	Analysis
MW-2	Eastern portion of the Site Underneath the Slab-on-grade	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury * Emerging Contaminants (1 sample only): - 1,4-dioxane via EPA Method 8270D SIM and
MW-3	Eastern portion of the Site in the Rear Yard	
MW-4	Southern sidewalk along Johnson Avenue	
GW-1	Western Central Portion of the basement	
GW-2	Northeastern Portion of the basement	

MW-1	Graham Avenue Sidewalk outside Northwestern Site Boundary	- 21 target Perfluorooctanoic acid (PFOA) via Modified EPA Method 537m
THPMW-01	Graham Avenue Sidewalk near 158 Graham Avenue Site	
THPMW-02	Intersection of Graham Avenue and Johnson Avenue Sidewalk near 150 Graham Avenue Site	
THPMW-03	Johnson Avenue Sidewalk near 185 Johnson Avenue Site	

Table 3 – Summary of Proposed Soil Vapor Sampling Locations and Analyses

Soil Vapor Samples (SV)	Location	Analysis
SV-4/IA-3	Central Portion of the basement	VOCs and via EPA Method TO-15
SV-5/IA-4	Inside the adjacent 4-story residential building to the west of the Site at 147 Graham Avenue	
SV-6/IA-5	Inside the adjacent 3-story residential and commercial building to the north of the Site at 156 Graham Avenue	
SV-7/IA-6	Inside the adjacent 4-story residential building to the east of the Site at 156 Graham Avenue	
SV-8/IA-7	Inside the adjacent 4-story residential and commercial building to the south of the Site at 150 Graham Avenue	

Historic Data Tables

Table 4: Soil Vapor Data - December 2014 – Merritt Environmental Group Consulting Corp

TABLE 1: SOIL VAPOR, INDOOR AIR AND OUTDOOR AIR SAMPLE ANALYSIS RESULTS
EPA Method TO-15, detected compounds only

Compound	SG1	SG2	IA1	OA1
Acetone	159	151	15.4	9.03
Carbon Disulfide	0.72J	4.67	ND	ND
Methylene Chloride	7.99	3.4	2.22	6.25
Chloroform	1.07J	76.7	ND	ND
2-Butanone (methyl ethyl ketone)	28.6	25.1	0.8J	0.53J
Dichlorodifluoromethane	72.2	8.41	27.2	1.63J
Chloromethane	0.43J	0.95J	1.24	1.09
Trichlorofluormethane	2.02J	1.8J	1.97J	1.57J
Chloroethane	0.5J	1.42	ND	ND
Tetrahydrofuran	0.86J	0.97J	ND	ND
1,1-Dichloroethene	ND	8.33	ND	ND
trans-1,2-Dichloroethene (1,1,1-TCA)	ND	3.05	ND	ND
1,1,1-Trichloroethane	ND	1.36	ND	ND
Trichloroethene (TCE)	13.4	1074	0.43	ND
cis-1,2-Dichloroethene	1.82J	2180	0.52J	ND
Carbon tetrachloride	0.5	0.69	0.5	0.5
Vinyl Chloride	ND	0.59	ND	ND
Tetrachloroethene (PCE)	1220	43399	44.1	2.85
Cyclohexane	2.55	7.23	0.55J	0.45J
tert-Butyl alcohol (TBA)	13.6	10.6	ND	ND
Methyl tert-butyl ether (MTBE)	0.36J	ND	ND	ND
Ethylbenzene	33.4	29.5	0.52J	ND
Benzene	2.65	13.1	1.25J	1.18J
Heptane	9.84	10.7	0.82J	0.41J
Toluene	45.6	46.4	6.41	2.0
Total Xylenes	269.5	235.7	2.13	0.87J
2,2,4-Trimethylpentane	ND	ND	0.84J	0.61J
1,3,5-Trimethylbenzene	1.87J	2.46	ND	ND
1,2,4-Trimethylbenzene	ND	8.36	0.64J	0.93J
4-Ethyltoluene	3.74	4.77	ND	ND
Hexane	9.16	8.81	3.52	2.96
Styrene	1.58J	1.75J	ND	ND
4-Methyl-2-pentanone	7.38	7.38	ND	ND

NOTES

1. All results are expressed in micrograms per cubic meter of air (ug/m^3)
2. J = Concentration is approximate and is less than the quantitation limit but greater than the method detection limit (MDL)
3. "ND" Not Detected

TABLE 2: FINAL GUIDANCE DECISION MATRIX SUMMARY

Compound	SG1	SG2	IA1	OA1	Final Guidance Recommendation
Carbon tetrachloride	0.5	0.69	0.5	0.5	Take reasonable and practical actions to identify source(s) and reduce exposures
1,1,1-Trichloroethane (1,1,1-TCA)	ND	3.05	ND	ND	No further action
Trichloroethene (TCE)	13.4	1074	0.43	ND	Mitigate
Tetrachloroethene (PCE)	1220	43399	44.1	2.85	Mitigate

NOTES

1. **All results are expressed in micrograms per cubic meter of air (ug/m^3)**
2. **"ND" Not Detected**

Table 4: Soil Vapor Data –October and November 2015– Parsons

TABLE 1
GROUNDWATER ELEVATION SUMMARY
OCTOBER 12, 2015
TOP HAT DRY CLEANERS
152 GRAHAM AVENUE
BROOKLYN, NEW YORK 11206
SITE CHARACTERIZATION

Well ID	Top of Casing Elevation (feet) (1a)(1b)	Depth to Product (feet)	Depth to Water (feet)	Depth to Thickness (feet)	Elevation of Water (feet)
THPMW-01	27.71	22.50	22.50	0.0	5.21
THPMW-02	26.85	17.61	17.61	0.0	9.24
THPMW-03	27.48	18.20	18.20	0.0	9.28

Notes:

(1a) Horizontal datum is via NY Long Island State Plane Coordination System NAD 83.
(1b) Vertical datum is the North American vertical datum of 1988 (NAVD88).

TABLE 2
SOIL SAMPLE ANALYTICAL DATA SUMMARY TABLE
TOP HAT DRY CLEANERS
152 GRAHAM AVENUE
BROOKLYN, NEW YORK 11206
SITE CHARACTERIZATION

NYSDEC-Top Hat Site 2015 Site Investigation Validated Soil Analytical Data Detected Compounds Only		NYSDEC Subpart 375 Unrestricted Use Soil Cleanup Objectives(1)	Location ID:	THPMW-01	THPMW-01(*)	THPMW-01	THPMW-02	THPMW-02
			Sample ID:	THPMW-01 (9-11)-20150922	THPMW-101 (9-11)-20150922	THPMW-01 (21-23)-20150922	THPMW-02 (12'-14')-20150923	THPMW-02 (17'-19')-20150924
			Lab Sample Id:	460-101583-1	460-101583-2	460-101583-3	460-101691-1	460-101691-2
			Source:	TALED	TALED	TALED	TALED	TALED
			SDG:	4601015831	4601015831	4601015831	4601016911	4601016911
			Matrix:	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampled:	9/22/2015 11:00	9/22/2015 12:01	9/22/2015 14:00	9/23/2015 14:00	9/24/2015 9:00
			Validated:	11/6/2015	11/6/2015	11/6/2015	11/6/2015	11/6/2015
CAS NO.	COMPOUND		UNITS					
	VOLATILES(2)							
67-64-1	Acetone	50	ug/kg	ND	ND	ND	ND	ND
75-27-4	Bromodichloromethane	NS	ug/kg	ND	ND	ND	ND	ND
67-66-3	Chloroform	370	ug/kg	ND	ND	ND	ND	ND
78-93-3	Methyl Ethyl Ketone	120	ug/kg	ND	ND	ND	ND	ND
127-18-4	Tetrachloroethylene (PCE)	1300	ug/kg	ND	ND	0.36 J	0.27 J	3.6
108-88-3	Toluene	700	ug/kg	ND	ND	ND	0.24 J	0.27 J

TABLE 2
SOIL SAMPLE ANALYTICAL DATA SUMMARY TABLE
TOP HAT DRY CLEANERS
152 GRAHAM AVENUE
BROOKLYN, NEW YORK 11206
SITE CHARACTERIZATION

NYSDEC-Top Hat Site 2015 Site Investigation Validated Soil Analytical Data Detected Compounds Only		NYSDEC Subpart 375 Unrestricted Use Soil Cleanup Objectives(1)	Location ID:	THPMW-03	THPMW-03	THPMW-004
			Sample ID:	THPMW-03(14'-15')-20150924	THPMW-03(15'-17')-20150925	THPMW-004 (5'-6')-20150929
			Lab Sample Id:	460-101771-1	460-101771-2	460-101970-1
			Source:	TALED	TALED	TALED
			SDG:	4601017711	4601017711	4601019701
			Matrix:	SOIL	SOIL	SOIL
			Sampled:	9/24/2015 16:00	9/25/2015 9:00	9/29/2015 11:00
			Validated:	11/6/2015	11/6/2015	11/6/2015
CAS NO.	COMPOUND		UNITS			
	VOLATILES(2)					
67-64-1	Acetone	50	ug/kg	ND	12 J	ND
75-27-4	Bromodichloromethane	NS	ug/kg	ND	ND	ND
67-66-3	Chloroform	370	ug/kg	ND	ND	ND
78-93-3	Methyl Ethyl Ketone	120	ug/kg	ND	2.5 J	ND
127-18-4	Tetrachloroethylene (PCE)	1300	ug/kg	0.96	0.33 J	1.7
108-88-3	Toluene	700	ug/kg	ND	ND	0.33 J

Notes for Table 2

J	The analyte was positively identified, but the quantitation is an estimation.
ND	Parameter deteted below or at method detection limit.
NS	Not specified.
ug/Kg	Micrograms per kilograms
*	Duplicate sample
(1)	Soil criteria obtained from the NYSDEC document entitled, "Division of Enviromental Remediation, 6NYCRR Part 375, Enviromental Remediation Programs, Subparts 375-1 to 375-4 and 375-6, Effective December 14, 2006." Compated soil data to Unrestricted Soil Criteria.
(2)	Only parameters exhibiting concentrations above method detection limit shown on table.

Table 3
GROUNDWATER SAMPLE ANALYTICAL SUMMARY TABLE
TOP HAT DRY CLEANERS
152 GRAHAM AVENUE
BROOKLYN, NEW YORK 11206
SITE CHARACTERIZATION

NYSDEC-Top Hat Site			Location ID:	THPMW-01	THPMW-02	THPMW-02(*)	THPMW-03
2015 Site Investigation			Sample ID:	THPMW-01-20151012	THPMW-02-20151013	THPMW-102-20151013	THPMW-03-20151013
Validated Water Analytical Data			Lab Sample Id:	460-102788-1	460-102788-2	460-102788-3	460-102788-4
Detected Compounds Only			Source:	TALED	TALED	TALED	TALED
			SDG:	4601027881	4601027881	4601027881	4601027881
		NYSDEC Class GA Groundwater TOGs(1)	Matrix:	WATER	WATER	WATER	WATER
			Sampled:	10/12/2015 11:25	10/13/2015 7:00	10/13/2015 7:15	10/13/2015 8:15
			Validated:	11/6/2015	11/6/2015	11/6/2015	11/6/2015
CAS NO.	COMPOUND		UNITS:				
	VOLATILES(2)						
67-64-1	Acetone	50	ug/l	ND	15 J	ND	ND
71-43-2	Benzene	1	ug/l	ND	0.12 J	ND	ND
67-66-3	Chloroform	7	ug/l	0.66 J	**8.3**	**8.7**	1.2
156-59-2	Cis-1,2-Dichloroethylene	5	ug/l	2	ND	ND	ND
100-41-4	Ethylbenzene	5	ug/l	ND	0.6 J	0.54 J	ND
179601-23-1	M,P-Xylenes	5	ug/l	ND	0.38 J	0.42 J	0.34 J
98-82-8	Isopropylbenzene (Cumene)	5	ug/l	ND	0.41 J	ND	ND
78-93-3	Methyl Ethyl Ketone (2-Butanone)	50	ug/l	ND	6.5 J	ND	ND
108-87-2	Methylcyclohexane	NS	ug/l	ND	0.28 J	ND	ND
75-09-2	Methylene Chloride	5	ug/l	ND	0.32 J	ND	ND
95-47-6	O-Xylene (1,2-Dimethylbenzene)	5	ug/l	ND	2.3	2.4	ND
1634-04-4	Tert-Butyl Methyl Ether	10	ug/l	ND	0.34 J	0.4 J	ND
127-18-4	Tetrachloroethylene (PCE)	5	ug/l	**56**	3.1	3.2	**10**
108-88-3	Toluene	5	ug/l	ND	0.38 J	0.35 J	0.42 J
79-01-6	Trichloroethylene (TCE)	5	ug/l	0.43 J	ND	0.26 J	0.5 J

Notes for Table 3

🟨	Concentration of parameter(s) exceeds New York State Department of Environmental Conservation (NYSDEC) Class GA Groundwater Standards. Standard Class used is for "Source of Drinking Water".
J	The analyte was positively identified, but the quantitation is an estimation.
ND	Parameter deteted below or at method detection limit.
NS	Not specified.
ug/L	Micrograms per liter
*	Duplicate sample
(1)	Groundwater criteria obtained from the NYSDEC document entitled, "Division of Water Technical and Operational Guidance Series (1.1.1.), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 1998; Errata Sheet for June 1998 Edition.
(2)	Only parameters exhibiting concentrations above method detection limit shown on table.

Table 4: Soil Vapor Data - November 2018 – HydroTech Environmental Engineering and Geology, DPC

Table 1 – Summary of Soil Sampling Locations and Analyses

Soil Boring	**Location**	**Soil Characterization Depth**	**Analytical Methods**
SB-1	Western Central Portion of the Basement	0 to 10 feet (interface with groundwater)	*TCL VOCs via EPA Method 8260 *TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 *TAL Metals via EPA Method 6010 & EPA Method 7473 for Mercury & Standard Methods (SM) 4500-CN for Cyanide
SB-2	Northeastern Portion of the Basement	0 to 12 feet (interface with groundwater)	

-QA/QC procedures followed in accordance with QAPP

Table 2 – Summary of Groundwater Monitoring Well Sampling Locations and Analyses

Monitoring Well ID	Location	Analytical Methods
GW-1	Western Central Portion of the Basement	*TCL VOCs via EPA Method 8260 and 1,4 Dioxane via EPA Method 8270D SIM *TCL SVOCs via EPA Method8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 *TAL Metals via EPA Method 6010 & & Standard Methods (SM) 4500-CN for Cyanide * PFOA and PFOS via modified EPA Method 537
GW-2	Northeastern Portion of the Basement	
MW-1	Graham Avenue Sidewalk outside Northwestern Site Boundary	

-QA/QC procedures followed in accordance with QAPP

Table 3 – Groundwater Monitoring and Surveying Results

Well ID	**Top of Casing Elevation* (feet)**	**Depth to Product (feet)**	**Depth to Water (feet)**	**Elevation of Water* (feet)**
GW-1	21.39	ND	13.75	7.64
GW-2	22.01	ND	17.25	4.76
MW-1	27.36	ND	22.3	5.06

*All elevations shown refer to the North American vertical datum of 1988 (NAVD88)

Notes:

ND – None detected

Table 4 – Summary of Sub-Slab/Soil Vapor and Indoor/Outdoor Air Sampling Locations and Analyses

Sub-slab/Soil Vapor & Indoor/Outdoor Air Sample ID	**Location**	**Analytical Method**
SV-1	Northwestern Portion of the Basement	*VOCs via EPA Method TO-15
SV-2	South-central Portion of the Basement	
SV-3	Graham Avenue Sidewalk outside Northwestern Site Boundary (a Few Feet Southwest of MW-1)	
IA-1	Western-central portion of the Basement	
IA-2	Central Portion of the Building on the First Floor	
OA-1	Rear Yard	

-QA/QC procedures followed in accordance with QAPP

Table 5
Soil Sample Analytical Results for VOCs
152 Graham Avenue, Brooklyn, New York

Sample ID	**SB1 (6-8)**		**SB1 (8-10)**		**SB2 (0-2)**		**SB2 (10-12)**		**Field Duplicate**		**NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Restricted Residential**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Protection of GW**
Sampling Date	**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**				
Client Matrix	**Soil**		**Soil**		**Soil**		**Soil**		**Soil**				
Compound	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**			
Units	**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**	**mg/Kg**	**mg/Kg**
1,1,1,2-Tetrachloroethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,1,1-Trichloroethane	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	0.68	100	0.68
1,1,2,2-Tetrachloroethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,1,2-Trichloroethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,1-Dichloroethane	**0.490**	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	0.27	26	0.27
1,1-Dichloroethylene	**0.490**	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	0.33	100	0.33
1,2,3-Trichlorobenzene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,2,3-Trichloropropane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,2,4-Trichlorobenzene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,2,4-Trimethylbenzene	**5.900**	D	0.160		1.800	U	0.200	U	**22**	D	3.6	52	3.6
1,2-Dibromo-3-chloropropane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,2-Dibromoethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,2-Dichlorobenzene	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	1.1	100	1.1
1,2-Dichloroethane	**0.490**	U	0.00250	U	**1.800**	U	**0.200**	U	0.00310	U	0.02	3.1	0.02
1,2-Dichloropropane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
1,3,5-Trimethylbenzene	1.400	D	0.0130		1.800	U	0.200	U	6.300	D	8.4	52	8.4
1,3-Dichlorobenzene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	2.4	49	2.4
1,4-Dichlorobenzene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	1.8	13	1.8
1,4-Dioxane	**9.800**	U	0.0500	U	**37**	U	**4**	U	0.0630	U	0.1	13	0.1
2-Butanone	**0.490**	U	0.00250	U	**1.800**	U	**0.200**	U	0.00310	U	0.12	100	0.12
2-Hexanone	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
4-Methyl-2-pentanone	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Acetone	**0.980**	U	0.0240		**3.700**	U	**0.400**	U	0.0310		0.05	100	0.05
Acrolein	0.980	U	0.00500	U	3.700	U	0.400	U	0.00630	U	~	~	~
Acrylonitrile	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Benzene	**0.490**	U	0.00250	U	**1.800**	U	**0.200**	U	0.00310	U	0.06	4.8	0.06
Bromochloromethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Bromodichloromethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Bromoform	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Bromomethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Carbon disulfide	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Carbon tetrachloride	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	0.76	2.4	0.76
Chlorobenzene	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	1.1	100	1.1
Chloroethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Chloroform	**0.490**	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	0.37	49	0.37
Chloromethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
cis-1,2-Dichloroethylene	**0.490**	U	0.230	E	**1.800**	U	0.200	U	NT		0.25	100	0.25
cis-1,3-Dichloropropylene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Cyclohexane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Dibromochloromethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Dibromomethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Dichlorodifluoromethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Ethyl Benzene	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.0210		1	41	1
Hexachlorobutadiene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Isopropylbenzene	0.490	U	0.00560		1.800	U	0.200	U	0.0380		~	~	~
Methyl acetate	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Methyl tert-butyl ether (MTBE)	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.00310	U	0.93	100	0.93
Methylcyclohexane	0.490	U	0.00950		1.800	U	0.200	U	0.0320		~	~	~
Methylene chloride	**0.980**	U	0.0220		**3.700**	U	**0.400**	U	0.0250		0.05	100	0.05
n-Butylbenzene	0.490	U	0.0130		1.800	U	0.200	U	0.0910		12	100	12
n-Propylbenzene	0.490	U	0.0110		1.800	U	0.200	U	0.0840		3.9	100	3.9
o-Xylene	0.490	U	0.0190		1.800	U	0.200	U	0.0920		~	~	~
p- & m- Xylenes	0.990	JD	0.0340		3.700	U	0.400	U	0.190		~	~	~
p-Isopropyltoluene	0.650	JD	0.0120		1.800	U	0.200	U	0.0850		~	~	~
sec-Butylbenzene	0.620	JD	0.0120		1.800	U	0.200	U	0.0860		11	100	11
Styrene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
tert-Butyl alcohol (TBA)	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
tert-Butylbenzene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00770		5.9	100	5.9
Tetrachloroethylene	**87**	D	0.670	D	**440**	D	**49**	D	**290**	D	1.3	19	1.3
Toluene	0.490	U	0.00250	U	**1.800**	U	0.200	U	0.00640		0.7	100	0.7
trans-1,2-Dichloroethylene	**0.490**	U	0.00250	U	**1.800**	U	**0.200**	U	0.00310	U	0.19	100	0.19
trans-1,3-Dichloropropylene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
trans-1,4-dichloro-2-butene	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Trichloroethylene	**0.520**	JD	0.0120		**1.800**	U	0.200	U	0.180		0.47	21	0.47
Trichlorofluoromethane	0.490	U	0.00250	U	1.800	U	0.200	U	0.00310	U	~	~	~
Vinyl Chloride	**0.490**	U	0.00480	J	**1.800**	U	**0.200**	U	0.0160		0.02	0.9	0.02
Xylenes, Total	**1.500**	U	0.0530		**5.500**	U	**0.600**	U	**0.280**		0.26	100	1.6

Notes:

🟨	Concentration exceeds NYSDEC Part 375 Unrestricted Use SCOs
🟦	Concentration exceeds NYSDEC Part 375 Restricted Use SCOs for Restricted Residential Use
🟩	Concentration exceeds NYSDEC Part 375 Restricted Use Soil Cleanup Objectives for Protection of Groundwater
🟧	Concentration exceeds NYSDEC Part 375 Unrestricted Use SCOs & Restricted Use Soil Cleanup Objectives for Protection of Groundwater
🟪	Concentration exceeds Restricted Residential Use SCOs, and Restricted Use SCOs for Protection of Groundwater

Q is the Qualifier Column with definitions as follows:

D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated
B=analyte found in the analysis batch blank
E=result is estimated and cannot be accurately reported due to levels encountered or interferences
NT=this indicates the analyte was not a target for this sample
~=this indicates that no regulatory limit has been established for this analyte

Table 5 Contd.
Soil Sample Analytical Results for SVOCs
152 Graham Avenue, Brooklyn, New York

Sample ID	SB1 (6-8)		SB1 (8-10)		SB2 (0-2)		SB2 (10-12)		Field Duplicate		NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Restricted Residential	NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Protection of GW
Sampling Date	11/19/2018		11/19/2018		11/19/2018		11/19/2018		11/19/2018				
Client Matrix	Soil		Soil		Soil		Soil		Soil				
Compound	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q			
Units	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg	mg/Kg	mg/Kg
1,1-Biphenyl	0.0656	JD	0.282	D	0.0460	U	0.416	D	0.321	D	~	~	~
1,2,4,5-Tetrachlorobenzene	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
1,2,4-Trichlorobenzene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
1,2-Dichlorobenzene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	1.1	100	1.1
1,2-Diphenylhydrazine (as Azobenze	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
1,3-Dichlorobenzene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	2.4	49	2.4
1,4-Dichlorobenzene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	1.8	13	1.8
2,3,4,6-Tetrachlorophenol	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
2,4,5-Trichlorophenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2,4,6-Trichlorophenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2,4-Dichlorophenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2,4-Dimethylphenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2,4-Dinitrophenol	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
2,4-Dinitrotoluene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2,6-Dinitrotoluene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2-Chloronaphthalene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2-Chlorophenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
2-Methylnaphthalene	0.699	D	1.550	D	0.0460	U	3.810	D	NT		~	~	~
2-Methylphenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.33	100	0.33
2-Nitroaniline	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
2-Nitrophenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
3- & 4-Methylphenols	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
3,3-Dichlorobenzidine	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
3-Nitroaniline	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
4,6-Dinitro-2-methylphenol	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
4-Bromophenyl phenyl ether	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
4-Chloro-3-methylphenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
4-Chloroaniline	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
4-Chlorophenyl phenyl ether	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
4-Nitroaniline	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
4-Nitrophenol	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
Acenaphthene	0.0566	JD	0.291	D	0.0460	U	0.415	D	0.0462	U	20	100	98
Acenaphthylene	0.0467	U	0.116	D	0.0460	U	0.0467	U	0.0462	U	100	100	107
Acetophenone	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Aniline	0.187	U	0.187	U	0.184	U	0.186	U	0.184	U	~	~	~
Anthracene	0.0467	U	0.167	D	0.0460	U	0.0796	JD	0.110	D	100	100	1000
Atrazine	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Benzaldehyde	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Benzidine	0.187	U	0.187	U	0.184	U	0.186	U	0.184	U	~	~	~
Benzo(a)anthracene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	1	1	1
Benzo(a)pyrene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	1	1	22
Benzo(b)fluoranthene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	1	1	1.7
Benzo(g,h,i)perylene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	100	100	1000
Benzo(k)fluoranthene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.8	3.9	1.7
Benzoic acid	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Benzyl alcohol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Benzyl butyl phthalate	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Bis(2-chloroethoxy)methane	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Bis(2-chloroethyl)ether	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Bis(2-chloroisopropyl)ether	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Bis(2-ethylhexyl)phthalate	0.0467	U	0.0694	JD	0.171	D	0.0618	JD	0.0462	U	~	~	~
Caprolactam	0.0932	U	0.0934	U	0.0918	U	0.0931	U	0.0921	U	~	~	~
Carbazole	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Chrysene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	1	3.9	1
Dibenzo(a,h)anthracene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.33	0.33	1000
Dibenzofuran	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	7	59	210
Diethyl phthalate	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Dimethyl phthalate	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Di-n-butyl phthalate	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Di-n-octyl phthalate	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Fluoranthene	0.0467	U	0.0468	U	0.0460	U	0.0581	JD	0.0462	U	100	100	1000
Fluorene	0.106	D	0.538	D	0.0460	U	0.674	D	0.340	D	30	100	386
Hexachlorobenzene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.33	1.2	3.2
Hexachlorobutadiene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Hexachlorocyclopentadiene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Hexachloroethane	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Indeno(1,2,3-cd)pyrene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.5	0.5	8.2
Isophorone	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Naphthalene	0.0901	JD	0.285	D	0.0460	U	1.530	D	0.540	D	12	100	12
Nitrobenzene	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
N-Nitrosodimethylamine	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
N-nitroso-di-n-propylamine	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
N-Nitrosodiphenylamine	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	~	~	~
Pentachlorophenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.8	6.7	0.8
Phenanthrene	0.269	D	1.110	D	0.0460	U	1.730	D	1	D	100	100	1000
Phenol	0.0467	U	0.0468	U	0.0460	U	0.0467	U	0.0462	U	0.33	100	0.33
Pyrene	0.0467	U	0.135	D	0.0460	U	0.207	D	0.0986	D	100	100	1000

Q is the Qualifier Column with definitions as follows:
D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated

Table 5 Contd.
Soil Sample Analytical Results for Metals
152 Graham Avenue, Brooklyn, New York

Sample ID	**SB1 (6-8)**		**SB1 (8-10)**		**SB2 (0-2)**		**SB2 (10-12)**		**Field Duplicate**		**NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Restricted Residential**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Protection of GW**
Sampling Date	**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**				
Client Matrix	**Soil**		**Soil**		**Soil**		**Soil**		**Soil**				
Compound	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**			
Units	**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**	**mg/Kg**	**mg/Kg**
Aluminum	6,290		6,610		6,110		6,860		6,930		~	~	~
Antimony	2.790	U	2.790	U	2.760	U	2.790	U	2.760	U	~	~	~
Arsenic	1.680	U	1.670	U	1.660	U	1.670	U	1.660	U	13	16	16
Barium	45.400		45.700		75.900		41.700		41.100		350	400	820
Beryllium	0.106		0.155		0.258		0.128		0.183		7.2	72	47
Cadmium	0.335	U	0.335	U	0.956		0.335	U	0.331	U	2.5	4.3	7.5
Calcium	5,100		16,600		2,130		9,400		1,750		~	~	~
Chromium	14		25.200		17.800		19.900		18.600		~	~	~
Cobalt	7.330		7.770		9.280		7.550		9.010		~	~	~
Copper	17.100		32.100		**175**		**53.500**		23.700		50	270	1720
Cyanide, total	0.559	U	0.558	U	0.552	U	0.558	U	0.552	U	27	27	40
Iron	13,300		18,400		23,000		15,500		17,800		~	~	~
Lead	4.150		11.100		49.500		5.980		5.490		63	400	450
Magnesium	2,300		6,230		2,020		2,850		2,660		~	~	~
Manganese	289		336		291		282		369		1600	2000	2000
Mercury	0.034	U	0.034	U	1.420		0.034	U	0.033	U	0.18	0.81	0.73
Nickel	15.900		15.200		16.900		14.400		18.500		30	310	130
Potassium	1,320		1,290		1,350		1,270		1,220		~	~	~
Selenium	2.790	U	2.790	U	2.760	U	2.790	U	2.760	U	3.9	180	4
Silver	0.559	U	0.558	U	0.552	U	0.558	U	0.552	U	2	180	8.3
Sodium	136		211		137		185		162		~	~	~
Thallium	2.790	U	2.790	U	2.760	U	2.790	U	2.760	U	~	~	~
Vanadium	23.400		26.500		27.800		25.400		30.400		~	~	~
Zinc	24		43.500		**657**		31		27.200		109	10000	2480

Notes:

🟨	Concentration exceeds NYSDEC Part 375 Unrestricted Use SCOs
🟦	Concentration exceeds NYSDEC Part 375 Restricted Use SCOs for Restricted Residential Use
🟩	Concentration exceeds NYSDEC Part 375 Restricted Use Soil Cleanup Objectives for Protection of Groundwater
🟧	Concentration exceeds NYSDEC Part 375 Unrestricted Use SCOs & Restricted Use Soil Cleanup Objectives for Protection of Groundwater
🟪	Concentration exceeds Restricted Residential Use SCOs, and Restricted Use SCOs for Protection of Groundwater

Q is the Qualifier Column with definitions as follows:

U=analyte not detected at or above the level indicated

Table 5 Contd.
Soil Sample Analytical Results for Pesticides and Herbicides
152 Graham Avenue, Brooklyn, New York

Sample ID	**SB1 (6-8)**		**SB1 (8-10)**		**SB2 (0-2)**		**SB2 (10-12)**		**Field Duplicate**		**NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Restricted Residential**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Protection of GW**
Sampling Date	**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**				
Client Matrix	**Soil**		**Soil**		**Soil**		**Soil**		**Soil**				
Compound	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**			
Units	**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**	**mg/Kg**	**mg/Kg**
Pesticides													
4,4'-DDD	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.0033	13	14
4,4'-DDE	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.0033	8.9	17
4,4'-DDT	0.00184	U	0.00184	U	**0.202**	D	**0.140**	D	0.00181	U	0.0033	7.9	136
Aldrin	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.005	0.097	0.19
alpha-BHC	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.02	0.48	0.02
alpha-Chlordane	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.094	4.2	2.9
beta-BHC	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.036	0.36	0.09
Chlordane, total	0.0367	U	0.0367	U	0.0363	U	0.0367	U	0.0363	U	~	~	~
delta-BHC	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.04	100	0.25
Dieldrin	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.005	0.2	0.1
Endosulfan I	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	2.4	24	102
Endosulfan II	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	2.4	24	102
Endosulfan sulfate	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	2.4	24	1000
Endrin	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.014	11	0.06
Endrin aldehyde	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	~	~	~
Endrin ketone	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	~	~	~
gamma-BHC (Lindar	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.1	1.3	0.1
gamma-Chlordane	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	~	~	~
Heptachlor	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	0.042	2.1	0.38
Heptachlor epoxide	0.00184	U	0.00184	U	0.00181	U	0.00184	U	0.00181	U	~	~	~
Methoxychlor	0.00918	U	0.00918	U	0.00906	U	0.00918	U	0.00907	U	~	~	~
Toxaphene	0.0929	U	0.0929	U	0.0917	U	0.0929	U	0.0917	U	~	~	~
Herbicides													
2,4,5-T	0.0224	U	0.0223	U	0.0221	U	0.0223	U	0.0221	U	~	~	~
2,4,5-TP (Silvex)	0.0224	U	0.0223	U	0.0221	U	0.0223	U	0.0221	U	3.8	100	3.8
2,4-D	0.0224	U	0.0223	U	0.0221	U	0.0223	U	0.0221	U	~	~	~

🟨 Concentration exceeds NYSDEC Part 375 Unrestricted Use SCOs

Q is the Qualifier Column with definitions as follows:

U=analyte not detected at or above the level indicated

Table 5 Contd.
Soil Sample Analytical Results for PCBs
152 Graham Avenue, Brooklyn, New York

Sample ID	**SB1 (6-8)**		**SB1 (8-10)**		**SB2 (0-2)**		**SB2 (10-12)**		**Field Duplicate**		**NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Commercial**	**NYSDEC Part 375 Restricted Use Soil Cleanup Objectives-Protection of GW**
Sampling Date	**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**		**11/19/2018**				
Client Matrix	**Soil**		**Soil**		**Soil**		**Soil**		**Soil**				
Compound	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**	**Result**	**Q**			
Units	**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**		**mg/Kg**	**mg/Kg**	**mg/Kg**
Aroclor 1016	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Aroclor 1221	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Aroclor 1232	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Aroclor 1242	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Aroclor 1248	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Aroclor 1254	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Aroclor 1260	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	~	~	~
Total PCBs	0.0185	U	0.0185	U	0.0183	U	0.0185	U	0.0183	U	0.1	1	3.2

Q is the Qualifier Column with definitions as follows:

U=analyte not detected at or above the level indicated

Table 5 Contd.
Soil Sample Analytical Results for Field and Trip Blanks
152 Graham Avenue, Brooklyn, New York

Sample ID	**Field Blank**		**Trip Blank**		**NYSDEC TOGS Standards and Guidance Values - GA**
Sampling Date	**11/19/2018**		**11/19/2018**		
Client Matrix	**Water**		**Water**		
Compound	**Result**	**Q**	**Result**	**Q**	
Units	**ug/L**		**ug/L**		**ug/L**
VOCs					
1,1,1,2-Tetrachloroethane	0.200	U	0.200	U	5
1,1,1-Trichloroethane	0.200	U	0.200	U	5
1,1,2,2-Tetrachloroethane	0.200	U	0.200	U	5
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.200	U	0.200	U	5
1,1,2-Trichloroethane	0.200	U	0.200	U	1
1,1-Dichloroethane	0.200	U	0.200	U	5
1,1-Dichloroethylene	0.200	U	0.200	U	5
1,2,3-Trichlorobenzene	0.200	U	0.200	U	5
1,2,3-Trichloropropane	**0.200**	U	**0.200**	U	0.04
1,2,4-Trichlorobenzene	0.200	U	0.200	U	5
1,2,4-Trimethylbenzene	0.200	U	0.200	U	5
1,2-Dibromo-3-chloropropane	**0.200**	U	**0.200**	U	0.04
1,2-Dibromoethane	**0.200**	U	**0.200**	U	0.0006
1,2-Dichlorobenzene	0.200	U	0.200	U	3
1,2-Dichloroethane	0.200	U	0.200	U	0.6
1,2-Dichloropropane	0.200	U	0.200	U	1
1,3,5-Trimethylbenzene	0.200	U	0.200	U	5
1,3-Dichlorobenzene	0.200	U	0.200	U	3
1,4-Dichlorobenzene	0.200	U	0.200	U	3
1,4-Dioxane	40	U	40	U	~
2-Butanone	0.200	U	0.200	U	50
2-Hexanone	0.200	U	0.200	U	50
4-Methyl-2-pentanone	0.200	U	0.200	U	~
Acetone	2.900		1	U	50
Acrolein	0.200	U	0.200	U	~
Acrylonitrile	0.200	U	0.200	U	~
Benzene	0.270	J	0.200	U	1
Bromochloromethane	0.200	U	0.200	U	5
Bromodichloromethane	0.200	U	0.200	U	50
Bromoform	0.200	U	0.200	U	50
Bromomethane	0.200	U	0.200	U	5
Carbon disulfide	0.200	U	0.200	U	~
Carbon tetrachloride	0.200	U	0.200	U	5
Chlorobenzene	0.200	U	0.200	U	5
Chloroethane	0.200	U	0.200	U	5
Chloroform	0.200	U	0.200	U	7
Chloromethane	0.200	U	0.200	U	5
cis-1,2-Dichloroethylene	0.200	U	0.200	U	5
cis-1,3-Dichloropropylene	0.200	U	0.200	U	0.4
Cyclohexane	0.200	U	0.200	U	~
Dibromochloromethane	0.200	U	0.200	U	50
Dibromomethane	0.200	U	0.200	U	~
Dichlorodifluoromethane	0.200	U	0.200	U	5
Ethyl Benzene	0.200	U	0.200	U	5
Hexachlorobutadiene	0.200	U	0.200	U	0.5
Isopropylbenzene	0.200	U	0.200	U	5
Methyl acetate	0.200	U	0.200	U	~
Methyl tert-butyl ether (MTBE)	0.200	U	0.200	U	10
Methylcyclohexane	0.200	U	0.200	U	~
Methylene chloride	1	U	1	U	5
n-Butylbenzene	0.200	U	0.200	U	5
n-Propylbenzene	0.200	U	0.200	U	5
o-Xylene	0.200	U	0.200	U	5
p- & m- Xylenes	0.500	U	0.500	U	5
p-Isopropyltoluene	0.200	U	0.200	U	5
sec-Butylbenzene	0.200	U	0.200	U	5
Styrene	0.200	U	0.200	U	5
tert-Butyl alcohol (TBA)	1.100	J	0.500	U	~
tert-Butylbenzene	0.200	U	0.200	U	5
Tetrachloroethylene	1.500		0.200	U	5
Toluene	0.220	J	0.200	U	5
trans-1,2-Dichloroethylene	0.200	U	0.200	U	5
trans-1,3-Dichloropropylene	0.200	U	0.200	U	0.4
trans-1,4-dichloro-2-butene	0.200	U	0.200	U	~
Trichloroethylene	0.200	U	0.200	U	5
Trichlorofluoromethane	0.200	U	0.200	U	5
Vinyl Chloride	0.200	U	0.200	U	2
Xylenes, Total	0.600	U	0.600	U	5
SVOCs					
1,1-Biphenyl	2.560	U	NT		~
1,2,4,5-Tetrachlorobenzene	2.560	U	NT		~
1,2,4-Trichlorobenzene	2.560	U	NT		5
1,2-Dichlorobenzene	2.560	U	NT		3
1,2-Diphenylhydrazine (as Azobenzene)	2.560	U	NT		~
1,3-Dichlorobenzene	2.560	U	NT		3
1,4-Dichlorobenzene	2.560	U	NT		3
2,3,4,6-Tetrachlorophenol	2.560	U	NT		~
2,4,5-Trichlorophenol	**2.560**	U	NT		1
2,4,6-Trichlorophenol	**2.560**	U	NT		1
2,4-Dichlorophenol	2.560	U	NT		5
2,4-Dimethylphenol	2.560	U	NT		50
2,4-Dinitrophenol	2.560	U	NT		10
2,4-Dinitrotoluene	2.560	U	NT		5
2,6-Dinitrotoluene	2.560	U	NT		5
2-Chloronaphthalene	2.560	U	NT		10
2-Chlorophenol	**2.560**	U	NT		1
2-Methylnaphthalene	2.560	U	NT		~
2-Methylphenol	**2.560**	U	NT		1
2-Nitroaniline	2.560	U	NT		5
2-Nitrophenol	**2.560**	U	NT		1
3- & 4-Methylphenols	2.560	U	NT		~
3,3-Dichlorobenzidine	2.560	U	NT		5
3-Nitroaniline	2.560	U	NT		5
4,6-Dinitro-2-methylphenol	2.560	U	NT		~
4-Bromophenyl phenyl ether	2.560	U	NT		~
4-Chloro-3-methylphenol	**2.560**	U	NT		1
4-Chloroaniline	2.560	U	NT		5
4-Chlorophenyl phenyl ether	2.560	U	NT		~
4-Nitroaniline	2.560	U	NT		5
4-Nitrophenol	**2.560**	U	NT		1
Acenaphthene	0.0513	U	NT		20
Acenaphthylene	0.0513	U	NT		~
Acetophenone	2.560	U	NT		~
Aniline	2.560	U	NT		5
Anthracene	0.0513	U	NT		50
Atrazine	0.513	U	NT		~
Benzaldehyde	2.560	U	NT		~
Benzidine	10.300	U	NT		~
Benzo(a)anthracene	**0.0513**	U	NT		0.002
Benzo(a)pyrene	**0.0513**	U	NT		0.002
Benzo(b)fluoranthene	**0.0513**	U	NT		0.002
Benzo(g,h,i)perylene	0.0513	U	NT		~
Benzo(k)fluoranthene	**0.0513**	U	NT		0.002
Benzoic acid	25.600	U	NT		~
Benzyl alcohol	2.560	U	NT		~
Benzyl butyl phthalate	2.560	U	NT		50
Bis(2-chloroethoxy)methane	2.560	U	NT		5
Bis(2-chloroethyl)ether	**2.560**	U	NT		1
Bis(2-chloroisopropyl)ether	2.560	U	NT		5
Bis(2-ethylhexyl)phthalate	0.513	U	NT		5
Caprolactam	2.560	U	NT		~
Carbazole	2.560	U	NT		~
Chrysene	**0.0513**	U	NT		0.002
Dibenzo(a,h)anthracene	0.0513	U	NT		~
Dibenzofuran	2.560	U	NT		~
Diethyl phthalate	2.560	U	NT		50
Dimethyl phthalate	2.560	U	NT		50
Di-n-butyl phthalate	2.560	U	NT		50
Di-n-octyl phthalate	2.560	U	NT		50
Fluoranthene	0.0513	U	NT		50
Fluorene	0.0513	U	NT		50
Hexachlorobenzene	0.0205	U	NT		0.04
Hexachlorobutadiene	**0.513**	U	NT		0.5
Hexachlorocyclopentadiene	2.560	U	NT		5
Hexachloroethane	0.513	U	NT		5
Indeno(1,2,3-cd)pyrene	**0.0513**	U	NT		0.002
Isophorone	2.560	U	NT		50
Naphthalene	0.0513	U	NT		10
Nitrobenzene	0.256	U	NT		0.4
N-Nitrosodimethylamine	0.513	U	NT		~
N-nitroso-di-n-propylamine	2.560	U	NT		~
N-Nitrosodiphenylamine	2.560	U	NT		50
Pentachlorophenol	0.256	U	NT		1
Phenanthrene	0.0821		NT		50
Phenol	**2.560**	U	NT		1
Pyrene	0.0513	U	NT		50
Pesticides					
4,4'-DDD	0.00410	U	NT		0.3
4,4'-DDE	0.00410	U	NT		0.2
4,4'-DDT	0.00410	U	NT		0.2
Aldrin	0.00410	U	NT		~
alpha-BHC	0.00410	U	NT		0.01
alpha-Chlordane	0.00410	U	NT		~
beta-BHC	0.00410	U	NT		0.04
Chlordane, total	0.0205	U	NT		0.05
delta-BHC	0.00410	U	NT		0.04
Dieldrin	0.00205	U	NT		0.004
Endosulfan I	0.00410	U	NT		~
Endosulfan II	0.00410	U	NT		~
Endosulfan sulfate	0.00410	U	NT		~
Endrin	0.00410	U	NT		~
Endrin aldehyde	0.0103	U	NT		5
Endrin ketone	0.0103	U	NT		5
gamma-BHC (Lindane)	0.00410	U	NT		0.05
gamma-Chlordane	0.0103	U	NT		~
Heptachlor	0.00410	U	NT		0.04
Heptachlor epoxide	0.00410	U	NT		0.03
Methoxychlor	0.00410	U	NT		35
Toxaphene	**0.103**	U	NT		0.06
Metals					
Aluminum	2,470		NT		~
Barium	68.200		NT		1000
Calcium	6,910		NT		~
Chromium	**82.200**		NT		50
Cobalt	11.200		NT		~
Copper	**459**		NT		200
Iron	11,700		NT		~
Lead	10.700		NT		25
Magnesium	1,600		NT		35000
Manganese	**514**		NT		300
Nickel	38.100		NT		100
Potassium	848		NT		~
Silver	5.560	U	NT		50
Sodium	9,790		NT		20000
Vanadium	11.100	U	NT		~
Zinc	254		NT		2000
Metals, Dissolved					
Aluminum	55.600	U	NT		~
Barium	27.800	U	NT		1000
Calcium	187		NT		~
Chromium	5.560	U	NT		50
Cobalt	4.440	U	NT		~
Copper	22.200	U	NT		200
Iron	278	U	NT		~
Lead	5.560	U	NT		25
Magnesium	55.600	U	NT		35000
Manganese	5.560	U	NT		300
Nickel	11.100	U	NT		100
Potassium	183	B	NT		~
Silver	5.560	U	NT		50
Sodium	556	U	NT		20000
Vanadium	11.100	U	NT		~
Zinc	27.800	U	NT		2000
Metals, ICPMS					
Antimony	1.110	U	NT		3
Arsenic	3.370		NT		25
Beryllium	0.333	U	NT		3
Cadmium	0.556	U	NT		5
Selenium	**12**		NT		10
Thallium	1.110	U	NT		~
Metals, , ICPMS Dissolved					
Antimony	1.110	U	NT		3
Arsenic	1.110	U	NT		25
Beryllium	0.333	U	NT		3
Cadmium	0.556	U	NT		5
Selenium	1.110	U	NT		10
Thallium	1.110	U	NT		~
Mercury	0.200	U	NT		0.7
Mercury	0.200	U	NT		0.7
Cyanide, total	10	U	NT		200
Herbicides					
2,4,5-T	5	U	NT		35
2,4,5-TP (Silvex)	**5**	U	NT		0.26
2,4-D	5	U	NT		50
Polychlorinated Biphenyls (PCB)					
Aroclor 1016	0.0513	U	NT		~
Aroclor 1221	0.0513	U	NT		~
Aroclor 1232	0.0513	U	NT		~
Aroclor 1242	0.0513	U	NT		~
Aroclor 1248	0.0513	U	NT		~
Aroclor 1254	0.0513	U	NT		~
Aroclor 1260	0.0513	U	NT		~
Total PCBs	0.0513	U	NT		0.09

Notes:

🟨 Sample exceeds NYSDEC TOGS Standards and Guidance Values - GA

Q is the Qualifier Column with definitions as follows:
D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated
B=analyte found in the analysis batch blank
E=result is estimated and cannot be accurately reported due to levels encountered or interferences

P=this flag is used for pesticide and PCB (Aroclor) target compounds when there is a % difference for detected concentrations that exceed method dictated limits between the two GC columns used for analysis

NT=this indicates the analyte was not a target for this sample
~=this indicates that no regulatory limit has been established for this analyte

Table 6
Groundwater Sample Analytical Results for VOCs
152 Graham Avenue, Brooklyn, New York

Sample ID	**GW-1**		**GW-2**		**MW-1**		**Field Duplicate**		**Field Blank**		**Trip Blank**		**NYSDEC TOGS Standards and Guidance Values - GA**
Sampling Date	**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		
Client Matrix	**Water**		**Water**		**Water**		**Water**		**Water**		**Water**		
Compound	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L
1,1,1,2-Tetrachloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,1,1-Trichloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,1,2,2-Tetrachloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,1,2-Trichloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	1
1,1-Dichloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,1-Dichloroethylene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,2,3-Trichlorobenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,2,3-Trichloropropane	**20**	U	**20**	U	**20**	U	**20**	U	**0.200**	U	**0.200**	U	0.04
1,2,4-Trichlorobenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,2,4-Trimethylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,2-Dibromo-3-chloropropane	**20**	U	**20**	U	**20**	U	**20**	U	**0.200**	U	**0.200**	U	0.04
1,2-Dibromoethane	**20**	U	**20**	U	**20**	U	**20**	U	**0.200**	U	**0.200**	U	0.0006
1,2-Dichlorobenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	3
1,2-Dichloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	0.6
1,2-Dichloropropane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	1
1,3,5-Trimethylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
1,3-Dichlorobenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	3
1,4-Dichlorobenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	3
1,4-Dioxane	4,000	U	4,000	U	4,000	U	4,000	U	40	U	40	U	~
2-Butanone	20	U	20	U	20	U	20	U	0.200	U	0.200	U	50
2-Hexanone	20	U	20	U	20	U	20	U	0.200	U	0.200	U	50
4-Methyl-2-pentanone	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Acetone	**100**	U	**100**	U	**100**	U	**100**	U	1	U	1	U	50
Acrolein	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Acrylonitrile	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Benzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	1
Bromochloromethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Bromodichloromethane	20	U	20	U	20	U	20	U	0.200	U	0.200	U	50
Bromoform	20	U	20	U	20	U	20	U	0.200	U	0.200	U	50
Bromomethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Carbon disulfide	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Carbon tetrachloride	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Chlorobenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Chloroethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Chloroform	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	7
Chloromethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
cis-1,2-Dichloroethylene	**1,400**	D	**200**	D	**360**	D	**380**	D	0.200	U	0.200	U	5
cis-1,3-Dichloropropylene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	0.4
Cyclohexane	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Dibromochloromethane	20	U	20	U	20	U	20	U	0.200	U	0.200	U	50
Dibromomethane	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Dichlorodifluoromethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Ethyl Benzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Hexachlorobutadiene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	0.5
Isopropylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Methyl acetate	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Methyl tert-butyl ether (MTBE)	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	10
Methylcyclohexane	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Methylene chloride	**100**	U	**100**	U	**100**	U	**100**	U	1	U	1	U	5
n-Butylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
n-Propylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
o-Xylene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
p- & m- Xylenes	**50**	U	**50**	U	**50**	U	**50**	U	0.500	U	0.500	U	5
p-Isopropyltoluene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
sec-Butylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Styrene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
tert-Butyl alcohol (TBA)	50	U	50	U	50	U	50	U	0.500	U	0.500	U	~
tert-Butylbenzene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Tetrachloroethylene	**29,000**	DE	**11,000**	D	**15,000**	D	**28,000**	D	2.200		0.200	U	5
Toluene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
trans-1,2-Dichloroethylene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
trans-1,3-Dichloropropylene	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	0.4
trans-1,4-dichloro-2-butene	20	U	20	U	20	U	20	U	0.200	U	0.200	U	~
Trichloroethylene	**200**	D	**110**	D	**120**	D	**120**	D	0.200	U	0.200	U	5
Trichlorofluoromethane	**20**	U	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	5
Vinyl Chloride	**25**	JD	**20**	U	**20**	U	**20**	U	0.200	U	0.200	U	2
Xylenes, Total	**60**	U	**60**	U	**60**	U	**60**	U	0.600	U	0.600	U	5

NOTES:

🟨 Sample exceeds NYSDEC TOGS Standards and Guidance Values - GA

Q is the Qualifier Column with definitions as follows:

D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated
B=analyte found in the analysis batch blank
E=result is estimated and cannot be accurately reported due to levels encountered or interferences
P=this flag is used for pesticide and PCB (Aroclor) target compounds when there is a % difference for detected concentrations that exceed method dictated limits between the two GC columns used for analysis
NT=this indicates the analyte was not a target for this sample
~=this indicates that no regulatory limit has been established for this analyte

Table 6
Groundwater Sample Analytical Results for SVOCs
152 Graham Avenue, Brooklyn, New York

Sample ID	**GW-1**		**GW-2**		**MW-1**		**Field Duplicate**		**Field Blank**		**Trip Blank**		**NYSDEC TOGS Standards and Guidance Values - GA**
Sampling Date	**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		
Client Matrix	**Water**		**Water**		**Water**		**Water**		**Water**		**Water**		
Compound	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L
1,1-Biphenyl	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
1,2,4,5-Tetrachlorobenzene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
1,2,4-Trichlorobenzene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
1,2-Dichlorobenzene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		3
1,2-Diphenylhydrazine (as Azobenzene)	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
1,3-Dichlorobenzene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		3
1,4-Dichlorobenzene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		3
2,3,4,6-Tetrachlorophenol	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
2,4,5-Trichlorophenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
2,4,6-Trichlorophenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
2,4-Dichlorophenol	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
2,4-Dimethylphenol	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
2,4-Dinitrophenol	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		10
2,4-Dinitrotoluene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
2,6-Dinitrotoluene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
2-Chloronaphthalene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		10
2-Chlorophenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
2-Methylnaphthalene	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
2-Methylphenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
2-Nitroaniline	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
2-Nitrophenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
3- & 4-Methylphenols	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
3,3-Dichlorobenzidine	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
3-Nitroaniline	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
4,6-Dinitro-2-methylphenol	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
4-Bromophenyl phenyl ether	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
4-Chloro-3-methylphenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
4-Chloroaniline	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
4-Chlorophenyl phenyl ether	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
4-Nitroaniline	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
4-Nitrophenol	NT		**5.130**	U	**5.130**	U	**5.560**	U	**5.260**	U	NT		1
Acetophenone	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
Aniline	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
Benzaldehyde	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
Benzidine	NT		5.130	U	5.130	U	5.560	U	5.260	U	NT		~
Benzoic acid	NT		25.600	U	25.600	U	27.800	U	26.300	U	NT		~
Benzyl alcohol	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
Benzyl butyl phthalate	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Bis(2-chloroethoxy)methane	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
Bis(2-chloroethyl)ether	NT		**1.030**	U	**1.030**	U	**1.110**	U	**1.050**	U	NT		1
Bis(2-chloroisopropyl)ether	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		5
Caprolactam	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
Carbazole	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
Dibenzofuran	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
Diethyl phthalate	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Dimethyl phthalate	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Di-n-butyl phthalate	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Di-n-octyl phthalate	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Hexachlorocyclopentadiene	NT		**5.130**	U	**5.130**	U	**5.560**	U	**5.260**	U	NT		5
Isophorone	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
N-nitroso-di-n-propylamine	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		~
N-Nitrosodiphenylamine	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Phenol	NT		**2.560**	U	**2.560**	U	**2.780**	U	**2.630**	U	NT		1
Pyridine	NT		2.560	U	2.560	U	2.780	U	2.630	U	NT		50
Acenaphthene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		20
Acenaphthylene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		~
Anthracene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		50
Atrazine	NT		0.513	U	0.513	U	0.556	U	0.526	U	NT		~
Benzo(a)anthracene	NT		**0.0513**	U	**0.0513**	U	**0.0556**	U	**0.0526**	U	NT		0.002
Benzo(a)pyrene	NT		**0.0513**	U	**0.0513**	U	**0.0556**	U	**0.0526**	U	NT		0.002
Benzo(b)fluoranthene	NT		**0.0513**	U	**0.0513**	U	**0.0556**	U	**0.0526**	U	NT		0.002
Benzo(g,h,i)perylene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		~
Benzo(k)fluoranthene	NT		**0.0513**	U	**0.0513**	U	**0.0556**	U	**0.0526**	U	NT		0.002
Bis(2-ethylhexyl)phthalate	NT		0.513	U	0.513	U	0.556	U	0.526	U	NT		5
Chrysene	NT		**0.0513**	U	**0.0513**	U	**0.0556**	U	**0.0526**	U	NT		0.002
Dibenzo(a,h)anthracene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		~
Fluoranthene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		50
Fluorene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		50
Hexachlorobenzene	NT		0.0205	U	0.0205	U	0.0222	U	0.0211	U	NT		0.04
Hexachlorobutadiene	NT		**0.513**	U	**0.513**	U	**0.556**	U	**0.526**	U	NT		0.5
Hexachloroethane	NT		0.513	U	0.513	U	0.556	U	0.526	U	NT		5
Indeno(1,2,3-cd)pyrene	NT		**0.0513**	U	**0.0513**	U	**0.0556**	U	**0.0526**	U	NT		0.002
Naphthalene	NT		0.0513		0.0821		0.111		0.0526	U	NT		10
Nitrobenzene	NT		0.256	U	0.256	U	0.278	U	0.263	U	NT		0.4
N-Nitrosodimethylamine	NT		0.513	U	0.513	U	0.556	U	0.526	U	NT		~
Pentachlorophenol	NT		0.256	U	0.256	U	0.278	U	0.263	U	NT		1
Phenanthrene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		50
Pyrene	NT		0.0513	U	0.0513	U	0.0556	U	0.0526	U	NT		50

NOTES:

Q is the Qualifier Column with definitions as follows:
D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated
B=analyte found in the analysis batch blank
E=result is estimated and cannot be accurately reported due to levels encountered or interferences
P=this flag is used for pesticide and PCB (Aroclor) target compounds when there is a % difference for detected concentrations that exceed method dictated limits
NT=this indicates the analyte was not a target for this sample
~=this indicates that no regulatory limit has been established for this analyte

Table 6

Groundwater Sample Analytical Results for Pesticides, Herbicides and PCBs

152 Graham Avenue, Brooklyn, New York

Sample ID	**GW-1**		**GW-2**		**MW-1**		**ield Duplicat**		**Field Blank**		**Trip Blank**		**NYSDEC TOGS Standards and Guidance Values - GA**
Sampling Date	**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		
Client Matrix	**Water**		**Water**		**Water**		**Water**		**Water**		**Water**		
Compound	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L
Pesticides													
4,4'-DDD	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.3
4,4'-DDE	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.2
4,4'-DDT	NT		0.0177		0.00410	U	0.00410	U	0.00457	U	NT		0.2
Aldrin	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		~
alpha-BHC	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.01
alpha-Chlordan	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		~
beta-BHC	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.04
Chlordane, tota	NT		0.0205	U	0.0205	U	0.0205	U	0.0229	U	NT		0.05
delta-BHC	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.04
Dieldrin	NT		0.00205	U	0.00205	U	0.00205	U	0.00229	U	NT		0.004
Endosulfan I	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		~
Endosulfan II	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		~
Endosulfan sulf	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		~
Endrin	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		~
Endrin aldehyd	NT		0.0103	U	0.0103	U	0.0103	U	0.0114	U	NT		5
Endrin ketone	NT		0.0103	U	0.0103	U	0.0103	U	0.0114	U	NT		5
gamma-BHC (L	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.05
gamma-Chlorda	NT		0.0103	U	0.0103	U	0.0103	U	0.0114	U	NT		~
Heptachlor	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.04
Heptachlor epo	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		0.03
Methoxychlor	NT		0.00410	U	0.00410	U	0.00410	U	0.00457	U	NT		35
Toxaphene	NT		**0.103**	U	**0.103**	U	**0.103**	U	**0.114**	U	NT		0.06
Herbicides													
2,4,5-T	NT		5	U	5	U	5	U	5	U	NT		35
2,4,5-TP (Silvex	NT		**5**	U	**5**	U	**5**	U	**5**	U	NT		0.26
2,4-D	NT		5	U	5	U	5	U	5	U	NT		50
PCBs													
Aroclor 1016	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Aroclor 1221	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Aroclor 1232	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Aroclor 1242	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Aroclor 1248	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Aroclor 1254	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Aroclor 1260	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		~
Total PCBs	NT		0.0513	U	0.0513	U	0.0513	U	0.0571	U	NT		0.09

NOTES:

Q is the Qualifier Column with definitions as follows:

D=result is from an analysis that required a dilution

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

U=analyte not detected at or above the level indicated

B=analyte found in the analysis batch blank

E=result is estimated and cannot be accurately reported due to levels encountered or interferences

P=this flag is used for pesticide and PCB (Aroclor) target compounds when there is a % difference for detected concentrations that excee

NT=this indicates the analyte was not a target for this sample

~=this indicates that no regulatory limit has been established for this analyte

Table 6

Groundwater Sample Analytical Results for Metals

152 Graham Avenue, Brooklyn, New York

Sample ID	**GW-1**		**GW-2**		**MW-1**		**Field Duplicate**		**Field Blank**		**Trip Blank**		**NYSDEC TOGS Standards and Guidance Values - GA**
Sampling Date	**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		
Client Matrix	**Water**		**Water**		**Water**		**Water**		**Water**		**Water**		
Compound	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	
Units	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L
Metals, ICP													
Aluminum	NT		786		96.500		64.100		88.500		NT		~
Barium	NT		73.800		27.800	U	27.800	U	27.800	U	NT		1000
Calcium	NT		59,900		57,200		57,000		55.600	U	NT		~
Chromium	NT		8.410		5.560	U	5.560	U	5.560	U	NT		50
Cobalt	NT		4.440	U	4.440	U	4.440	U	4.440	U	NT		~
Copper	NT		57.700		22.200	U	22.200	U	22.200	U	NT		200
Iron	NT		1,700		278	U	278	U	278	U	NT		~
Lead	NT		18		5.560	U	5.560	U	5.560	U	NT		25
Magnesium	NT		21,700		25,500		24,700		55.600	U	NT		35000
Manganese	NT		**396**		159		181		5.560	U	NT		300
Nickel	NT		11.100	U	11.100	U	11.100	U	11.100	U	NT		100
Potassium	NT		12,300		7,540		7,480		55.600	U	NT		~
Silver	NT		5.560	U	5.560	U	5.560	U	5.560	U	NT		50
Sodium	NT		**35,500**		**65,000**		**66,500**		556	U	NT		20000
Vanadium	NT		11.100	U	11.100	U	11.100	U	11.100	U	NT		~
Zinc	NT		99.200		27.800	U	27.800	U	27.800	U	NT		2000
Metals, ICP Dissolved													
Aluminum	NT		55.600	U	55.600	U	64.700		55.600	U	NT		~
Barium	NT		55.600		27.800	U	27.800	U	27.800	U	NT		1000
Calcium	NT		60,400		59,100		57,400		55.600	U	NT		~
Chromium	NT		5.560	U	5.560	U	5.560	U	5.560	U	NT		50
Cobalt	NT		4.440	U	4.440	U	4.440	U	4.440	U	NT		~
Copper	NT		22.200	U	22.200	U	22.200	U	22.200	U	NT		200
Iron	NT		278	U	278	U	278	U	278	U	NT		~
Lead	NT		5.560	U	5.560	U	5.560	U	5.560	U	NT		25
Magnesium	NT		20,800		24,900		24,500		55.600	U	NT		35000
Manganese	NT		**357**		177		170		5.560	U	NT		300
Nickel	NT		11.100	U	11.100	U	11.100	U	11.100	U	NT		100
Potassium	NT		12,200	B	7,770	B	7,530	B	70.800	B	NT		~
Silver	NT		5.560	U	5.560	U	5.560	U	5.560	U	NT		50
Sodium	NT		**36,300**		**68,700**		**67,200**		556	U	NT		20000
Vanadium	NT		11.100	U	11.100	U	11.100	U	11.100	U	NT		~
Zinc	NT		27.800	U	304		27.800	U	27.800	U	NT		2000
Metals, ICPMS													
Antimony	NT		1.110	U	1.110	U	1.110	U	1.110	U	NT		3
Arsenic	NT		1.110	U	1.110	U	1.110	U	1.110	U	NT		25
Beryllium	NT		0.333	U	0.333	U	0.333	U	0.333	U	NT		3
Cadmium	NT		0.556	U	0.556	U	0.556	U	0.556	U	NT		5
Selenium	NT		5.390		1.110	U	1.110	U	1.110	U	NT		10
Thallium	NT		1.110	U	1.110	U	1.110	U	1.110	U	NT		~
Metals, ICPMS Dissolved													
Antimony	NT		1.110	U	1.110	U	1.110	U	1.110	U	NT		3
Arsenic	NT		1.110	U	1.110	U	1.110	U	1.110	U	NT		25
Beryllium	NT		0.333	U	0.333	U	0.333	U	0.333	U	NT		3
Cadmium	NT		0.556	U	0.556	U	0.556	U	0.556	U	NT		5
Selenium	NT		1.950		3.270		1.910		1.110	U	NT		10
Thallium	NT		1.110	U	1.110	U	1.110	U	1.110	U	NT		~
Mercury, Dissolve	NT		0.200	U	0.200	U	0.200	U	0.200	U	NT		0.7
Mercury	NT		0.200	U	0.200	U	0.200	U	0.200	U	NT		0.7
Cyanide, total	NT		10	U	10	U	10	U	10	U	NT		200

NOTES:

🟨 Sample exceeds NYSDEC TOGS Standards and Guidance Values - GA

Q is the Qualifier Column with definitions as follows:

D=result is from an analysis that required a dilution

J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated

U=analyte not detected at or above the level indicated

B=analyte found in the analysis batch blank

E=result is estimated and cannot be accurately reported due to levels encountered or interferences

P=this flag is used for pesticide and PCB (Aroclor) target compounds when there is a % difference for detected concentrations that e

NT=this indicates the analyte was not a target for this sample

~=this indicates that no regulatory limit has been established for this analyte

Table 6
Groundwater Sample Analytical Results for PFOA, PFOS, and 1,4-dioxane
152 Graham Avenue, Brooklyn, New York

Sample ID	**GW-1**		**GW-2**		**MW-1**		**Field Duplicate**		**Field Blank**		**Trip Blank**		**NYSDEC TOGS Standards and Guidance Values - GA**
Sampling Date	**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		**11/21/2018**		
Client Matrix	**Water**		**Water**		**Water**		**Water**		**Water**		**Water**		
Compound	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	
Units	ng/L		ng/L		ng/L		ng/L		ng/L		ng/L		ug/L
1,4-Dioxane	NT		ND		0.23		0.26		ND		ND		NS
Perfluorobutanesulfonic acid (PFBS)	NT		35		41		47		47		ND		NS
Perfluorohexanic acid (PFHxA)	NT		51		46		45		45		ND		NS
Perfluoroheptanoic acid (PFHpA)	NT		59		45		43		43		ND		NS
Perfluorobutanic acid (PFBA)	NT		4.9		10		11		11		ND		NS
Perfluorodecanesulfonic acid (PFDS)	NT		ND		ND		ND		ND		ND		NS
Perfluoroheptanesulfonic acid (PFHpS)	NT		4.8		2		2.1		2.1		ND		NS
Perfluorooctanesulfonamide (FOSA)	NT		ND		ND		ND		ND		ND		NS
Perflouropentanoic acid (PFPeA)	NT		78		77		66		66		ND		NS
6:2 Fluorotelomersulfonate (6:2 FTS)	NT		4.6		ND		ND		ND		4.1		NS
8:2 Fluorotelomersulfonate (8:2 FTS)	NT		ND		ND		ND		ND		ND		NS
Perfluorohexanesulfonic acid (PFHxS)	NT		20		9.3		11		11		ND		NS
Perfluorooctanoic acid (PFOA)	NT		140		88		88		88		ND		NS
Perfluorooctanesulfonic acid (PFOS)	NT		270		36		38		38		ND		NS
Perfluorononanoic acid (PFNA)	NT		13		4.8		4.6		4.6		ND		NS
Perfluorodecanoic acid (PFDA)	NT		2.9		ND		ND		ND		ND		NS
NMeFOSAA	NT		ND		ND		ND		ND		ND		NS
Perfluoroundecanoic acid (PFUnA)	NT		ND		ND		ND		ND		ND		NS
NEtFOSAA	NT		ND		ND		ND		ND		ND		NS
Perfluorododecanoic acid (PFDoA)	NT		ND		ND		ND		ND		ND		NS
Perfluorotridecanoic acid (PFTrDA)	NT		ND		ND		ND		ND		ND		NS
Perfluorotetradecanoic acid (PFTA)	NT		ND		ND		ND		ND		ND		NS

Notes:

NT = Not tested

NS = Indicates that no regulatory limit has been established for this analyte

ND = None detected

Table 7
Soil/Sub-slab Vapor Sample Analytical Results for VOCs
152 Graham Avenue, Brooklyn, New York

Sample ID	SV-1		SV-2		SV-3		IA-1		FD		IA-2		OA-1	
Sampling Date	11/20/2018		11/20/2018		11/20/2018		11/20/2018		11/20/2018		11/20/2018		11/20/2018	
Client Matrix	Air		Air		Air		Air		Air		Air		Air	
Compound	Result		Result		Result		Result		Result		Result		Result	
Units	ug/m3	Q	ug/m3	Q	ug/m3	Q	ug/m3	Q	ug/m3	Q	ug/m3	Q	ug/m3	Q
1,1-Dichloroethene	**14.6**		<0.20	U	**18.7**		<0.20	U	<0.20	U	<0.20	U	<0.20	U
1,2,4-Trichlorobenzene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,2,4-Trimethylbenzene	**189**		**6.29**		**128**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,2-Dibromoethane(EDB)	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,2-Dichlorobenzene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,2-Dichloroethane	<5.02	U	<1.00	U	<5.02	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,2-dichloropropane	<4.99	U	<1.00	U	<4.99	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,2-Dichlorotetrafluoroethane	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,3,5-Trimethylbenzene	**47.5**		**1.56**		**37.7**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,3-Butadiene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,3-Dichlorobenzene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
1,4-Dichlorobenzene	<5.00	U	<1.00	U	<5.00	U	**1.36**		**1.44**		<1.00	U	<1.00	U
1,4-Dioxane	<5.01	U	<1.00	U	<5.01	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
2-Hexanone(MBK)	<4.99	U	<1.00	U	<4.99	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
4-Ethyltoluene	**26.9**		**1.44**		**26.1**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
4-Isopropyltoluene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
4-Methyl-2-pentanone(MIBK)	**13.9**		<1.00	U	<4.99	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Acetone	**34.4**	S	**27.3**		<5.01	U	**16**		**15.4**		**17.8**		**10.8**	
Acrylonitrile	<5.01	U	<1.00	U	<5.01	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Benzene	**10.6**		**4.69**		**96.4**		**6.39**		**5.43**		**2.36**		**1.26**	
Benzyl chloride	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Bromodichloromethane	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Bromoform	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Bromomethane	<5.01	U	<1.00	U	<5.01	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Carbon Disulfide	**21.1**		<1.00	U	**59.7**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
Carbon Tetrachloride	**1.38**		**0.64**		**1.01**		**0.64**		**0.57**		**0.7**		**0.62**	
Chlorobenzene	<5.01	U	<1.00	U	<5.01	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Chloroethane	<5.01	U	<1.00	U	<5.01	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Chloroform	**15.7**		**7.08**		**85.4**		**6.39**		**5.81**		**1.66**		<1.00	U
Chloromethane	**39.2**		**1.07**		<4.99	U	**1.28**		**1.23**		**1.12**		**1.25**	
Cis-1,2-Dichloroethene	**2070**		**1.18**		**128**		**1.24**		**1.09**		<0.20	U	<0.20	U
cis-1,3-Dichloropropene	<4.99	U	<1.00	U	<4.99	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Cyclohexane	**37.2**		**3.75**		**100**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
Dibromochloromethane	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Dichlorodifluoromethane	**7.12**		**2.31**		<4.99	U	**2.59**		**2.69**		**2.64**		**2.59**	
Ethanol	**11.4**		**26.9**		**20.9**		**27.5**		**23.7**		**48.6**		**26.9**	
Ethyl acetate	<5.01	U	<1.00	U	<5.01	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Ethylbenzene	**35.3**		**3.15**		**103**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
Heptane	<5.00	U	**3.86**		**168**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
Hexachlorobutadiene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Hexane	**6.45**	S	**4.58**	S	**191**		**1.12**	S	**1.12**	S	<1.00	U	**1.09**	S
Isopropylalcohol	**39.6**		**15.2**		**19**		**19.1**		**29.5**		**36.4**		**23.7**	
Isopropylbenzene	<5.01	U	<1.00	U	**8.45**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
m,p-Xylene	**142**		**12.3**		**334**		**1.72**		**1.51**		**1.41**		**1.29**	
Methyl Ethyl Ketone	**10**		**6.04**		**38.9**		**1.51**		**1.58**		**2.07**		**1.21**	
Methyl tert-butyl ether(MTBE	<5.01	U	<1.00	U	<5.01	U	**1.22**		**1.13**		<1.00	U	<1.00	U
Methylene Chloride	<15.0	U	<3.00	U	<15.0	U	<3.00	U	<3.00	U	<3.00	U	<3.00	U
n-Butylbenzene	**14.3**		<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
o-Xylene	**79**		**5.21**		**141**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
Propylene	<5.01	U	<1.00	U	**1510**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
sec-Butylbenzene	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Styrene	<4.98	U	<1.00	U	<4.98	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Tetrachloroethene	**277000**		**331**		**929000**		**396**		**352**		**20.4**		**10.5**	
Tetrahydrofuran	**44.5**		**11.3**		**60.7**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
Toluene	**307**		**14.8**		**459**		**3.33**		**3.22**		**3.13**		**2.26**	
Trans-1,2-Dichloroethene	**9.03**		<1.00	U	**11.6**		<1.00	U	<1.00	U	<1.00	U	<1.00	U
trans-1,3-Dichloropropene	<4.99	U	<1.00	U	<4.99	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Trichloroethene	**1240**		**3.58**		**1230**		**3.75**		**3.05**		**6.87**		<0.20	U
Trichlorofluoromethane	<5.00	U	**1.31**		<5.00	U	**1.54**		**1.57**		**1.71**		**1.65**	
Trichlorotrifluoroethane	<5.00	U	<1.00	U	<5.00	U	<1.00	U	<1.00	U	<1.00	U	<1.00	U
Vinyl Chloride	<1.00	U	<0.20	U	**3.14**		<0.20	U	<0.20	U	<0.20	U	<0.20	U

NOTE:

Q is the Qualifier Column with definitions as follows:
U=analyte not detected at or above the level indicated
NT=this indicates the analyte was not a target for this sample
J=Estimated
NS=this indicates that no regulatory limit has been established for this analyte

APPENDIX A:

HEALTH AND SAFETY PLAN

HEALTH & SAFETY PLAN

152 Graham Avenue
Block 3062; Lot 2
Brooklyn, New York 11206

Table of Content

Figures

Attachments

1.0 Introduction

The HASP has been prepared in conformance with applicable regulations, safe work practices and the project's requirements. It addresses those activities associated with the installation and sampling of soil probes, monitoring wells, sub-slab/soil vapor probes and the in-field characterization of soil samples. The Project Manager (PM), Site Safety Officer (SSO) and Hydro Tech field staff will implement the Plan during site work. Compliance with this HASP is required of all persons and third parties who perform fieldwork for this project. Assistance in implementing this HASP can be obtained from the Hydro Tech's SSO. The content of this HASP may change or undergo revision based upon additional information that is made available to health and safety personnel, monitoring results or changes in the technical scope of work. Any changes proposed must be reviewed by the SSO.

SCOPE OF WORK

The Scope of Work activities will include the following:

- Installation of soil probes, temporary monitoring wells and a soil vapor sampling point
- Characterization and collection of soil, groundwater, and soil vapor samples

EMERGENCY NUMBERS

Contact	Phone Number
Woodhull Medical Center	718-963-8000
New York City EMS	911
NYPD	911
NYFD	911
National Response Center	800-424-8802
Poison Information Center	800-562-8816
Chemtree	800-424-9555

Project Management/Health and Safety Personnel

Title	Contact	Phone Number	Cell Phone
QEP	Mark E. Robbins	(631) 462-5866	(631) 457-0030
PM/SSO	Dorina Aliu, P.E.	(718) 636-0800	(631) 457-0032
QAO	Anusha Agnoor	(631) 462-5866	(631) 822 -8021

Directions to Woodhull Medical Center *(See Figure 1)*
Upon leaving the Site, head south on Graham Avenue/Avenue of Puerto Rico toward Johnson Avenue. Turn right onto Debevoise Street. Turn right onto Flushing Avenue and turn left to Woodhull Medical Center.

2.0 Health and Safety Staff

This section briefly describes the personnel and their health and safety responsibilities for the:

PROJECT MANAGER (PM)

- Has the overall responsibility for the health and safety of site personnel
- Ensures that adequate resources are provided to the field health and safety staff to carry out their responsibilities as outlined below.
- Ensures that fieldwork is scheduled with adequate personnel and equipment resources to complete the job safely.
- Ensures that adequate telephone communication between field crews and emergency response personnel is maintained.
- Ensures that field site personnel are adequately trained and qualified to work at the Site.

Resumes for Hydro Tech Project Staff involved in this project are provided in the QAPP (Appendix E) of the Supplemental Remedial Investigation Work Pan (Supplemental RIWP).

SITE SAFETY OFFICER (SSO)

- Directs and coordinates health and safety monitoring activities.
- Ensures that field teams utilize proper personal protective equipment (PPE).
- Conducts initial onsite, specific training prior to personnel and/or subcontractors proceeding to work.
- Conducts and documents periodic safety briefings; ensures that field team members comply with this HASP.
- Completes and maintains Accident/Incident Report Forms.
- Notifies Hydro Tech corporate administration of all accidents/incidents.
- Determines upgrade or downgrade of PPE based on site conditions and/or downgrade of PPE based on site conditions and/or real-time monitoring results.
- Ensures that monitoring instruments are calibrated daily or as determined by manufactured suggested instructions.
- Maintains health and safety field log books.

- Develops and ensures implementation of the HASP.
- Approves revised or new safety protocols for field operations.
- Coordinates revisions of this HASP with field personnel and the SSO Division Contracting Officer.
- Responsible for the development of new company safety protocols and procedures and resolution of any outstanding safety issues which may arise during the conduction of site work.
- Reviews personnel and subcontractors current and up-to-date medical examination and acceptability of health and safety training.

FIELD PERSONNEL AND SUBCONTRACTORS (IF ANY)

- Reports any unsafe or potentially hazardous conditions to the SSO.
- Maintains knowledge of the information, instructions and emergency response actions contained in this HASP.
- Comply with rules, regulations and procedures as set forth in this HASP and any revisions that are instituted.
- Prevents admittance to work sites by unauthorized personnel.

3.0 Chemical & Waste Description/Characterization

The following list of chemicals is based on the materials once stored onsite:

- VOCs, SVOCs, TAL metals, and pesticides

Attachment A contains information regarding assessing health risks from contaminants of concern.

The following information references are presented in order to identify the properties and hazards of the materials that may/will be encountered at the Site.

- Dangerous Properties of Industrial Materials - Sax
- Chemical Hazards of the Workplace - Proctor/Hughes
- Condensed Chemical Dictionary – Hawley
- Rapid Guide to Hazardous Chemical in the Workplace - Lewis 1990.
- NIOSH Guide to Chemical Hazards - 1990
- ACGIH TLV Values and Biological Exposure Indices - 1991-1992

5.4 Hazard Assessment

The potential hazards associated with planned site activities include chemical, physical and biological hazards. This section discusses those hazards that are anticipated to be encountered during the activities listed in the scope of work.

The potential to encounter chemical hazards is dependent upon the work activity performed (invasive or non-invasive), the duration and location of the work activity. Such hazards could include inhalation or skin contact with chemicals that could cause: dermatitis, skin burn, being overcome by vapors or asphyxiation. In addition, the handling of contaminated materials and chemicals could result in fire and/or explosion.

The potential to encounter physical hazards during site work includes: heat stress, exposure to excessive noise, loss of limbs, being crushed, head injuries, cuts and bruises and other physical hazards due to motor vehicle operation, heavy equipment and power tools.

CHEMICAL HAZARDS

The potential for personnel and subcontractors to come in contact with chemical hazards may occur during the following tasks:

- Installation of soil probes, monitoring wells and a soil vapor sampling points
- Removal of any contaminated materials during sampling

Exposure Pathways
Exposure to these compounds during ongoing activities may occur through inhalation of contaminated dust particles, inhalation of volatile (VOC) and semi-volatile (SVOC) vapor fume compounds, by way of dermal absorption, and accidental ingestion of the contaminant by either direct or indirect cross contamination activities (eating, smoking, poor hygiene). Indirectly, inhalation of contaminated dust particles (VOCs, SVOCs) can occur during adverse weather conditions (high or changing wind directions) or during operations that may generate airborne dust such as excavation, and sampling activities. Dust control measures such as applying water to roadways and work sites will be implemented, where visible dust is generated from non-contaminated and contaminated soils. Where dust control measures are not feasible or effective, respiratory protection will be used.

Additional Precautions
Dermal absorption or skin contact with chemical compounds is possible during invasive activities at the Site, including removal of product, excavation of tanks, and handling of contaminated soils. The use of PPE in accordance with Section 9.2 and strict adherence to proper decontamination procedures should significantly reduce the risk of skin contact.

The potential for accidental ingestion of potentially hazardous chemicals is expected to be remote, when good hygiene practices are used.

PHYSICAL HAZARDS

A variety of physical hazards may be present during Site activities. These hazards are similar to those associated with any construction type project. These physical hazards are due to motor vehicles, and heavy equipment operation, the use of improper use of power and hand tools, misuse of pressurized cylinders, walking on objects, tripping over objects, working on surfaces which have the potential to promote falling, mishandling and improper storage of solid and hazardous materials, skin burns, crushing of fingers, toes, limbs, hit on the head by falling objects or hit one's head due to not seeing the object of concern, temporary loss of one's hearing and/or eyesight. Theses hazards are not unique and are generally familiarly to most hazardous waste site workers at construction sites. Additional task specific safety requirements will be covered during safety briefings.

Noise

Noise is a potential hazard associated with operation of heavy equipment, power tools, pumps and generators. High noise operators will be evaluated at the discretion of the SSO. Employees with an 8-hour time weighted average exposure exceeding 85 decibels (db) will be included in the hearing conservation program in accordance with 29 CFR 1910.85.

It is mandated that employees working around heavy equipment or using power tools that dispense noise levels exceeding 95 db are to wear hearing protection that shall consist of earplugs and earphones. This is particularly relevant as the jet engines of modern airplanes can give sound level readings of greater than 110 db.

Heat/Cold Stress

Extremes in temperature and the effects of hard work in impervious clothing can result in heat stress and/or hypothermia. The human body is designed to function at a certain internal temperature. When metabolism or external sources (fire, hot summer day, winter weather, etc.) cause the body temperature to rise or fall excessively, the body seeks to protect itself by triggering cooling/warming mechanisms. Profuse sweating is an example of a cooling mechanism, while uncontrollable shivering is an example of a warming mechanism. The SSO monitor the temperature to determine potential adverse affects the weather can cause on site personnel.

Protective clothing worn to guard against chemical contact effectively stops the evaporation of perspiration. Thus the use of protective clothing increases heat stress problems. Cold stress can easily occur in winter with sub-freezing ambient temperatures. Workers in protective garments may heat-up and sweat, only to rapidly cool once out of the tank and the PPE. The major disorders due to heat stress are heat cramps, heat exhaustion and heat stroke.

HEAT CRAMPS are painful spasms that occur in the skeletal muscles of workers who sweat profusely in the heat and drink large quantities of water, but fail to replace the body's lost salts or electrolytes. Drinking water while continuing to lose salt tends to dilute the body's extra cellular fluids. Soon water seeps by osmosis into active muscles and causes pain. Muscles fatigued from work as usually most susceptible to cramps.

HEAT EXHAUSTION is characterized by extreme weakness or fatigue, dizziness, nausea, and headache. In serious cases, a person may vomit or lose consciousness. The skin is clammy and moist, complexion pale or flushed, and body temperature normal or slightly higher than normal. Treatment is rest in a cool place and replacement of body water lost by perspiration. Mild cases may recover spontaneously with this treatment; severe cases may require care for several days. There are no permanent effects.

HEAT STROKE is a very serious condition caused by the breakdown of the body's heat regulating mechanisms. The skin is very dry and hot with red mottled or bluish appearance. Unconsciousness, mental confusion or convulsions may occur. Without quick and adequate treatment, the result can be death or permanent brain damage. Get medial assistance quickly! As first aid treatment, the person should be moved to a cool place. Soaking the person's clothes with water and fanning them should reduce body heat artificially, but not too rapidly.

Steps that can be taken to reduce heat stress are:

- Acclimatize the body. Allow a period of adjustment to make further heat exposure endurable.
- Drink more liquids to replace body water lost during sweating.
- Rest is necessary and should be conducted under the monitoring condition from the SSO and the effect personnel physiological state.

- Wearing personal cooling devices. There are two basic designs; units with pockets for holding frozen packets and units that circulate a cooling fluid from a reservoir through tubes to different parts of the body. Both designs can be in the form of a vest, jacket or coverall. Some circulating units also have a copy for cooling the head.

Cold temperatures can cause problems. The severe effects are FROSTBITE and HYPOTHERMIA.

FROSTBITE is the most common injury resulting from exposure to cold. The extremities of the body are often affected. The signs of frostbite are:

- The skin turns white or grayish-yellow
- Pain is sometimes felt early but subsides later. Often there is no pain
- The affected part feels intensely cold and numb

Shivering, numbness, drowsiness, muscular weakness and a low internal body temperature characterize the condition known as HYPOTHERMIA. This can lead to unconsciousness and death. With both frostbite and hypothermia, the affected areas need to be warmed quickly. Immersing in warm, not hot, water best does this. In such cases medical assistance will be sought.

To prevent these effects from occurring, persons working in the cold should wear adequate clothing and reduce the time spent in the cold area. The field SSO, to determine appropriate time personnel may spend in adverse weather conditions, will monitor this.

Lockout/Tagout

PURPOSE -- This program establishes procedures for de-energizing, isolating and ensuring the energy isolation of equipment and machinery. The program will be used to ensure that equipment and machinery is de-energizing and isolated from unexpected energization by physically locking (Lockout) energy isolation devices or, in the absence of locking capabilities, tagout (Tagout) the device to warn against energization. These procedures will provide the means of achieving the purpose of this program, prevention of injury to Hydro Tech employees from the unexpected energization or start-up of equipment and machinery, or from the release of stored energy.

APPLICATION -- This program applies to the control of energy during the servicing and/or maintenance of equipment and machinery. This program covers normal operations only if a guard or other safety device is removed or bypassed, or any part of the body is placed into an area of the equipment or machinery where work is performed on the material, or a danger zone exists during the operating cycle. Minor tool changes, adjustments, and other minor servicing activities which take place during normal production operations do not require isolation and lockout/tagout if they are routine and integral to the use of the equipment.

SCOPE -- This program will include all employees whose duties require them to service, install, repair, adjust, lubricate, inspect or perform work on powered equipment or machinery that may also have the potential for stored energy.

PROGRAM RESPONSIBILITIES -- The SSO will have the overall responsibility of the program to ensure that; authorized and affected employees receive adequate training and information, the program is evaluated annually, and the lockout/tagout equipment is properly used and the procedures of this program are followed.

The program evaluation will be conducted to ensure that the procedures and requirements of the program are being followed and will be utilized to correct any deviations or inadequacies that may be discovered. The evaluation will consist of one or more inspections or audits of actual lockout/tagout procedures being used to isolate equipment. A review of the authorized and affected employee's responsibilities will be conducted at the time of the inspection /audit. Any authorized employee, except the one(s) utilizing the energy isolation procedure being inspected, may perform the inspection/audit.
A record will be maintained of program evaluation inspections and will include:

1. The identity of the equipment or machine on which energy control procedures were being utilized.
2. The date(s) of the inspection(s).
3. The employee(s) included in the inspection(s).
4. The person performing the inspection.

Authorized employees (persons who implement lockout/tagout procedures) will be responsible for following the procedures established by this program.

Affected employees are responsible for understanding the significance of a lockout/tagout device and the prohibition relating to attempts to restart or re-energize equipment or machinery that is locked out or tagged out.

TRAINING – Where applicable, Hydro Tech employees will be provided instruction in the purpose and functions of the energy control program to ensure that they understand the significance of locked or tagged out equipment and also have the knowledge and skill to correctly apply and remove energy controls. Training will include:

The recognition of applicable hazardous energy source(s), the type and magnitude of energy available, and the policies and procedures of the Hydro Tech energy control program.

1. Affected employees will be made aware of the purpose and use of energy control procedures and the prohibition relating to attempts to remove lockout or tagout devices.
3. Instruction in the limitations of tagout as a sole means of energy control.
   a. Tags are warning devices and <u>do not</u> provide the physical restraint that a lock would.
   b. Tags may provide a false sense of security.
   c. Tags may become detached during use.

Initial training will be provided during to energy control program implementation, when new employees are hired or when job responsibilities change to include utilization of energy control procedures.

Retraining will be conducted whenever there is a change in job assignments that require the employee to utilize energy control procedures, a change in equipment that presents a new hazard, a change in the energy control procedures or when the program evaluation identifies inadequacies in the energy control program procedures.

Records of employee training will be maintained and will include the employee's name and date(s) of training.

STANDARD OPERATING PROCEDURES –where necessary, Hydro Tech will provide the necessary devices to effectively lockout or tagout energy isolating devices. Lockout/tagout devices will be the only devices used for controlling energy and shall not be used for other purposes. Any device used for lockout/tagout will be capable of withstanding the environment to which they are exposed for the maximum period they are to be exposed. The devices will be substantial enough to prevent removal without excessive force. Excessive force for a locking device would be bolt cutters or other metal cuttings tools. Tagout devices will be attached by a non-reusable method, attachable by hand, and very difficult to remove by hand. A nylon cable tie or equivalent will be used.

Lockout/tagout devices will indicate the identity of the employee who applied the device, and the tagout device will warn against the hazards if the equipment is energized.

Lockout is the preferred method of energy isolation. When physical lockout is not possible, the energy isolation will be tagged out of service with a warning tag attached at the power source. In the case of plug-in power source, the tag will be attached at the male plug. To ensure full employee protection using tagout instead of lockout, additional steps should be taken to guard against accidental or inadvertent energization. These steps may include, where applicable: removal of fuses, blocking switches, removal of a valve handle.

STANDARD OPERATING PROCEDURES

I. APPLICATION OF CONTROLS

A. Preparing to Shut Down Equipment

1. Prior to equipment shutdown, the authorized employee(s) must have knowledge of:
    a. The type(s) and magnitude of power.
    b. The hazards of the energy to be controlled.
    c. The method(s) to control the energy.
    d. The location and identity of all isolating devices that control or feed the equipment to be locked/tagged out.
2. Notify all affected employees that the lockout/tagout system will be in effect.
3. Assemble applicable lockout/tagout devices, i.e., padlocks, tags, multiple lock hasps, etc.

B. Equipment Shutdown and Isolation

1. If equipment is in operation, shut it down by the normal stopping procedure (stop button, switch).
2. Operate disconnects, switches, valves, or other energy isolating devices so that the equipment is de-energizing and isolated from its energy source(s).
3. Verify that equipment is shut down by operating equipment from the normal operating location and any remote locations.

C. Installation of Lockout/Tagout Device, Release of Stored Energy, and Verification

1. Attach individually assigned lock(s) or tag(s) to energy isolating device(s). Where it is not possible to lock a switch, valve or other isolating device, electrical fuses must be removed, blank flanges installed in piping, lines disconnected, or other suitable methods used to ensure that equipment is isolated from energy sources. A tag must

be installed at the point of power interruption to warn against energizing.

        a. Each lock or tag must positively identify the person who applied it and locks must be individually keyed.
        b. If more than one person is involved in the task, employees will place their own lock and tag. Multiple lock hasps are available for this.

    2. Release, restrain, or dissipate stored energy such spring tension, elevated machine members, rotating flywheels, hydraulic pressure, pistons and air, gas, steam, water pressure, etc. by repositioning, blocking bleeding, or other suitable means.
    3. Prior to starting work on equipment and after ensuring that no personnel are exposed, the authorized employee will verify that isolation and de-energization have been accomplished by:
        a. Attempting, through normal effort, to operate energy isolating devices such as switches, valves, or circuit breaker with locks or tags installed.
        b. Attempting to operate the equipment or machinery that is locked or tagged out. This includes all sources of energy, i.e. electrical, hydraulic, gravity, air, water, stream pressure, etc.
        c. Verifying the presence and effectiveness of restraint (blocking) and energy dissipation or release (bleeding).
    4. If there is a possibility of the re-accumulation of stored energy to a hazardous level, verification of isolation will be contained until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

D. Group Lockout/Tagout

    1. When more than one individual is involved in locking or tagging equipment out of operation, each individual will attach their individual lock or tag, or the equivalent, to the energy isolating device(s).

        a. An equivalent lockout device may be in the form of a group lockout device such as a multiple lock hasp or lock box.
        b. Primary responsibility for a group of authorized employees working under a group lockout device will be vested in a designated authorized employee.
        c. Group lockout methods will provide a level of protection equal to that afforded by a personal lockout/tagout device.

II. RETURNING EQUIPMENT TO SERVICE

A. Restore Equipment to Normal Operating Status

1. Re-install all parts or subassemblies removed for servicing or maintenance.
2. Re-install all tools, rests, or other operating devices
3. Re-install all guards and protective devices (i.e. limit switches).
4. Remove all blocks, wedges, or other restraints from the operating area of the equipment (ways, slides, etc.).
5. Remove all tools, equipment, and shop towels from the operating area of the equipment.

B. Verify Equipment Ready for Operation

1. Inspect area for non-essential items
2. Ensure that all employees are safely positioned clear of the operating areas of the equipment. Post a watch if energy isolation devices are not in line of sight of the equipment.

C. Notify Affected Employees of Impending Start-up

1. The sudden noise of start-up may startle nearby employees.
2. Equipment may need to be tested to determine operational safety by a qualified operator.

D. Remove Energy Isolation Devices - Only by authorized employee(s) who installed it/them.

1. Remove line blanks, reconnect piping (if applicable), and remove warning tag.
2. Close bleeder valves, remove warning tag.
3. Replace fuse(s), close circuit breaker(s) and remove warning tag.
4. Remove lock and tag from control panel, valve, etc.

Employee(s) who installed them may make an exception for removal of lockout/tagout devices. If it is necessary to operate a piece of equipment that is locked/tagged out, <u>every</u> effort must be made to locate the employee whose lock or tag is on the equipment. If he or she cannot be located and only after positive assurance is made that no one is working on the locked out equipment, the <u>supervisor</u> may personally remove the lock. The supervisor must assure that the equipment is once again locked out, or the employee notified that the equipment has been re-energized, before the employee resumes work. Employees will recheck locked out equipment if they have left the equipment (breaks, lunch, and end of shift) to make sure it is still de-energized and locked out.

III. TEMPORARY REMOVAL OF LOCKOUT/TAGOUT PROTECTION

A. In situations when the equipment must be temporarily energized to test or position the equipment or its components, the following steps will be followed:

1. Clear the equipment of tools and materials that are non-essential to the operation.
2. Ensure the equipment components are operationally intact.
3. Remove employees from the equipment area.
4. Remove the lockout/tagout devices by the employee who installed in/them.
5. Energize and proceed with testing or positioning.
6. De-energize all systems and re-install all energy control measures.
7. Verify re-installed energy control measures are effective.

IV. SHIFT OR PERSONNEL CHANGES

A. The following steps will be followed to ensure continuity of employee protection during personnel changes.

1. All personnel involved in the maintenance or servicing activity will be notified that a transfer of personal locks/tags is about to occur.
2. Clear all personnel from hazardous area(s) of equipment.
3. Under the supervision of the shift supervisor or group designee, the off-going employee will immediately install theirs.
    a. If an entire group or more than one employee will be transferring work responsibility, locks/tags will be removed and replaced one at a time in order of installation.
4. When the transfer of lockout/tagout devices is complete, the effectiveness of all energy isolation devices will be verified to the satisfaction of all personnel involved.
5. Once the effectiveness of energy isolation protection is confirmed, the service/maintenance operation may continue.

V. CONTRACTOR NOTIFICATION

A. Whenever outside personnel may be engaged in activities covered by this program, they will inform the contractor of applicable lockout/tagout procedures used to protect Hydro Tech employees from the hazards of working near energized equipment.

1. The contractor will be expected to ensure that his/her employees understand and comply with the restrictions and prohibitions of this program.
2. Hydro Tech requires, under these circumstances, the contractor to inform us of their lockout/tagout procedures so that HTE employees can comply with the restrictions and prohibitions of the contractor’s program.
3. Hydro Tech also requires the contractor to notify the program

administrator, the area supervisor, and affected Hydro Tech employees prior to de-energizing, isolating and locking out Hydro Tech equipment. Conversely, notification is also required when this equipment will be returned to service.

DEFINITIONS

Affected employee - An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee(s) - A person or persons who locks or implements a tagout system procedure to perform servicing or maintenance on a machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee’s duties also include performing maintenance or service on a machine or equipment that must be locked or tagged out.

“Capable of being locked out” - An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it. Other energy isolating devices will also be considered to be capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.

Energized - Connected to an energy source or containing residual or stored energy.

Energy isolating device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a slide gate; a slip blind; a line valve; a block; and any similar device used to block or isolate energy. The term does not include a push button, selector switch, and other control circuit type devices.

Energy source - any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other type of energy.

Lockout - The placement of lockout device on an energy-isolating device, in accordance with an established procedure, is ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device - A device that utilizes positive means such as a lock, either key or combination type, to hold an energy isolating device in the safety position and prevent the energizing of a machine or equipment.

Normal production operations - The utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance - Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting up - Any work performed to prepare a machine or equipment to perform its normal production operation.

Stored energy - Energy that is available and may cause movement even after energy sources have been isolated. Stored energy may be in the form of compressed springs, elevated equipment components, hydraulic oil pressure, pressurized water, air, steam, or gas, or rotating flywheels, shafts or cams.

Tagout - The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

GENERAL MACHINERY AND EQUIPMENT LIST

EQUIPMENT/LOCATION	ENERGY SOURCES/LOCATION
A. GeoProbe Direct Push Equipment	Diesel Engine

5.5 Training

GENERAL HEALTH AND SAFETY TRAINING

In accordance with Hydro Tech corporate policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. As a minimum, the training shall have consisted of instruction in the topics outlined in the above reference. Personnel who have not met the requirements for initial training will not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

Completion of the Hydro Tech Health and Safety Training Course for Hazardous Waste Operations or an approved equivalent will fulfill the requirements of this section. In addition to the required initial training, each employee shall have received 3 days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.
The Hydro Tech SSO the responsibility of ensuring that personnel assigned to this project complies with these requirements. Written certification of completion of the required training will be provided to the SSO.

MANAGER/SUPERVISOR TRAINING

In accordance with 29 CFR 1910.120, onsite management and supervisors who will be directly responsible for, or who supervise employees engaged in hazardous waste operation shall receive training as required in this HASP and at least eight (8) additional hours of specialized training on managing such operations at the time of job assignment.

ANNUAL 8-HOUR REFRESHER TRAINING

Annual 8-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualification for fieldwork. The following topics will be reviewed: toxicology, respiratory protection, including air purifying devices and self-contained breathing apparatus (SCBA), medical surveillance, decontamination procedures and personnel protective clothing. In addition, topics deemed necessary by the SSO may be added to the above list.

SITE SPECIFIC TRAINING

Prior to commencement of field activities, all personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring and equipment for the site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

ONSITE SAFETY BRIEFINGS

Project personnel and visitors will be given periodic onsite health and safety briefings by the SSO, or their designee, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the Site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

ADDITIONAL TRAINING

Additional training may be required by the SSO for participation in certain field tasks during the course of the project. Such additional training could be in the safe operation of heavy or power tool equipment or hazard communication training.

SUBCONTRACTOR TRAINING

Subcontractor personnel who work onsite, only occasionally, for a specific limited task and who are unlikely to be exposed over permissible exposure limits, may be exempted from the initial 40-hour training requirement. The SSO will determine if this exemption is allowed. In any case, the subcontractor personnel who are exposed to hazards are not exempted from the 40-hours training requirement nor medical surveillance requirements found in Section 8.1.

5.6 Medical Surveillance

GENERAL

All contractor and subcontractor personnel performing field work at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). A physician's medical release for work will be confirmed by the SSO before an employee can begin site activities. Such examinations shall include a statement as to the worker's present health status, the ability to work in a hazardous environment (including any required PPE which may be used during temperature extremes), and the worker's ability to wear respiratory protection.

A medical data sheet will be completed by all onsite personnel and kept at the Site. Where possible, this medical data sheet will accompany the personnel needing medical assistance or transport to hospital facilities.

MEDICAL SURVEILLANCE PROTOCOL
The medical surveillance protocol to be implemented is the occupational physicians' responsibility, but shall meet the requirements of CFR 1910.120 and ANSI Z88.2 (1980). The medical surveillance protocol shall, as a minimum, cover the following:

a. Medical and Occupational History
b. General physical examination (including evaluation of major organ system)
c. Serum lead and ZPP
d. Chest X-ray (performed no more frequently that every four years, except when otherwise indicated).
e. Pulmonary Function Testing (FVC and FEV1.0).
f. Ability to wear respirator
g. Audiometric testing.

Additional clinical tests may be included at the discretion of the occupational physician.

5.7 Site Control, PPE & Communications

SITE CONTROL

A Support Zone (SZ) is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel or materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples. A contamination reduction corridor will be established. This is the route of entry and egress to the Site, and it provides an area for decontamination of personnel and portable equipment as well.

The area where contamination exists is considered to be the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered the EZ. This zone will be clearly delineated by cones, tape or other means. The SSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy
- Appropriate personal protective equipment
- Medical authorization
- Training certification

PERSONAL PROTECTIVE EQUIPMENT

GENERAL

The level of protection worn by field personnel will be enforced by the SSO. Levels of protection for general operations are provided below and are defined in this section. Levels of protection may be upgraded or downgraded at the discretion of the SSO. The decision shall be based on real-time air monitoring, site history data, and prior site experience. Any changes in the level of protection shall be recorded in the health and safety field logbook.

PERSONAL PROTECTIVE EQUIPMENT SPECIFICATIONS

For tasks requiring Level B PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Chemical protective suit (e.g. Saran-coated Tyvek®)
- Gloves, inner (latex)

- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot Covers (as needed)
- Hard Hat
- Hearing protection (as needed)

For tasks requiring Level C PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Disposable outer coveralls (Poly-coated Tyvek)
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot covers (as needed)
- Hard Hat
- Hearing protection (as needed)
- Splash suit and face shield for decontamination operations (as needed)

For tasks requiring Level D PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)
- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring respiratory protection, the following equipment shall be used:

Level D - No respiratory protective equipment necessary except for a dust mask
Level C - A full-face air-purifying respirator equipped with organic vapor/pesticide-HEPA cartridges
Level B - An air line respirator or a self-contained breathing apparatus (SCBA)

INITIAL LEVELS OF PROTECTION
Levels of protection for the activities may be upgraded or downgraded depending on direct-reading instruments or personnel monitoring. The

following are the initial levels of protection that shall be used for each planned field activity.

LEVEL OF PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Activity	**Level of Protection Respiratory/PPE**
Drilling/Coring	C/D
Sampling	C/D
Ground-Penetrating Radar/Magnetometer	C/D

COMMUNICATIONS

Communications is the ability to talk with others. While working in Level C/B Protection, personnel may find that communication becomes a more difficult task and process to accomplish. This is further complicated by distance and space. In order to address this problem, electronic instruments, mechanical devices or hand signals will be used as follows:

- Walkie-Talkies - Hand held radios would be utilized as much as possible by field teams for communication between downrange operations and the Command Post base station.

- Telephones - A mobile telephone will be located in the Command Post vehicle in the Support Zone for communication with emergency support services/facilities. If a telephone is demobilized, the nearest public phones will be identified.

- Air Horns - A member of the downrange field team will carry an air horn and another will be evident in the Support Zone to alert field personnel to an emergency situation.

- Hand Signals - Members of the field team long with use of the buddy system will employ this communication method. Signals become especially important when in the vicinity of heavy moving equipment and when using Level B respiratory equipment. The signals shall become familiar to the entire field team before site operations commence and they will be reinforced and reviewed during site-specific training.

HAND SIGNALS FOR ONSITE COMMUNICATION

Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip partners' wrist	Leave area immediately; no debate
Hands on top of head	Need assistance
Thumbs up	OK, I'm all right; I understand
Thumbs down	No; negative, unable to understand you. I'm not all right

5.8 Air Monitoring Plan

GENERAL

Continuous air monitoring in the EZ during invasive tasks will accompany site operations, as indicated in this HASP or as required by the SSO. Monitoring will be performed to verify the adequacy of respiratory protection, to aid in site layout and to document work exposure. All monitoring instruments shall be operated by qualified personnel only and will be calibrated daily prior to use, or more often as necessary.

REAL-TIME MONITORING

INSTRUMENTATION

At least one (1) of the following monitoring instruments will be available for use during field operations as necessary:

- Photoionization Detector (PID), Rae Instruments with 10.2 EV probe or equivalent

- Flame Ionization Detector (FID), Foxboro Model 128 or equivalent

- Combustible Gas Indicator (CGI)/Oxygen (O_2) Meter, MSA or equivalent.

A FID or PID shall be used to monitor the organic vapor concentrations in active work areas. Organic vapor concentrations shall be measured upwind of the work areas to determine background concentrations. The SSO will interpret monitoring results using professional judgment. The PPE utilized shall always be the most protective, thus the action level criteria are flexible guidelines.

A CGI/O_2 meter shall be used to monitor for combustible gases and oxygen content in the boreholes during drilling activities.

Calibration records shall be documented, and included in the health and safety logbook or instrument calibration logbook. All instruments shall be calibrated before and after each daily use in accordance with the manufacturers' procedures.

ACTION LEVELS

Action levels for upgrading of PPE in this HASP will apply to all site work during the duration of field activities at the Site. Action levels are for unknown contaminants using direct reading in the Breathing Zone (BZ) for organic vapors and dusts, and at the source for combustible gases.

MONITORING DURING FIELD ACTIVITIES

Hydro Tech shall perform real time air monitoring prior to the commencement of work to establish baseline conditions. Baseline conditions will be established at the approximate center of the Site and at the perimeter of the Site both upwind and downwind.

During all work activities real time monitoring will occur. As necessary, Hydro Tech shall have at each applicable workstation a PID, explosimeter and oxygen deficiency meter. The real time monitoring for remedial activities will be conducted approximating the Breathing Zone of the workers. The monitoring will be continuous during working operations.

The air-monitoring instrument may indicate that personnel working in the exclusion zone increase their level of protection. All personnel will be trained in the action levels. When conditions warrant an increase in protection, all personnel will stop working and immediately leave the exclusion zone. They will then don the appropriate safety equipment necessary and return to their current workstation. All of this activity will be monitored by the SSO. The SSO will keep the Hydro Tech Project Manager aware of any extraordinary situations and conditions that may occur. Working conditions and monitoring levels will be noted in the Field Notebook along with the time, date and page number. Verbal reports will be given to the Project Manager when there is a change in the PPE level.

The previous day's results shall be reviewed each morning to determine what actions are necessary and the general conditions resulting from and around the Site.

The record keeping will include:

- Date & Time of Monitoring

- Air Monitoring Location
- Instrument, Model #, Serial #
- Calibration/Background Levels
- Results of Monitoring
- SSO Signature
- Comments

Excavation Operations - Monitoring will be performed continuously during all excavation and demolition operations. A PID and/or FID shall be utilized to monitor the breathing zone, the excavated area and any material taken from the excavation. A CGI/O_2 meter shall be used to monitor the excavation for the presence of combustible gases.

ACTION LEVELS OF AIRBORNE CONTAMINANTS

Instrument	Action Level	Action to be Taken
FID/PID	< 100 ppm, for a 15-minute average	Stop work & initiate vapor control
	> 100 ppm, for a 15-minute average	Stop work & initiate evacuation procedure
CGI	10% LEL	Stop work, initiate ventilating
	50% LEL	Stop work, initiate evacuation procedure and contact fire dept.

PERSONNEL MONITORING PROCEDURE

The Site SSO, concurrent with activities that may generate the contaminants in excess of OSHA PEL's, may perform assessment and evaluation of field personnel exposures to airborne contaminants.

Procedures to be followed include:

The SSO may select high-risk individuals who may be subject to contaminant exposure based on job assignment.
The Personal Sampling is being conducted to determine the proper levels of respiratory protection required, to document potential exposures to compounds,

and to assure compliance with OSHA standards. Therefore, it is important that the data collected be from "worst case" locations and personnel.

For example: when work is being conducted to excavate at an underground tank location, those persons closest to the excavation and most intimately involved with the work should be sampled. If a backhoe operator solely conducted the excavation, then that employee should be monitored. However, if there are additional workers who must enter the excavation and work with the freshly excavated soil, these persons would be closer to the potential contaminants and they should be sampled.

To meet the intent of the sampling will require sampling at periods of the most disturbances. To be accurate in determining potential exposures, as many tasks/trades shall be sampled as possible during the course of this project. At completion of the project, a goal of 20% of all workers who must perform their duties in or around the contaminated soil, tanks and excavations is sought.

Hydro Tech must provide all sampling data in writing to the employees within three (3) days of receipt of results.

Air sampling pumps used to collect employee exposure samples shall be calibrated before and after use each day. Calibration shall be accomplished using a primary standard calibration system, e.g. the bubble tube method. Results of the calibrations shall be included in the health and safety field logbook and with the exposure report.

Chemical analysis of samples collected for assessment of employee exposures shall be performed in accordance with NIOSH or OSHA analytical methods only by laboratories accredited by the American Industrial Hygiene Association.

Results of the personal exposure assessment shall be provided to the individual, in writing within fifteen (15) working days after receipt of laboratory reports. Reports to field personnel shall provide calculated time-weighted average exposures and shall provide comparative information relative to established permissible exposure limits. The air sampling data sheet and laboratory report is considered a part of the employee exposure report. A copy of the employee personal exposure assessment report shall also be included in the project file and the employees' medical record for Hydro Tech employees. Reports for subcontractor employees will be sent directly to the subcontractors' employer.

AIR MONITORING REPORTS

Air Monitoring Reports will be completed by the SSO and/or authorized personnel and submitted to the Project Manager in the daily safety logs and will include the following:

- Date of monitoring
- Equipment utilized for air monitoring
- Real-time air monitoring results from each work location
- Calibration method of equipment and results

5.9 Safety Considerations

GENERAL

In addition to the specific requirements of this HASP, common sense should be used at all times. The general safety rules and practices below will be in effect at the Site at the discretion of the Project Manager, SSO or other authorized personnel.

- The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors but not hinder emergency services if needed.

- As needed, all open holes, trenches and obstacles will be properly barricaded in accordance with local site requirements. These requirements will be determined by proximity to traffic ways, both pedestrian and vehicular, and site of the hole, trench or obstacle. If holes are required to be left open during non-working hours, they will be adequately decked over or barricaded and sufficiently lighted.

- Before any digging or boring operations are conducted, underground utility locations will be identified. All boring, excavation and other site work will be planned and performed with consideration for underground lines. Any excavation work will be performed in accordance with Hydro Tech's Standard Operating Procedures for Excavations.

- Either workers or other people will enact dust-mitigating procedures when there exists the potential for the inhalation of dust particles.

- The act of smoking and ignition sources in the vicinity of potentially flammable or contaminated material is strictly prohibited.

- Drilling, boring, and use of cranes and drilling rigs, erection of towers, movement of vehicles and equipment and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs; canopies; building and other structures and construction; and natural features such as trees, boulders, bodies of water, and terrain.

- When working in areas where flammable vapors may be present, particular care shall be exercised with tools and equipment that may be sources of ignition. All tools and equipment provided must be properly bonded and/or grounded. Metal buttons and zippers are prohibited on safety clothing for areas that may contain a flammable or explosive atmosphere.

- Approved and appropriate safety equipment (as specified in this HASP), such as eye protection, hard hats, foot protection, and respirators, must be worn in areas where required. In addition, eye protection must be worn when sampling soil or water that may be contaminated.

- Beards interfere with respirator fit and are not allowed within the site boundaries because all site personnel may be called upon to use respirator protection is some situations.

- No smoking, eating, chewing tobacco, gum chewing or drinking will be allowed in the contaminated areas.

- Contaminated tools and hands must be kept away from the face.

- Personnel must use personal hygiene safe guards (washing up) at the end of the shift or as soon as possible after leaving the Site.

- Each sample must be treated and handled as though it were contaminated.

- Persons with long hair and/or loose fitting clothing that could become entangled in power equipment must take adequate precautions.

- Horseplay is prohibited in the work area.

- Work while under the influence of intoxicants, narcotics or controlled substances is prohibited.

POSTED SIGNS

Posted danger signs will be used where an immediate hazard exists. Caution signs will be posted to warn against potential hazards and to caution against unsafe practices. Traffic control methods and barricades will be used as needed. Wooden stakes and flagging tape, or equally effective material will be used to demarcate all restricted areas.

Other postings may include the OSHA poster, emergency hospital route and telephone numbers of contact personnel.

INVASIVE OPERATIONS

The SSO will be present onsite during all invasive work (e.g. demolition, excavations). The SSO will ensure that appropriate levels of protection and safety procedures are followed. No personnel will enter any excavations for any reasons. All personnel will stay at least 10 feet back from the edge of the excavation and out of the swing radius of the backhoe. No drums or other potential sources will be sampled or removed during this phase without further additions to the HASP.

The proximity of water, sewer and electrical lines will be identified prior to invasive operations. The possibility of the presence of underground conduits or vessels containing materials under pressure will also be investigated prior to invasive operations. Properly-sized containment systems will be utilized and consideration of the potential volume of liquid or waste released during operations will be discussed with members of the field team to minimize the potential for spills and provide a method for collection of waste materials. Emergency evacuation procedures and the location of safety equipment will be established prior to start up operations. The use of protective clothing, especially hard hats, boots, and gloves will be required during drilling and other heavy equipment work.

SOIL AND GROUNDWATER SAMPLING

Personnel must wear prescribed protective clothing and equipment including eye protection, chemical resistant gloves and splash aprons (where appropriate) when sampling solids and liquids. Sample bottles are to be bagged prior to sampling to ease decontamination. Personnel must be aware of the location of emergency equipment, including spill containment materials prior to sampling. Personnel are to practice contamination avoidance at all times, as well as to utilize the buddy system and maintain communications with the Command Post.

SAMPLE HANDLING

Personnel responsible for the handling of samples will wear the prescribed level of protection. Samples are to be identified as to their hazard and packaged as to prevent spillage or breakage. Any unusual sample conditions shall be noted. Laboratory personnel and all field personnel shall be advised of sample hazard levels and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or including a written statement with the samples reviewing lab safety procedures in handling in order to assure that the practices are appropriate for the suspected contaminants in the sample.

HEAVY EQUIPMENT DECONTAMINATION

Personnel steam cleaning heavy equipment shall use the prescribed level of protection and adhere to the buddy system. Initially this task usually employs level C. The heavy equipment decontamination shall be restricted to authorized personnel only. Special consideration will be given to wind speed and direction. Downwind areas are to be kept free of personnel to avoid unnecessary exposure to potential airborne contamination.

ADDITIONAL SAFETY CONSIDERATIONS

No other additional safety considerations at this time.

5.10 Decontamination and Disposal Procedures

CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include:

<u>Personnel:</u>
Do not walk through areas of obvious or known contamination
Do not directly handle or touch contaminated materials
Make sure that there are no cuts or tears on PPE
Fasten all closures in suits; cover with tape if necessary
Particular care should be taken to prevent any skin injuries
Stay upwind of airborne contaminants
Do not carry cigarettes, cosmetics, gum, etc. into contaminated areas

Sampling and Monitoring:
When required by the SSO, cover instruments with clear plastic, leaving openings for sampling ports and bag sample containers prior to emplacement of sample material.

Heavy Equipment:
Care should be taken to limit the amount of contamination that comes in contact with heavy equipment (tires, contaminated augers). Dust control measures may be needed on roads inside the site boundaries.

PERSONNEL DECONTAMINATION

All personnel shall pass through an outlined decontamination procedure when exiting the hot zone at each location. Field washes for equipment and PPE shall be set up at each drilling location. The system will include a gross wash and rinse for all disposable clothing and boots worn in the EZ. Upon exiting the EZ, all personnel will wash their hands, arms, neck, and face before entering the Support Zone.

EQUIPMENT DECONTAMINATION

Equipment used at the Site that is potentially contaminated shall be decontaminated to prevent hazardous materials from leaving the Site. All heavy equipment will be decontaminated at the decontamination pad and inspected by the SSO and Project Manager before it leaves the Site. The decontamination area will provide for the containment of all wastewater from the decontamination process. Respirators, airline and any other personnel equipment that comes in contact with contaminated soils shall pass through a field wash.

DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or omitted. The Site SSO or designee will accompany contaminated victims to the medical facility to advice on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances and /or medical personnel. Outer garments are then removed at the medical facility.

No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed. Note that heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention and removal of protective clothing immediately; unless the victim is obviously contaminated, decontamination should be omitted or minimized and treatment begun immediately.

DISPOSAL PROCEDURES

A segregating system of non-hazardous waste and hazardous waste will be developed by the SSO and PM. All discarded material, waste materials or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating sanitary hazards, or causing litter to be left on site. All potentially contaminated materials, e.g. clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as normal domestic waste.

5.11 Emergency Plan

The potential for the development of an emergency situation is low considering the low concentrations of hazardous substances at the work site. Nevertheless, an emergency situation could occur. All Hydro Tech and subcontractor field team members prior to the start of work will know the emergency plan outlined in this section. The emergency plan will be available for use at all times during site work.

Various individual site characteristics will determine preliminary actions taken to assure that this emergency plan is successfully implemented in the event of a site emergency. Careful consideration must be given to the proximity of neighborhood housing or places of employment, and to the relative possibility of site fire, explosion or release of vapors or gases that could affect the surrounding community.

The Project Manager shall make contact with local fire, police and other emergency units prior to beginning work on site. In these contacts, the Project Manager will inform the emergency units about the nature and duration of work expected to the Site and the type of contaminants and the possible health or safety effects of emergencies involving these contaminants. At this time, the Project Manager and the emergency response units shall make the necessary arrangements to be prepared for any emergencies that could occur.

The Project Manager shall implement the contingency plan whenever conditions at the Site warrant such action. The Project Manager will be responsible for coordination of the evacuation emergency treatment, and transportation of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

The cases where the PM is not available, the SSO shall serve as the alternate emergency coordinator.

EVACUATION

In the event of an emergency situation, such as fire, explosion, or significant release of toxic gases, an air horn or other appropriate device will be sounded for approximately 10 second intervals indicating the initiation of evacuation procedures. All personnel will evacuate and assemble near the entrance to the site. The location shall be upwind of the Site where possible.
For efficient and safe site evacuation and assessment of the emergency situation, the Project Manager will have authority to initiate action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSO or designated SSO must ensure that access for emergency equipment is provided and that all combustion apparatuses have been shut down once the alarm has been sounded. Once the safety of all personnel is established, the Fire Department and other emergency response groups as necessary will be notified by telephone of the emergency.

POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Immediately evacuate the Site (air horn will sound for 10-second intervals), notify the local fire and police departments, and other appropriate emergency response groups if an actual fire or explosion has taken place.

PERSONNEL INJURY

Emergency first aid shall be applied on site as deemed necessary. If necessary, the individual shall be decontaminated and transported to the nearest medical facility.

The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. However, since some situations may require transport of an injured party by other means, the hospital route is identified below. A map to this facility provided with this HASP in Section 2.2.3.

ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

1. Mark E. Robbins-Cell phone (631) 457-0030
2. The employer of any injured worker if not an Hydro Tech employee

Written confirmation of verbal reports is to be submitted within 24 hours. The report form entitled "Accident Data Report" is to be used for this purpose. All Hydro Tech representatives contacted by telephone are to receive a copy of this report. If the employee involved is not a Hydro Tech employee, his employer shall receive a copy of this report.

For reporting purposes, the term accident refers to fatalities, lost time injuries, spill or exposure to hazardous materials (toxic materials, explosive or flammable materials).
Any information released from the health care provider, which is not deemed confidential patient information, is to be attached to the appropriate form. Any medical information that is released by patient consent is to be filed in the individuals' medical records and treated as confidential.

OVERT PERSONNEL EXPOSURE

SKIN CONTACT:	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination.
INHALATION:	Move personnel to fresh air and if necessary, decontaminate and transport to hospital.
INGESTION:	Decontamination and transport to medical facility.
PUNCTURE WOUND OR LACERATION:	Decontaminate and transport to medical facility.

ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSO or designee will determine if work can continue without sacrificing the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries
- Potential for cold stress and cold-related injuries
- Treacherous weather-related conditions
- Limited visibility
- Potential for electrical storms

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lighting. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

EMERGENCY RESPONSE EQUIPMENT LIST

Some or all of the following will either be available onsite or be able to be brought to the Site within a 2-hour period:
- 55 Gallon Drums
- 85 Gallon Drums
- Absorbent Pads
- Absorbent Booms
- Speedy-Dry
- Plastic Sheeting
- Hay Bales
- Pneumatic Nibbler
- Back Hoe
- Pressure Washer
- Air Compressor
- Wilden Pumps
- Equipment Storage Trailer
- Submersible Pumps
- Miscellaneous Hand Tools
- Portable Lighting

LARGE EQUIPMENT

If necessary, Hydro Tech can have the following large equipment brought to the Site within 2-hours:

- Large Vacuum Truck
- Super Sucker
- Dump Trucks
- Drill Rig
- Utility Vehicle

5.12 Logs, Reports and Record Keeping

MEDICAL AND TRAINING RECORDS

The employer keeps medical and training records. All subcontractors must provide verification of training and medical qualifications to the SSO. The SSO will keep a log of personnel meeting appropriate training and medical qualifications for site work. The log will be kept in the project file. Medical records will be maintained in accordance with 29 CFR 1910.20.

ONSITE LOG

A log of personnel onsite each day will be kept by the SSO or designee. A copy of these logs will be sent to the Hydro Tech records coordinator for data entry. Originals will be kept in the project file.

EXPOSURE RECORDS

Any personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR 1910.20. For Hydro Tech employees, the originals will be sent to the Hydro Tech records coordinator. For subcontractor employees, the original will be sent to the subcontractor employer and a copy kept in the project file.

ACCIDENT/INCIDENT REPORTS

An accident/incident report must be completed for all accidents and incidents. Hydro Tech will send the originals to the appropriate Hydro Tech records coordinator for maintenance. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

OSHA FORM 200

An OSHA Form 200 (Log of Occupational Injuries and Illnesses) will be kept at the Site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the Hydro Tech corporate records administrator for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA 200 form.

The Hydro Tech accident/incident report meets the requirements of the OSHA Form 101 (Supplemental Record) and must be maintained with the OSHA Form 200 for all recordable injuries or illnesses.

HEALTH AND SAFETY FIELD LOG BOOK

The SSO or designee will maintain the logbook in accordance with standard Hydro Tech procedures. Daily site conditions, activities, personnel, calibration records, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

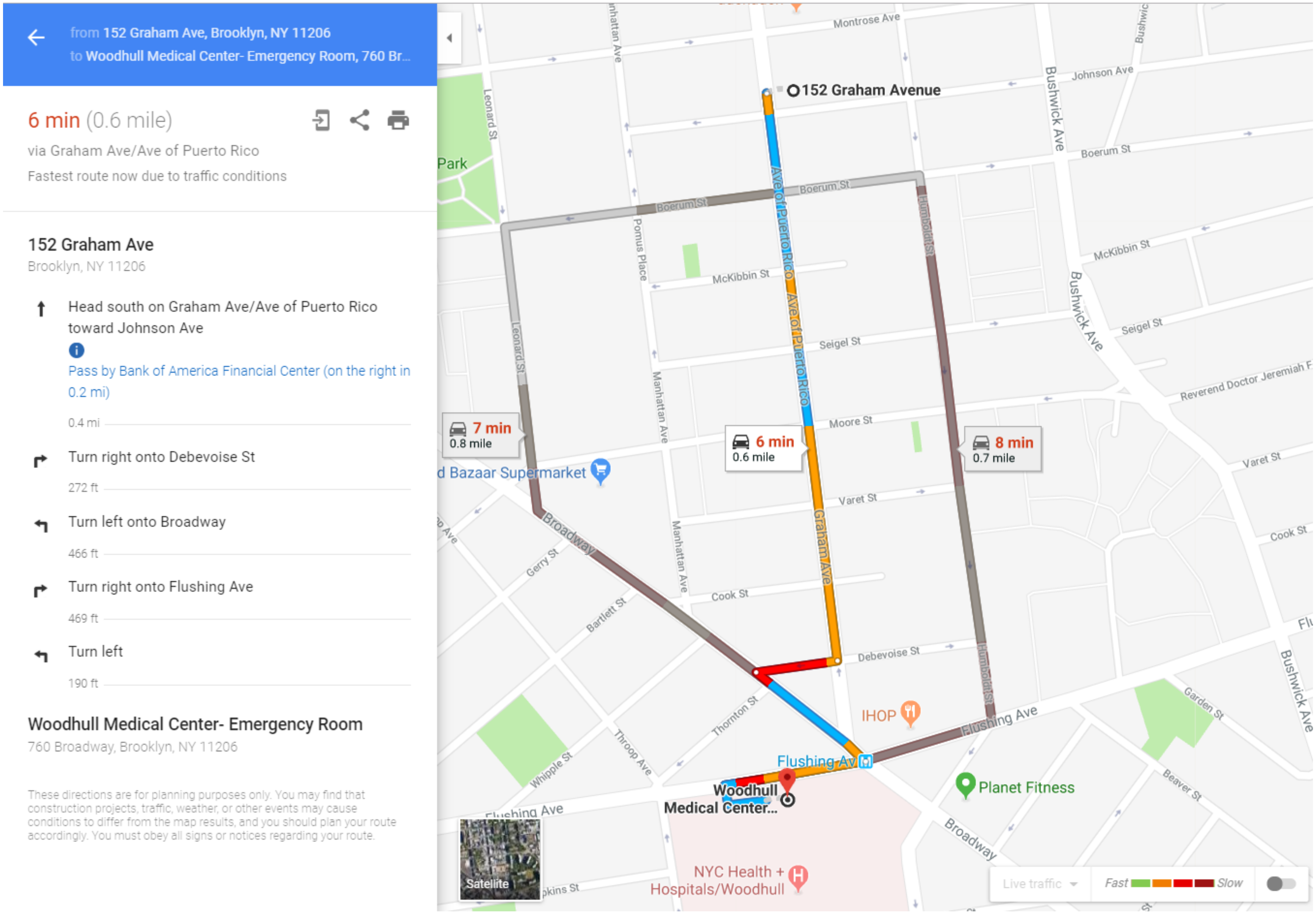
5.13 Sanitation

If sanitary sewers are not provided at the Site, provisions shall be made for access to sanitary systems by using nearby public facilities consistent with provisions of governing local ordinance codes. In the latter case, provisions are required for the removal of accumulated waste products within those units.

If a commercial/industrial laundry is used to clean or launder clothing that is potentially contaminated, they shall be informed of the potential harmful effects of exposure to hazardous substances related to the affected clothing.

Personnel and subcontractors sites shall follow decontamination procedures described in the HASP, or as directed by the SSO. This will generally include at a minimum site-specific training in shower usage and cleanup, personal hygiene requirements and the donning of protective equipment/clothing.

FIGURE 1
DIRECTIONS TO HOSPITAL



from 152 Graham Ave, Brooklyn, NY 11206
to Woodhull Medical Center- Emergency Room, 760 Br...

6 min (0.6 mile)

via Graham Ave/Ave of Puerto Rico

Fastest route now due to traffic conditions

152 Graham Ave

Brooklyn, NY 11206

↑ Head south on Graham Ave/Ave of Puerto Rico toward Johnson Ave

Pass by Bank of America Financial Center (on the right in 0.2 mi)

0.4 mi

↱ Turn right onto Debevoise St

272 ft

↰ Turn left onto Broadway

466 ft

↱ Turn right onto Flushing Ave

469 ft

↰ Turn left

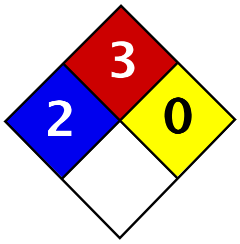
190 ft

Woodhull Medical Center- Emergency Room

760 Broadway, Brooklyn, NY 11206

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

ATTACHMENT A
HEALTH AND SAFETY FACT SHEETS



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
p-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: p-Xylene

Catalog Codes: SLX1120

CAS#: 106-42-3

RTECS: ZE2625000

TSCA: TSCA 8(b) inventory: p-Xylene

CI#: Not applicable.

Synonym: p-Methyltoluene

Chemical Name: 1,4-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{p-}Xylene	106-42-3	100

Toxicological Data on Ingredients: p-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 12400 mg/kg [Rabbit.]. VAPOR (LC50): Acute: 4550 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 138°C (280.4°F)

Melting Point: 12°C (53.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 9 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 12400 mg/kg [Rabbit.].
Acute toxicity of the vapor (LC50): 4550 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: p-Xylene
Florida: p-Xylene
Massachusetts RTK: p-Xylene
New Jersey: p-Xylene
TSCA 8(b) inventory: p-Xylene
SARA 313 toxic chemical notification and release reporting: p-Xylene
CERCLA: Hazardous substances.: p-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R48/20- Harmful: danger of serious

damage to health by prolonged
exposure through inhalation.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

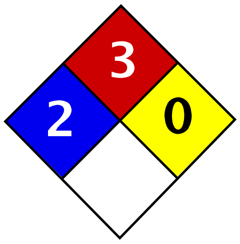
References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

Created: 10/10/2005 08:33 PM

Last Updated: 10/10/2005 08:33 PM



Health	2
Fire	3
Reactivity	0
Personal Protection	J

Material Safety Data Sheet

m-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: m-Xylene

Catalog Codes: SLX1066

CAS#: 108-38-3

RTECS: ZE2275000

TSCA: TSCA 8(b) inventory: m-Xylene

CI#: Not applicable.

Synonym: m-Methyltoluene

Chemical Name: 1,3-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{m-}Xylene	108-38-3	100

Toxicological Data on Ingredients: m-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water.

Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 139.3°C (282.7°F)

Melting Point: -47.87°C (-54.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 6 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: m-Xylene
Massachusetts RTK: m-Xylene
TSCA 8(b) inventory: m-Xylene
SARA 313 toxic chemical notification and release reporting: m-Xylene
CERCLA: Hazardous substances.: m-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

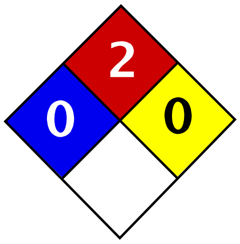
References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

Created: 10/10/2005 08:33 PM

Last Updated: 10/10/2005 08:33 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	0
Fire	2
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Mesitylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Mesitylene

Catalog Codes: SLM2410

CAS#: 108-67-8

RTECS: OX6825000

TSCA: TSCA 8(b) inventory: Mesitylene

CI#: Not available.

Synonym: 1,3,5-Trimethylbenzene

Chemical Formula: C9H12

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Mesitylene	108-67-8	100

Toxicological Data on Ingredients: Mesitylene: VAPOR (LC50): Acute: 4881.9 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (irritant, permeator), .

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes,

keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 559°C (1038.2°F)

Flash Points: CLOSED CUP: 43°C (109.4°F).

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a

concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Avoid contact with eyes Wear suitable protective clothing If ingested, seek medical advice immediately and show the container or the label.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 CEIL: 35 (ppm)
TWA: 125 CEIL: 170 (mg/m3)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 120.2 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 164.7°C (328.5°F)

Melting Point: -44.8°C (-48.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.8637 (Water = 1)

Vapor Pressure: 1.86 mm of Hg (@ 20°C)

Vapor Density: 4.14 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.23 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute toxicity of the vapor (LC50): 4881.9 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation (lung irritant).
Slightly hazardous in case of skin contact (irritant, permeator), .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : 1,3,5-Trimethylbenzene : UN2325 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Florida: Mesitylene
New Jersey: Mesitylene
TSCA 8(b) inventory: Mesitylene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F).

DSCL (EEC):
R10- Flammable.
R36/37- Irritating to eyes and respiratory system.

HMIS (U.S.A.):

Health Hazard: 0

Fire Hazard: 2

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:06 PM

Last Updated: 10/09/2005 06:06 PM

International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

BENZO(B)FLUORANTHENE
Benzo(e)acephenanthrylene
2,3-Benzofluoroanthene
$C_{20}H_{12}$
Molecular mass: 252.3

CAS # 205-99-2
RTECS # CU1400000
ICSC # 0720

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• **EYES**		Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Tightly closed.	Unbreakable packaging; put breakable packaging into closed unbreakable container.

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0720

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS TO YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Melting point: 168°C Solubility in water: none	Vapour pressure, Pa at 20°C: <10 Octanol/water partition coefficient as log Pow: 6.04
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0720 **BENZO(B)FLUORANTHENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

BENZO(K)FLUOROANTHENE
11,12-Benzofluoroanthene
Dibenzo(b,j,k)fluorene
$C_{20}H_{12}$
Molecular mass: 252.3

CAS # 207-08-9
RTECS # DF6350000
ICSC # 0721

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• **EYES**		Safety goggles or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Separated from strong oxidants. Tightly closed.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0721

International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. Reacts with strong oxidants. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: 480°C Melting point: 215.7°C	Solubility in water: none Octanol/water partition coefficient as log Pow: 6.84
ENVIRONMENTAL DATA	This substance may be hazardous to the environment; special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0721 **BENZO(K)FLUORANTHENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

BENZ(a)ANTHRACENE
1,2-Benzoanthracene
Benzo(a)anthracene
2,3-Benzphenanthrene
Naphthanthracene
$C_{18}H_{12}$
Molecular mass: 228.3

CAS # 56-55-3
RTECS # CV9275000
ICSC # 0385
EC # 601-033-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.		Water spray, powder. In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**		Safety goggles, face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Well closed.	T symbol R: 45 S: 53-45

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0385

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** COLOURLESS TO YELLOW-BROWN FLUORESCENT FLAKES OR POWDER. **PHYSICAL DANGERS:** Dust explosion possible if in powder or granular form, mixed with air. **CHEMICAL DANGERS:** **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation, through the skin and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is probably carcinogenic to humans.
PHYSICAL PROPERTIES	Sublimation point: 435°C Melting point: 162°C Relative density (water = 1): 1.274	Solubility in water: none Vapour pressure, Pa at 20°C: 292 Octanol/water partition coefficient as log Pow: 5.61
ENVIRONMENTAL DATA	In the food chain important to humans, bioaccumulation takes place, specifically in seafood.	

NOTES

This substance is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form. Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home. Tetraphene is a common name.

ADDITIONAL INFORMATION

ICSC: 0385 **BENZ(a)ANTHRACENE**

IMPORTANT LEGAL NOTICE:	Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

Material Safety Data Sheet
Benzo[a]pyrene, 98%

ACC# 37175

Section 1 - Chemical Product and Company Identification

MSDS Name: Benzo[a]pyrene, 98%
Catalog Numbers: AC105600000, AC105600010, AC105601000, AC377200000, AC377200010, AC377201000 AC377201000
Synonyms: 3,4-Benzopyrene; 3,4-Benzpyrene; Benzo[def]chrysene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
50-32-8	Benzo[a]pyrene	>96	200-028-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow to brown powder.
Danger! May cause harm to the unborn child. May impair fertility. May cause eye, skin, and respiratory tract irritation. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Cancer hazard. May cause allergic skin reaction. May cause heritable genetic damage.
Target Organs: Reproductive system, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion: May cause irritation of the digestive tract. The toxicological properties of this substance have not been fully investigated. May be harmful if swallowed.
Inhalation: May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated. May be harmful if inhaled.
Chronic: May cause cancer in humans. May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic effects.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or appropriate foam.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs

Benzo[a]pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Benzo[a]pyrene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Powder
Appearance: yellow to brown
Odor: faint aromatic odor
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 495 deg C @ 760 mm Hg
Freezing/Melting Point:175 - 179 deg C
Decomposition Temperature: Not available.
Solubility: 1.60x10-3 mg/l @25°C
Specific Gravity/Density: Not available.
Molecular Formula:C20H12
Molecular Weight:252.31

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 50-32-8: DJ3675000
LD50/LC50:

Not available.

Carcinogenicity:
CAS# 50-32-8:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 7/1/87
- **NTP:** Suspect carcinogen
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.
Mutagenicity: Mutagenic effects have occurred in humans.Mutagenic effects have occurred in experimental animals.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 50-32-8: waste number U022.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	NOT REGULATED FOR DOMESTIC TRANSPORT	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOL (Benzo{a} pyrene)
Hazard Class:		9
UN Number:		UN3077
Packing Group:		III

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 50-32-8 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 50-32-8: 1 lb final RQ; 0.454 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 50-32-8: immediate, delayed.

Section 313

This material contains Benzo[a]pyrene (CAS# 50-32-8, >96%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 50-32-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 50-32-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Benzo[a]pyrene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 50-32-8: 0.06 æg/day NSRL

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T N

Risk Phrases:

R 43 May cause sensitization by skin contact.
R 45 May cause cancer.
R 46 May cause heritable genetic damage.
R 60 May impair fertility.
R 61 May cause harm to the unborn child.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)
CAS# 50-32-8: No information available.

Canada - DSL/NDSL
CAS# 50-32-8 is listed on Canada's DSL List.

Canada - WHMIS
This product has a WHMIS classification of D2A.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List
CAS# 50-32-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #7 Date: 6/30/2006

Material Safety Data Sheet

Chrysene, 98%

ACC# 95251

Section 1 - Chemical Product and Company Identification

MSDS Name: Chrysene, 98%
Catalog Numbers: AC224140000, AC224140010, AC224140050, AC224145000
Synonyms: 1,2-Benzophenanthrene; Benzo(a)phenanthrene; 1,2,5,6-Dibenzonaphthalene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
218-01-9	Chrysene	98	205-923-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: very light beige solid.
Caution! May cause eye and skin irritation. May cause respiratory tract irritation. May cause cancer in humans.
Target Organs: Liver, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: May cause cancer according to animal studies.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air

immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.
Flash Point: Not applicable.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: ; Flammability: 1; Instability:

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Wash hands before eating. Avoid contact with eyes, skin, and clothing. Use only with adequate ventilation. Avoid breathing dust.
Storage: Store in a tightly closed container. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Chrysene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Chrysene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: very light beige
Odor: Not available.
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 448 deg C @ 760 mm Hg
Freezing/Melting Point:250-255 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density: Not available.
Molecular Formula:$C_{18}H_{12}$
Molecular Weight:228.29

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 218-01-9: GC0700000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 218-01-9:

- **ACGIH:** A3 - Confirmed animal carcinogen with unknown relevance to humans

- **California:** carcinogen, initial date 1/1/90
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Chrysene was mutagenic to S. Typhimurium in the presence of an exogenous metabolic system.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Water flea LC50 = 1.9 mg/L; 2 Hr.; Unspecified Fish toxicity : LC50 (96hr) Neauthes arenacedentata >1ppm.(Rossi,S.S. et al Marine Pollut. Bull. 1978) Invertebrate toxicity : lethal treshold concentration (24hr) Daphnia Magna 0,7æg/l.(* Newsted,J.L. et al Environ. Toxicol. Chem. 1987) Bioaccumulation : 24hr Daphnia Magna log bioconcentration factor 3.7845 (*)
Environmental: Degradation studies : biodegradated by white rot fungus (Proc.Annu.Meet.Am.Wood-Preserv.Assoc.1989) May be utilised by axenic cultures of microorganisms e.g. Pseudomonas pancimobilis EPA505, which may have novel degradative systems(Mueller,J.G. et al ppl.Environ.Microbiol.1990; Mueller, J.G. et al Environ.Sci.Technol.1991).
Physical: Not found.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 218-01-9: waste number U050.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 218-01-9 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 218-01-9: 100 lb final RQ; 45.4 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

Section 313

This material contains Chrysene (CAS# 218-01-9, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 218-01-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Chrysene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 218-01-9: 0.35 æg/day NSRL (oral)

European / International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.

S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 218-01-9: No information available.

Canada - DSL/NDSL

CAS# 218-01-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 218-01-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/30/1999
Revision #4 Date: 10/03/2005

Material Safety Data Sheet
Fluoranthene, 98%

ACC# 80991

Section 1 - Chemical Product and Company Identification

MSDS Name: Fluoranthene, 98%
Catalog Numbers: AC119170000, AC119170250, AC119171000, AC119175000
Synonyms: 1,2-(1,8-Naphthalenediyl)benzene; 1,2-(1,8-Naphthylene)benzene; 1,2-Benzacenaphthene; Benzene, 1,2-(1,8-naphthylene)-; Benzo(j,k)fluorene; Benzo(jk)fluoranthene; Benzo(jk)fluorene
Company Identification:
Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
206-44-0	Fluoranthene	98	205-912-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow needles.
Caution! Harmful. Causes eye and skin irritation and possible burns. May be harmful if absorbed through the skin. May be harmful if swallowed. May cause heart and liver injury.
Target Organs: Heart, liver, lungs.

Potential Health Effects

Eye: Causes eye irritation and possible burns.
Skin: May be harmful if absorbed through the skin. Causes severe skin irritation and possible burns.
Ingestion: May be harmful if swallowed. May cause rapid heartbeat and cardiac arrythmias. May cause liver injury, pulmonary edema, and respiratory arrest. May cause gastrointestinal disturbances such as nausea.
Inhalation: May cause effects similar to those described for ingestion. May produce cardiac failure and pulmonary edema.
Chronic: Prolonged or repeated skin contact may cause defatting and dermatitis.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the

upper and lower eyelids. Get medical aid immediately. Do NOT allow victim to rub eyes or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Remove contaminated clothing and shoes.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid immediately. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale. Use only in a chemical fume hood. Do not breathe dust.
Storage: Keep containers tightly closed. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Fluoranthene	none listed	none listed	none listed

OSHA Vacated PELs: Fluoranthene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves and clothing to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Needles
Appearance: yellow
Odor: None reported.
pH: Not available.
Vapor Pressure: 0.01 mm Hg @ 20 deg C
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 384 deg C @ 760.00mmHg
Freezing/Melting Point:107.00 - 110.00 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.252 g/cm3
Molecular Formula:$C_{16}H_{10}$
Molecular Weight:202.25

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide, acrid smoke and fumes.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 206-44-0: LL4025000
LD50/LC50:
CAS# 206-44-0:
Oral, rat: LD50 = 2 gm/kg;

Skin, rabbit: LD50 = 3180 mg/kg;

.

Carcinogenicity:

CAS# 206-44-0: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: IARC Group 3: Limited or insufficient evidence for carcinogenicity in both animals and humans.Experimental tumorigenic data has been reported.

Teratogenicity: No information found

Reproductive Effects: No information found

Mutagenicity: Mutation in microorganisms: Salmonella typhimurium = 5ug/plate.Mutation in mammalian somatic cells: Human Lymphocyte = 2 umol/L.

Neurotoxicity: No information found

Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: 3980 um/L; 96 H; (not specified) No data available.

Environmental: Remains in the upper few cm of soil, but can be transported to groundwater. Biodegrades from soil in a few years. Will not volatilize from soil or water. Rapidly absorbed to sediment and particulates and will readily bioconcentrate. Unadsorbed substance in water will degrade by photolysis in a days to weeks. Stable in sediment for decades or more. In the atmostphere, photodegrades with half life of 4 - 5 days, but may transport long distances without settling or raining out.

Physical: No information available.

Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series:

CAS# 206-44-0: waste number U120.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 206-44-0 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 206-44-0: 100 lb final RQ; 45.4 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 206-44-0: immediate.

Section 313

This material contains Fluoranthene (CAS# 206-44-0, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 206-44-0 is listed as a Priority Pollutant under the Clean Water Act. CAS# 206-44-0 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 206-44-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

XN

Risk Phrases:

R 21/22 Harmful in contact with skin and if swallowed.

Safety Phrases:

S 22 Do not breathe dust.
S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 206-44-0: No information available.

Canada - DSL/NDSL

CAS# 206-44-0 is listed on Canada's NDSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

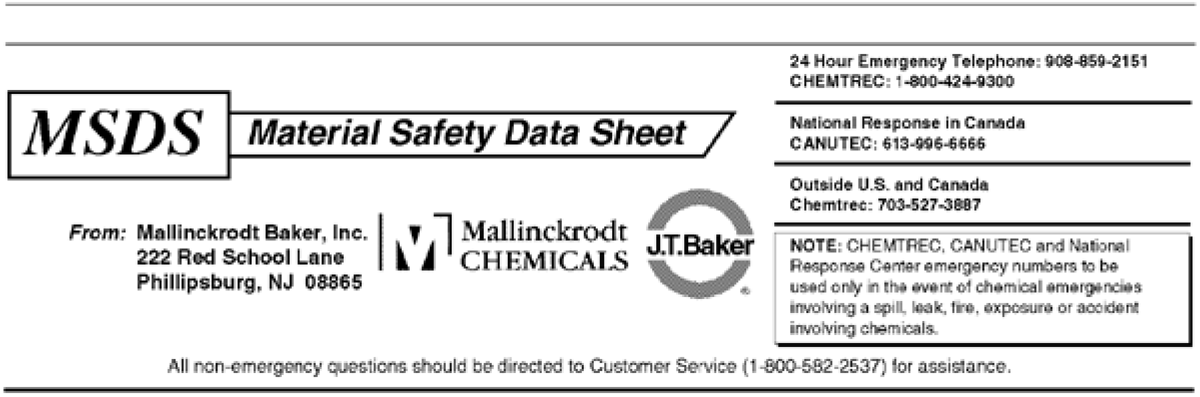
Canadian Ingredient Disclosure List

CAS# 206-44-0 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #5 Date: 10/03/2005

MSDS Number: **L2347** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/02/01***



MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

LEAD METAL

1. Product Identification

Synonyms: Granular lead, pigment metal; C.I. 77575
CAS No.: 7439-92-1
Molecular Weight: 207.19
Chemical Formula: Pb
Product Codes:
J.T. Baker: 2256, 2266
Mallinckrodt: 5668

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Lead	7439-92-1	95 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. NEUROTOXIN. AFFECTS THE GUM TISSUE, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD AND REPRODUCTIVE SYSTEM. POSSIBLE CANCER HAZARD. MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:

Lead can be absorbed through the respiratory system. Local irritation of bronchia and lungs can occur and, in cases of acute exposure, symptoms such as metallic taste, chest and abdominal pain, and increased lead blood levels may follow. See also Ingestion.

Ingestion:

POISON! The symptoms of lead poisoning include abdominal pain and spasms, nausea, vomiting, headache. Acute poisoning can lead to muscle weakness, "lead line" on the gums, metallic taste, definite loss of appetite, insomnia, dizziness, high lead levels in blood and urine with shock, coma and death in extreme cases.

Skin Contact:

Lead and lead compounds may be absorbed through the skin on prolonged exposure; the symptoms of lead poisoning described for ingestion exposure may occur. Contact over short periods may cause local irritation, redness and pain.

Eye Contact:

Absorption can occur through eye tissues but the more common hazards are local irritation or abrasion.

Chronic Exposure:

Lead is a cumulative poison and exposure even to small amounts can raise the body's content to toxic levels. The symptoms of chronic exposure are like those of ingestion poisoning; restlessness, irritability, visual disturbances, hypertension and gray facial color may also be noted.

Aggravation of Pre-existing Conditions:

Persons with pre-existing kidney, nerve or circulatory disorders or with skin or eye problems may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Powder/dust is flammable when heated or exposed to flame.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Can produce toxic lead fumes at elevated temperatures and also react with oxidizing materials.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Areas in which exposure to lead metal or lead compounds may occur should be identified by signs or appropriate means, and access to the area should be limited to authorized persons. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For lead, metal and inorganic dusts and fumes, as Pb:
-OSHA Permissible Exposure Limit (PEL): 0.05 mg/m3 (TWA)
For lead, elemental and inorganic compounds, as Pb:
-ACGIH Threshold Limit Value (TLV): 0.05 mg/m3 (TWA), A3 animal carcinogen
ACGIH Biological Exposure Indices (BEI): 30 ug/100ml, notation B (see actual Indices for more information).
For lead, inorganic:
-NIOSH Recommended Exposure Limit (REL): 0.1 mg/m3 (TWA)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face high efficiency particulate respirator (NIOSH type N100 filter) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece high efficiency particulate respirator (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.
Other Control Measures:
Eating, drinking, and smoking should not be permitted in areas where solids or liquids containing lead compounds are handled, processed, or stored. See OSHA substance-specific standard for more information on personal protective equipment, engineering and work practice controls, medical surveillance, record keeping, and reporting requirements. (29 CFR 1910.1025).

---

9. Physical and Chemical Properties

Appearance:
Small, white to blue-gray metallic shot or granules.
Odor:
Odorless.
Solubility:
Insoluble in water.
Density:
11.34
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1740C (3164F)
Melting Point:
327.5C (622F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
1.77 @ 1000C (1832F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Does not decompose but toxic lead or lead oxide fumes may form at elevated temperatures.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Ammonium nitrate, chlorine trifluoride, hydrogen peroxide, sodium azide, zirconium, disodium acetylide, sodium acetylide and oxidants.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Lead and other smelter emissions are human reproductive hazards. (Chemical Council on

Environmental Quality; Chemical Hazards to Human Reproduction, 1981).
Carcinogenicity:
EPA / IRIS classification: Group B2 - Probable human carcinogen, sufficient animal evidence.

--------\Cancer Lists\--

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Lead (7439-92-1)	No	No	2B

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to leach into groundwater. This material may bioaccumulate to some extent.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Lead (7439-92-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

--Canada--

Ingredient	Korea	DSL	NDSL	Phil.
Lead (7439-92-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Lead (7439-92-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Lead (7439-92-1)	10	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

WARNING:
THIS PRODUCT CONTAINS CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: None allocated.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. NEUROTOXIN. AFFECTS THE GUM TISSUE, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD AND REPRODUCTIVE SYSTEM. POSSIBLE CANCER HAZARD. MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not

breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **M1599** * * * * * *Effective Date:* ***12/19/05*** * * * * * *Supercedes:* ***08/10/04***

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS
J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

MERCURY

1. Product Identification

Synonyms: Quicksilver; hydrargyrum; Liquid Silver
CAS No.: 7439-97-6
Molecular Weight: 200.59
Chemical Formula: Hg
Product Codes:
J.T. Baker: 2564, 2567, 2569
Mallinckrodt: 1278, 1280, 1288

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Mercury	7439-97-6	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE KIDNEYS AND CENTRAL NERVOUS SYSTEM. MAY CAUSE ALLERGIC SKIN REACTION.

SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Life)
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Mercury vapor is highly toxic via this route. Causes severe respiratory tract damage. Symptoms include sore throat, coughing, pain, tightness in chest, breathing difficulties, shortness of breath, headache, muscle weakness, anorexia, gastrointestinal disturbance, ringing in the ear, liver changes, fever, bronchitis and pneumonitis. Can be absorbed through inhalation with symptoms similar to ingestion.

Ingestion:
May cause burning of the mouth and pharynx, abdominal pain, vomiting, corrosive ulceration, bloody diarrhea. May be followed by a rapid and weak pulse, shallow breathing, paleness, exhaustion, tremors and collapse. Delayed death may occur from renal failure. Gastrointenstinal uptake of mercury is less than 5% but its ability to penetrate tissues presents some hazard. Initial symptoms may be thirst, possible abdominal discomfort.

Skin Contact:
Causes irritaton and burns to skin. Symptoms include redness and pain. May cause skin allergy and sensitization. Can be absorbed through the skin with symptoms to parallel ingestion.

Eye Contact:
Causes irritation and burns to eyes. Symptoms include redness, pain, blurred vision; may cause serious and permanent eye damage.

Chronic Exposure:
Chronic exposure through any route can produce central nervous system damage. May cause muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain damage and kidney damage. Can cause skin allergies and accumulate in the body. Repeated skin contact can cause the skin to turn gray in color. A suspected reproductive hazard; may damage the developing fetus and decrease fertility in males and females.

Aggravation of Pre-existing Conditions:
Persons with nervous disorders, or impaired kidney or respiratory function, or a history of allergies or a known sensitization to mercury may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Undergoes hazardous reactions in the presence of heat and sparks or ignition. Smoke may contain toxic mercury or mercuric oxide. Smoke may contain toxic mercury or mercuric oxide.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Clean-up personnel require protective clothing and respiratory protection from vapor.

Spills: Pick up and place in a suitable container for reclamation or disposal in a method that does not generate misting. Sprinkle area with sulfur or calcium polysulfide to suppress mercury. Do not flush to sewer. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker CINNASORB® and RESISORB® are recommended for spills of this product.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Do not use or store on porous work surfaces (wood, unsealed concrete, etc.). Follow strict hygiene practices. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Acceptable Ceiling Concentration:
mercury and mercury compounds: 0.1 mg/m3 (TWA), skin
- ACGIH Threshold Limit Value (TLV):
inorganic and metallic mercury, as Hg: 0.025 mg/m3 (TWA) skin, A4 Not classifiable as a human carcinogen.
- ACGIH Biological Exposure Indices:
total inorganic mercury in urine (preshift): 35 ug/g creatinine;
total inorganic mercury in blood (end of shift): 15 ug/l.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face respirator with a mercury vapor or chlorine gas cartridge may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with a mercury vapor or chlorine gas cartridge may be worn up to 50 times the exposure limit, or the maximum use concentraiton specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Silver-white, heavy, mobile, liquid metal.
Odor:
Odorless.
Solubility:
Insoluble in water.
Density:
13.55
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
356.7C (675F)
Melting Point:
-38.87C (-38F)
Vapor Density (Air=1):
7.0
Vapor Pressure (mm Hg):
0.0018 @ 25C (77F)
Evaporation Rate (BuAc=1):
4

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
At high temperatures, vaporizes to form extremely toxic fumes.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acetylenes, ammonia, ethylene oxide, chlorine dioxide, azides, metal oxides, methyl silane, lithium, rubidium, oxygen, strong oxidants, metal carbonyls.
Conditions to Avoid:
Heat, flames, ignition sources, metal surfaces and incompatibles.

11. Toxicological Information

Toxicological Data:
Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
All forms of mercury can cross the placenta to the fetus, but most of what is known has

been learned from experimental animals. See Chronic Health Hazards.
Carcinogenicity:
EPA / IRIS classification: Group D1 - Not classifiable as a human carcinogen.

```
--------\Cancer Lists\---------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
------------------------------------    -----    -----------    -------------
Mercury (7439-97-6)                      No          No               3
```

12. Ecological Information

Environmental Fate:
This material has an experimentally-determined bioconcentration factor (BCF) of greater than 100. This material is expected to significantly bioaccumulate.
Environmental Toxicity:
This material is expected to be toxic to aquatic life. The LC50/96-hour values for fish are less than 1 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, MERCURY
Hazard Class: 8
UN/NA: UN2809
Packing Group: III
Information reported for product/size: 1LB

International (Water, I.M.O.)

Proper Shipping Name: MERCURY
Hazard Class: 8
UN/NA: UN2809
Packing Group: III
Information reported for product/size: 1LB

International (Air, I.C.A.O.)

Proper Shipping Name: MERCURY
Hazard Class: 8
UN/NA: UN2809
Packing Group: III
Information reported for product/size: 1LB

---

15. Regulatory Information

```
  --------\Chemical Inventory Status - Part 1\---------------------------------
  Ingredient                                       TSCA  EC   Japan  Australia
  -----------------------------------------------  ----  ---  -----  ---------
  Mercury (7439-97-6)                               Yes  Yes   No       Yes

  --------\Chemical Inventory Status - Part 2\---------------------------------
                                                          --Canada--
  Ingredient                                       Korea  DSL   NDSL  Phil.
  -----------------------------------------------  -----  ---   ----  -----
  Mercury (7439-97-6)                               Yes   Yes   No     Yes

  --------\Federal, State & International Regulations - Part 1\----------------
                                             -SARA 302-    ------SARA 313------
  Ingredient                                 RQ    TPQ     List  Chemical Catg.
  -----------------------------------------  ---   -----   ----  --------------
  Mercury (7439-97-6)                        No    No      Yes        No

  --------\Federal, State & International Regulations - Part 2\----------------
                                                        -RCRA-    -TSCA-
  Ingredient                                 CERCLA     261.33     8(d)
  -----------------------------------------  ------     ------    ------
  Mercury (7439-97-6)                        1          U151       No
```

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Pure / Liquid)
```

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: 2Z
Poison Schedule: S7
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE KIDNEYS AND CENTRAL NERVOUS SYSTEM. MAY CAUSE ALLERGIC SKIN REACTION.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 3.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Material Safety Data Sheet

Phenanthrene, 90%

ACC# 59921

Section 1 - Chemical Product and Company Identification

MSDS Name: Phenanthrene, 90%
Catalog Numbers: AC130100000, AC130100010, AC130102500
Synonyms:
Company Identification:
Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
85-01-8	Phenanthrene	90.0	201-581-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: brown solid.
Caution! Powdered material may form explosive dust-air mixtures. May cause allergic skin reaction. May cause eye and skin irritation. May cause respiratory tract irritation. Cancer suspect agent.
Target Organs: None.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May cause photosensitive skin reactions in certain individuals.
Ingestion: May cause irritation of the digestive tract.
Inhalation: Inhalation of dust may cause respiratory tract irritation.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid imme diately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Dusts at sufficient concentrations can form explosive mixtures with air. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray or dry chemical.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 1; Flammability: 1; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation. Do not let this chemical enter the environment.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Keep container closed when not in use. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Phenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Phenanthrene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: brown
Odor: none reported
pH: Not available.
Vapor Pressure: 1 mm Hg @116c
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 340 deg C
Freezing/Melting Point:101 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.0630g/cm3
Molecular Formula:$C_{14}H_{10}$
Molecular Weight:178.23

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, dust generation, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 85-01-8: SF7175000
LD50/LC50:
CAS# 85-01-8:
Oral, mouse: LD50 = 700 mg/kg;
Oral, rat: LD50 = 1.8 gm/kg;
.

Carcinogenicity:
CAS# 85-01-8:

- **ACGIH:** A1 - Confirmed Human Carcinogen (as benzene soluble aerosol) (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Mutagenicity: No data available.
Neurotoxicity: No data available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 85-01-8 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 85-01-8: 5000 lb final RQ; 2270 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 85-01-8: immediate.

Section 313

This material contains Phenanthrene (CAS# 85-01-8, 90.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 85-01-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 85-01-8: No information available.

Canada - DSL/NDSL

CAS# 85-01-8 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

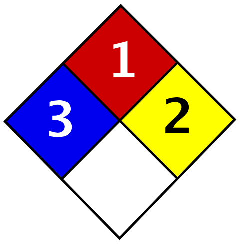
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 85-01-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 7/14/1998
Revision #3 Date: 10/03/2005



Health	3
Fire	1
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Arsenic MSDS

Section 1: Chemical Product and Company Identification

Product Name: Arsenic

Catalog Codes: SLA1006

CAS#: 7440-38-2

RTECS: CG0525000

TSCA: TSCA 8(b) inventory: Arsenic

CI#: Not applicable.

Synonym:

Chemical Name: Arsenic

Chemical Formula: As

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Arsenic	7440-38-2	100

Toxicological Data on Ingredients: Arsenic: ORAL (LD50): Acute: 763 mg/kg [Rat]. 145 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, the nervous system, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat, of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits highly toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not

present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 from ACGIH (TLV) [United States] [1995]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 74.92 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: Sublimation temperature: 615°C (1139°F)

Critical Temperature: Not available.

Specific Gravity: 5.72 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 145 mg/kg [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
Causes damage to the following organs: kidneys, lungs, the nervous system, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Arsenic UNNA: UN1558 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Arsenic
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Arsenic
Pennsylvania RTK: Arsenic
Massachusetts RTK: Arsenic
TSCA 8(b) inventory: Arsenic

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R22- Harmful if swallowed.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References:

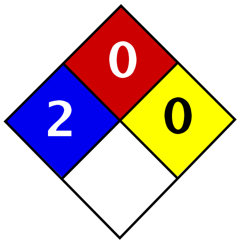
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 04:16 PM

Last Updated: 10/09/2005 04:16 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: QR5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot; Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer).
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to skin.
The substance may be toxic to kidneys, lungs, liver, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion.
Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode.
Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion.
Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 0.5 (mg/m3) [United Kingdom (UK)]
TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Insoluble in Ammonia.
Soluble in dilute Nitric Acid.
Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate + titanium powder + indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
Causes damage to the following organs: skin.
May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:

Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Rat] - Route: Oral; Dose: 5000 mg/kg
LDL [Guinea Pig] - Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Nickel dust and fume can irritate skin.
Eyes: Nickel dust and fume can irritate eyes.
Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis.
Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation).
Chronic Potential Health Effects:
Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis.
Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count).
Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy. Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis.
Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal
Connecticut hazardous material survey.: Nickel metal
Illinois toxic substances disclosure to employee act: Nickel metal
Illinois chemical safety act: Nickel metal
New York release reporting list: Nickel metal
Rhode Island RTK hazardous substances: Nickel metal
Pennsylvania RTK: Nickel metal
Michigan critical material: Nickel metal
Massachusetts RTK: Nickel metal
Massachusetts spill list: Nickel metal
New Jersey: Nickel metal
New Jersey spill list: Nickel metal
Louisiana spill reporting: Nickel metal
California Director's List of Hazardous Substances: Nickel metal
TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R43- May cause sensitization by skin contact.
S22- Do not breathe dust.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:42 PM

Last Updated: 10/10/2005 08:42 PM

U.S. Environmental Protection Agency

Pesticides: Topical & Chemical Fact Sheets

Recent Additions | Contact Us | Print Version Search: GO

EPA Home > Pesticides > About Pesticides > Fact Sheets > Health and Safety > Assessing Health Risks from Pesticides

Health & Safety
Specific Chemicals
Regulatory Actions

Assessing Health Risks from Pesticides

January 1999
735-F-99-002

The Federal Government, in cooperation with the States, carefully regulates pesticides to ensure that they do not pose unreasonable risks to human health or the environment. As part of that effort, the Environmental Protection Agency (EPA) requires extensive test data from pesticide producers that demonstrate pesticide products can be used without posing harm to human health and the environment. EPA scientists and analysts carefully review these data to determine whether to register (license) a pesticide product or a use and whether specific restrictions are necessary. This fact sheet is a brief overview of EPA's process for assessing potential risks to human health when evaluating pesticide products.

Background

There are more than 865 active ingredients registered as pesticides, which are formulated into thousands of pesticide products that are available in the marketplace. About 350 pesticides are used on the foods we eat, and to protect our homes and pets.

EPA plays a critical role in evaluating these chemicals prior to registration, and in reevaluating older pesticides already on the market, to ensure that they can be used with a reasonable certainty of no harm. The process EPA uses for evaluating the health impacts of a pesticide is called risk assessment.

EPA uses the National Research Council's four-step process for human health risk assessment:

Step One: Hazard Identification
Step Two: Dose-Response Assessment
Step Three: Exposure Assessment
Step Four: Risk Characterization

Step One: Hazard Identification (Toxicology)

The first step in the risk assessment process is to identify potential health effects that may occur from different types of pesticide exposure. EPA considers the full spectrum of a pesticide's potential health effects.

Generally, for human health risk assessments, many toxicity studies are conducted on animals by pesticide companies in independent laboratories and evaluated for acceptability by EPA scientists. EPA evaluates pesticides for a wide range of adverse effects, from eye and skin irritation to cancer and birth defects in laboratory animals. EPA may also consult the public literature or other sources of supporting information on any aspect of the chemical.

Step Two: Dose-Response Assessment

Paracelsus, the Swiss physician and alchemist, the “father” of modern toxicology (1493-1541) said,

> "The dose makes the poison."

In other words, **the amount of a substance a person is exposed to** is as important as **how toxic the chemical might be**. For example, small doses of aspirin can be beneficial to people, but at very high doses, this common medicine can be deadly. In some individuals, even at very low doses, aspirin may be deadly.

Dose-response assessment involves considering the dose levels at which adverse effects were observed in test animals, and using these dose levels to calculate an equal dose in humans.

Step Three: Exposure Assessment

People can be exposed to pesticides in three ways:

1. Inhaling pesticides (inhalation exposure),
2. Absorbing pesticides through the skin (dermal exposure), and
3. Getting pesticides in their mouth or digestive tract (oral exposure).

Depending on the situation, pesticides could enter the body by any one or all of these routes. Typical sources of pesticide exposure include:

- **Food**
  Most of the foods we eat have been grown with the use of pesticides. Therefore, pesticide residues may be present inside or on the surfaces of these foods.

- **Home and Personal Use Pesticides**
  You might use pesticides in and around your home to control insects, weeds, mold, mildew, bacteria, lawn and garden pests and to protect your pets from pests such as fleas. Pesticides may also be used as insect repellants which are directly applied to the skin or clothing.

- **Pesticides in Drinking Water**
  Some pesticides that are applied to farmland or other land structures can make their way in small amounts to the ground water or surface water systems that feed drinking water supplies.

- **Worker Exposure to Pesticides**
  Pesticide applicators, vegetable and fruit pickers and others who work around pesticides can be exposed due to the nature of their jobs. To address the unique risks workers face from occupational exposure, EPA evaluates occupational exposure through a separate program. All pesticides registered by EPA have been shown to be safe when used properly.

Step Four: Risk Characterization

Risk characterization is the final step in assessing human health risks from pesticides. It is the process of combining the hazard, dose-response and exposure assessments to describe the overall risk from a pesticide. It explains the assumptions used in assessing exposure as well as the uncertainties that are built into the dose-response assessment. The strength of the overall database is considered, and broad conclusions are made. EPA's role is to evaluate both toxicity and exposure and to determine the risk associated with use of the pesticide.

Simply put,

RISK = TOXICITY x EXPOSURE.

This means that the risk to human health from pesticide exposure depends on both the toxicity of the pesticide and the likelihood of people coming into contact with it. At least *some* exposure and *some* toxicity are required to result in a risk. For example, if the pesticide is very poisonous, but no people are exposed, there is no risk. Likewise, if there is ample exposure but the chemical is non-toxic, there is no risk. However, usually when pesticides are used, there is some toxicity and exposure, which results in a potential risk.

EPA recognizes that effects vary between animals of different species and from person to person. To account for this variability, *uncertainty factors* are built into the risk assessment. These uncertainty factors create an additional margin of safety for protecting people who may be exposed to the pesticides. FQPA requires EPA to use an extra 10-fold safety factor, if necessary, to protect infants and children from effects of the pesticide.

Types of Toxicity Tests EPA Requires for Human Health Risk Assessments

EPA evaluates studies conducted over different periods of time and that measure specific types of effects. These tests are evaluated to screen for potential health effects in infants, children and adults.

Acute Testing: Short-term exposure; a single exposure (dose).

- Oral, dermal (skin), and inhalation exposure
- Eye irritation
- Skin irritation
- Skin sensitization
- Neurotoxicity

Sub-chronic Testing: Intermediate exposure; repeated exposure over a longer period of time (i.e., 30-90 days).

- Oral, dermal (skin), and inhalation
- Neurotoxicity (nerve system damage)

Chronic Toxicity Testing: Long-term exposure; repeated exposure lasting for most of the test animal's life span. Intended to determine the effects of a pesticide after prolonged and repeated exposures.

- Chronic effects (non-cancer)
- Carcinogenicity (cancer)

Developmental and Reproductive Testing: Identify effects in the fetus of an exposed pregnant female (birth defects) and how pesticide exposure affects the ability of a test animal to successfully reproduce.

Mutagenicity Testing: Assess a pesticide's potential to affect the cell's genetic components.

Hormone Disruption: Measure effects for their potential to disrupt the endocrine system. The endocrine system consists of a set of glands and the hormones they produce that help guide the development, growth, reproduction, and behavior of animals including humans.

Risk Management

Once EPA completes the risk assessment process for a pesticide, we use this information to determine if (when used according to label directions), there is a reasonable certainty that the pesticide will not harm a person's health.

Using the conclusions of a risk assessment, EPA can then make a more informed decision regarding whether to approve a pesticide chemical or use, as proposed, or whether additional protective measures are necessary to limit occupational or non-occupational exposure to a pesticide. For example, EPA may prohibit a pesticide from being used on certain crops because consuming too much food treated with the pesticide may result in an unacceptable risk to consumers. Another example of protective measures is requiring workers to wear personal protective equipment (PPE) such as a respirator or chemical resistant gloves, or not allowing workers to enter treated crop fields until a specific period of time has passed.

If, after considering all appropriate risk reduction measures, the pesticide still does not meet EPA's safety standard, the Agency will not allow the proposed chemical or use. Regardless of the specific measures enforced, EPA's primary goal is to ensure that legal uses of the pesticide are protective of human health, especially the health of children, and the environment.

Human Health Risk Assessment and the Law

Federal law requires detailed evaluation of pesticides to protect human health and the environment. In 1996, Congress made significant changes to strengthen pesticide laws through the Food Quality Protection Act (FQPA). Many of these changes are key elements of the current risk assessment process. FQPA required that EPA consider:

- **A New Safety Standard**: FQPA strengthened the safety standard that pesticides must meet before being approved for use. EPA must ensure with a reasonable certainty that no harm will result from the legal uses of the pesticide.
- **Exposure from All Sources**: In evaluating a pesticide, EPA must estimate the combined risk from that pesticide from all non-occupational sources, such as:
  - Food Sources
  - Drinking Water Sources
  - Residential Sources
- **Cumulative Risk**: EPA is required to evaluate pesticides in light of similar toxic effects that different pesticides may share, or "a common mechanism of toxicity." At this time, EPA is developing a methodology for this type of assessment.
- **Special Sensitivity of Children to Pesticides**: EPA must ascertain whether there is an increased susceptibility from exposure to the pesticide to infants and children. EPA must build an additional 10-fold safety factor into risk assessments to ensure the protection of infants and children, unless it is determined that a lesser margin of safety will be safe for infants and children.

For More Information

If you would like more information about EPA's pesticide programs, contact the Communication Service Branch at (703) 305-5017 or visit the Pesticides Web site.

For more information on specific pesticides, or to inquire about the symptoms of pesticide poisoning, call the National Pesticide Information Center (NPIC), a toll-free hotline information at: 1-800-858-7378, or visit their Web site EXIT Disclaimer .

Publications | Glossary | A-Z Index | Jobs

EPA Home | Privacy and Security Notice | Contact Us

Last updated on Tuesday, May 2nd, 2006
URL: http://www.epa.gov/pesticides/factsheets/riskassess.htm

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Search | Index | Home | Glossary | Contact Us

CONTENTS

February 2001

ToxFAQs™
for
Polychlorinated Biphenyls (PCBs)

(Bifenilos Policlorados (BPCs))

This fact sheet answers the most frequently asked health questions about polychlorinated biphenyls (PCBs). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls (PCBs)?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors,

Contact Information

RELATED RESOURCES

ToxFAQ™ 35k

ToxFAQ™ en Español 32k

Public Health Statement 125k

Public Health Statement en Español 321k

Toxicological Profile 13.6MB

A-Z INDEX

A B C
D E
F G H I
J K
L M N O P
Q R S
T U
V W X Y Z

ATSDR RESOURCES

ToxFAQs™

ToxFAQs™ en Español

Public Health Statements

Toxicological Profiles

Minimum Risk Levels

MMGs

MHMIs

Interaction Profiles

Priority List of Hazardous Substances

Division of Toxicology

and old microscope and hydraulic oils.

back to top

What happens to polychlorinated biphenyls (PCBs) when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

back to top

How might I be exposed to polychlorinated biphenyls (PCBs)?

- Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- Breathing air near hazardous waste sites and drinking contaminated well water.
- In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

back to top

How can polychlorinated biphenyls (PCBs) affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

back to top

How likely are polychlorinated biphenyls (PCBs) to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

back to top

How do polychlorinated biphenyls (PCBs) affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

back to top

How can families reduce the risk of exposure to polychlorinated biphenyls (PCBs)?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

back to top

Is there a medical test to show whether I've been exposed to polychlorinated biphenyls (PCBs)?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

back to top

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

back to top

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

back to top

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-888-42-ATSDR (1-888-422-8737)
FAX: (770)-488-4178
Email: ATSDRIC@cdc.gov

back to top

ATSDR Information Center / ATSDRIC@cdc.gov / 1-888-422-8737

This page was updated on January , 2007

ATSDR Home | Search | Index | Glossary | Contact Us
About ATSDR | News Archive | ToxFAQs | HazDat | Public Health Assessments
Privacy Policy | External Links Disclaimer | Accessibility
U.S. Department of Health and Human Services

ATSDR **Department of Health and Human Services**
Agency for Toxic Substances & Disease Registry

2007 CERCLA Priority List of Hazardous Substances

2007 RANK	SUBSTANCE NAME	TOTAL POINTS	2005 RANK	CAS #
1	ARSENIC	1672.58	1	007440-38-2
2	LEAD	1534.07	2	007439-92-1
3	MERCURY	1504.69	3	007439-97-6
4	VINYL CHLORIDE	1387.75	4	000075-01-4
5	POLYCHLORINATED BIPHENYLS	1365.78	5	001336-36-3
6	BENZENE	1355.96	6	000071-43-2
7	CADMIUM	1324.22	8	007440-43-9
8	POLYCYCLIC AROMATIC HYDROCARBONS	1316.98	7	130498-29-2
9	BENZO(A)PYRENE	1312.45	9	000050-32-8
10	BENZO(B)FLUORANTHENE	1266.55	10	000205-99-2
11	CHLOROFORM	1223.03	11	000067-66-3
12	DDT, P,P'-	1193.36	12	000050-29-3
13	AROCLOR 1254	1182.63	13	011097-69-1
14	AROCLOR 1260	1177.77	14	011096-82-5
15	DIBENZO(A,H)ANTHRACENE	1165.88	15	000053-70-3
16	TRICHLOROETHYLENE	1154.73	16	000079-01-6
17	DIELDRIN	1150.91	17	000060-57-1
18	CHROMIUM, HEXAVALENT	1149.98	18	018540-29-9
19	PHOSPHORUS, WHITE	1144.77	19	007723-14-0
20	CHLORDANE	1133.21	21	000057-74-9
21	DDE, P,P'-	1132.49	20	000072-55-9
22	HEXACHLOROBUTADIENE	1129.63	22	000087-68-3
23	COAL TAR CREOSOTE	1124.32	23	008001-58-9
24	ALDRIN	1117.22	25	000309-00-2
25	DDD, P,P'-	1114.83	24	000072-54-8
26	BENZIDINE	1114.24	26	000092-87-5
27	AROCLOR 1248	1112.20	27	012672-29-6
28	CYANIDE	1099.48	28	000057-12-5
29	AROCLOR 1242	1093.14	29	053469-21-9
30	AROCLOR	1091.52	62	012767-79-2
31	TOXAPHENE	1086.65	30	008001-35-2
32	HEXACHLOROCYCLOHEXANE, GAMMA-	1081.63	32	000058-89-9
33	TETRACHLOROETHYLENE	1080.43	31	000127-18-4
34	HEPTACHLOR	1072.67	33	000076-44-8
35	1,2-DIBROMOETHANE	1064.06	34	000106-93-4
36	HEXACHLOROCYCLOHEXANE, BETA-	1060.22	37	000319-85-7
37	ACROLEIN	1059.07	36	000107-02-8
38	DISULFOTON	1058.85	35	000298-04-4
39	BENZO(A)ANTHRACENE	1057.96	38	000056-55-3
40	3,3'-DICHLOROBENZIDINE	1051.61	39	000091-94-1

41	ENDRIN	1048.57	41	000072-20-8
42	BERYLLIUM	1046.12	40	007440-41-7
43	HEXACHLOROCYCLOHEXANE, DELTA-	1038.27	42	000319-86-8
44	1,2-DIBROMO-3-CHLOROPROPANE	1035.55	43	000096-12-8
45	PENTACHLOROPHENOL	1028.01	45	000087-86-5
46	HEPTACHLOR EPOXIDE	1027.12	44	001024-57-3
47	CARBON TETRACHLORIDE	1023.32	46	000056-23-5
48	AROCLOR 1221	1018.41	47	011104-28-2
49	COBALT	1015.57	50	007440-48-4
50	DDT, O,P'-	1014.71	49	000789-02-6
51	AROCLOR 1016	1014.33	48	012674-11-2
52	DI-N-BUTYL PHTHALATE	1007.49	52	000084-74-2
53	NICKEL	1005.40	55	007440-02-0
54	ENDOSULFAN	1004.65	54	000115-29-7
55	ENDOSULFAN SULFATE	1003.56	53	001031-07-8
56	DIAZINON	1002.08	57	000333-41-5
57	ENDOSULFAN, ALPHA	1001.30	58	000959-98-8
58	XYLENES, TOTAL	996.07	59	001330-20-7
59	CIS-CHLORDANE	995.08	51	005103-71-9
60	DIBROMOCHLOROPROPANE	994.87	60	067708-83-2
61	METHOXYCHLOR	994.47	61	000072-43-5
62	BENZO(K)FLUORANTHENE	981.26	63	000207-08-9
63	ENDRIN KETONE	978.99	64	053494-70-5
64	TRANS-CHLORDANE	973.99	56	005103-74-2
65	CHROMIUM(VI) OXIDE	969.58	66	001333-82-0
66	METHANE	959.78	67	000074-82-8
67	ENDOSULFAN, BETA	959.19	65	033213-65-9
68	AROCLOR 1232	955.64	68	011141-16-5
69	ENDRIN ALDEHYDE	954.86	69	007421-93-4
70	BENZOFLUORANTHENE	951.48	70	056832-73-6
71	TOLUENE	947.50	71	000108-88-3
72	2-HEXANONE	942.02	72	000591-78-6
73	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	938.11	73	001746-01-6
74	ZINC	932.89	74	007440-66-6
75	DIMETHYLARSINIC ACID	922.06	75	000075-60-5
76	DI(2-ETHYLHEXYL)PHTHALATE	919.02	76	000117-81-7
77	CHROMIUM	908.52	77	007440-47-3
78	NAPHTHALENE	896.67	78	000091-20-3
79	1,1-DICHLOROETHENE	891.19	79	000075-35-4
80	METHYLENE CHLORIDE	888.96	81	000075-09-2
81	AROCLOR 1240	888.11	80	071328-89-7
82	2,4,6-TRINITROTOLUENE	883.59	82	000118-96-7
83	BROMODICHLOROETHANE	870.00	83	000683-53-4
84	HYDRAZINE	864.41	85	000302-01-2
85	1,2-DICHLOROETHANE	863.99	84	000107-06-2
86	2,4,6-TRICHLOROPHENOL	863.71	86	000088-06-2
87	2,4-DINITROPHENOL	860.45	87	000051-28-5
88	BIS(2-CHLOROETHYL) ETHER	859.88	88	000111-44-4
89	THIOCYANATE	849.21	89	000302-04-5
90	ASBESTOS	841.54	90	001332-21-4
91	CHLORINE	840.37	92	007782-50-5
92	CYCLOTRIMETHYLENETRINITRAMINE (RDX)	840.28	91	000121-82-4
93	HEXACHLOROBENZENE	838.34	93	000118-74-1

94	2,4-DINITROTOLUENE	837.88	96	000121-14-2
95	RADIUM-226	835.93	94	013982-63-3
96	ETHION	834.03	97	000563-12-2
97	1,1,1-TRICHLOROETHANE	833.81	95	000071-55-6
98	URANIUM	833.41	98	007440-61-1
99	ETHYLBENZENE	832.13	99	000100-41-4
100	RADIUM	828.07	100	007440-14-4
101	THORIUM	825.17	101	007440-29-1
102	4,6-DINITRO-O-CRESOL	822.78	102	000534-52-1
103	1,3,5-TRINITROBENZENE	820.17	103	000099-35-4
104	CHLOROBENZENE	819.69	105	000108-90-7
105	RADON	817.89	104	010043-92-2
106	RADIUM-228	816.76	106	015262-20-1
107	THORIUM-230	814.72	107	014269-63-7
107	URANIUM-235	814.72	107	015117-96-1
109	BARIUM	813.46	109	007440-39-3
110	FLUORANTHENE	812.40	113	000206-44-0
111	URANIUM-234	812.11	110	013966-29-5
112	N-NITROSODI-N-PROPYLAMINE	811.05	111	000621-64-7
113	THORIUM-228	810.36	112	014274-82-9
114	RADON-222	809.78	114	014859-67-7
115	HEXACHLOROCYCLOHEXANE, ALPHA-	809.56	116	000319-84-6
116	1,2,3-TRICHLOROBENZENE	808.41	143	000087-61-6
117	MANGANESE	807.90	115	007439-96-5
118	COAL TARS	807.07	117	008007-45-2
119	CHRYSOTILE ASBESTOS	806.68	119	012001-29-5
119	STRONTIUM-90	806.68	119	010098-97-2
121	PLUTONIUM-239	806.67	118	015117-48-3
122	POLONIUM-210	806.39	122	013981-52-7
123	METHYLMERCURY	806.39	121	022967-92-6
124	PLUTONIUM-238	806.01	123	013981-16-3
125	LEAD-210	805.90	124	014255-04-0
126	PLUTONIUM	805.23	125	007440-07-5
127	CHLORPYRIFOS	804.93	125	002921-88-2
128	COPPER	804.86	133	007440-50-8
129	AMERICIUM-241	804.55	128	086954-36-1
130	RADON-220	804.54	127	022481-48-7
131	AMOSITE ASBESTOS	804.07	129	012172-73-5
132	IODINE-131	803.48	130	010043-66-0
133	HYDROGEN CYANIDE	803.08	132	000074-90-8
134	TRIBUTYLTIN	802.61	131	000688-73-3
135	GUTHION	802.32	134	000086-50-0
136	NEPTUNIUM-237	802.13	135	013994-20-2
137	CHRYSENE	802.10	139	000218-01-9
138	CHLORDECONE	801.64	136	000143-50-0
138	IODINE-129	801.64	136	015046-84-1
138	PLUTONIUM-240	801.64	136	014119-33-6
141	S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	797.88	140	000078-48-8
142	BROMINE	789.15	142	007726-95-6
143	POLYBROMINATED BIPHENYLS	789.11	141	067774-32-7
144	DICOFOL	787.56	144	000115-32-2
145	PARATHION	784.14	145	000056-38-2
146	1,1,2,2-TETRACHLOROETHANE	782.15	146	000079-34-5

147	SELENIUM	778.98	147	007782-49-2	
	148	HEXACHLOROCYCLOHEXANE, TECHNICAL GRADE	774.91	148	000608-73-1
149	TRICHLOROFLUOROETHANE	770.74	149	027154-33-2	
150	TRIFLURALIN	770.12	150	001582-09-8	
151	DDD, O,P'-	768.73	151	000053-19-0	
152	4,4'-METHYLENEBIS(2-CHLOROANILINE)	766.66	152	000101-14-4	
153	HEXACHLORODIBENZO-P-DIOXIN	760.42	153	034465-46-8	
154	HEPTACHLORODIBENZO-P-DIOXIN	754.47	154	037871-00-4	
155	PENTACHLOROBENZENE	753.58	155	000608-93-5	
156	1,3-BUTADIENE	747.31	201	000106-99-0	
157	AMMONIA	745.55	156	007664-41-7	
158	2-METHYLNAPHTHALENE	743.24	157	000091-57-6	
159	1,4-DICHLOROBENZENE	737.32	159	000106-46-7	
160	1,1-DICHLOROETHANE	736.23	158	000075-34-3	
161	ACENAPHTHENE	731.25	160	000083-32-9	
162	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	726.14	161	039001-02-0	
163	1,1,2-TRICHLOROETHANE	724.96	162	000079-00-5	
164	TRICHLOROETHANE	723.32	163	025323-89-1	
165	HEXACHLOROCYCLOPENTADIENE	719.01	164	000077-47-4	
166	HEPTACHLORODIBENZOFURAN	718.58	165	038998-75-3	
167	1,2-DIPHENYLHYDRAZINE	713.90	166	000122-66-7	
168	2,3,4,7,8-PENTACHLORODIBENZOFURAN	710.71	167	057117-31-4	
169	TETRACHLOROBIPHENYL	709.21	168	026914-33-0	
170	CRESOL, PARA-	707.83	169	000106-44-5	
171	OXYCHLORDANE	706.32	170	027304-13-8	
172	1,2-DICHLOROBENZENE	704.91	171	000095-50-1	
173	1,2-DICHLOROETHENE, TRANS-	704.04	178	000156-60-5	
174	INDENO(1,2,3-CD)PYRENE	703.30	180	000193-39-5	
175	GAMMA-CHLORDENE	702.59	172	056641-38-4	
176	CARBON DISULFIDE	702.55	174	000075-15-0	
177	TETRACHLOROPHENOL	702.54	173	025167-83-3	
178	AMERICIUM	701.62	175	007440-35-9	
178	URANIUM-233	701.62	175	013968-55-3	
180	PALLADIUM	700.66	177	007440-05-3	
181	HEXACHLORODIBENZOFURAN	700.56	179	055684-94-1	
182	PHENOL	696.96	183	000108-95-2	
183	CHLOROETHANE	693.90	182	000075-00-3	
184	ACETONE	693.31	181	000067-64-1	
185	P-XYLENE	690.20	185	000106-42-3	
186	DIBENZOFURAN	689.19	187	000132-64-9	
187	ALUMINUM	688.13	186	007429-90-5	
188	2,4-DIMETHYLPHENOL	685.76	189	000105-67-9	
189	CARBON MONOXIDE	684.49	188	000630-08-0	
190	TETRACHLOROETHANE	677.97	190	025322-20-7	
191	HYDROGEN SULFIDE	676.51	193	007783-06-4	
192	PENTACHLORODIBENZOFURAN	673.21	192	030402-15-4	
193	CHLOROMETHANE	670.19	191	000074-87-3	
194	BIS(2-METHOXYETHYL) PHTHALATE	666.08	194	034006-76-3	
195	BUTYL BENZYL PHTHALATE	659.38	195	000085-68-7	
196	CRESOL, ORTHO-	658.66	196	000095-48-7	
197	HEXACHLOROETHANE	653.10	199	000067-72-1	
198	VANADIUM	651.70	198	007440-62-2	

199	N-NITROSODIMETHYLAMINE	650.71	200	000062-75-9
200	1,2,4-TRICHLOROBENZENE	647.30	203	000120-82-1
201	BROMOFORM	643.53	202	000075-25-2
202	TETRACHLORODIBENZO-P-DIOXIN	635.74	204	041903-57-5
203	1,3-DICHLOROBENZENE	631.41	205	000541-73-1
204	PENTACHLORODIBENZO-P-DIOXIN	625.12	207	036088-22-9
205	N-NITROSODIPHENYLAMINE	624.79	208	000086-30-6
206	1,2-DICHLOROETHYLENE	622.49	206	000540-59-0
207	2,3,7,8-TETRACHLORODIBENZOFURAN	622.15	210	051207-31-9
208	2-BUTANONE	620.01	209	000078-93-3
209	2,4-DICHLOROPHENOL	616.45	212	000120-83-2
210	1,4-DIOXANE	616.29	215	000123-91-1
211	FLUORINE	613.28	214	007782-41-4
212	NITRITE	612.64	216	014797-65-0
213	CESIUM-137	612.50	217	010045-97-3
214	SILVER	612.19	213	007440-22-4
215	CHROMIUM TRIOXIDE	610.85	218	007738-94-5
216	NITRATE	610.66	219	014797-55-8
217	POTASSIUM-40	608.91	220	013966-00-2
218	DINITROTOLUENE	607.65	221	025321-14-6
219	ANTIMONY	605.37	222	007440-36-0
220	COAL TAR PITCH	605.33	224	065996-93-2
221	THORIUM-227	605.32	223	015623-47-9
222	2,4,5-TRICHLOROPHENOL	604.83	225	000095-95-4
223	ARSENIC ACID	604.45	226	007778-39-4
224	ARSENIC TRIOXIDE	604.36	227	001327-53-3
225	PHORATE	603.10	228	000298-02-2
226	BENZOPYRENE	603.00	230	073467-76-2
227	CRESOLS	602.74	229	001319-77-3
228	CHLORDANE, TECHNICAL	602.62	231	012789-03-6
229	DIMETHOATE	602.61	232	000060-51-5
230	ACTINIUM-227	602.57	233	014952-40-0
230	STROBANE	602.57	233	008001-50-1
232	4-AMINOBIPHENYL	602.51	235	000092-67-1
232	PYRETHRUM	602.51	235	008003-34-7
234	ARSINE	602.42	237	007784-42-1
235	NALED	602.32	238	000300-76-5
236	DIBENZOFURANS, CHLORINATED	602.13	239	042934-53-2
236	ETHOPROP	602.13	239	013194-48-4
238	ALPHA-CHLORDENE	601.94	241	056534-02-2
238	CARBOPHENOTHION	601.94	241	000786-19-6
240	DICHLORVOS	601.64	243	000062-73-7
241	CALCIUM ARSENATE	601.45	244	007778-44-1
241	MERCURIC CHLORIDE	601.45	244	007487-94-7
241	SODIUM ARSENITE	601.45	244	007784-46-5
244	FORMALDEHYDE	599.64	247	000050-00-0
245	2-CHLOROPHENOL	599.62	248	000095-57-8
246	PHENANTHRENE	597.68	249	000085-01-8
247	HYDROGEN FLUORIDE	588.03	250	007664-39-3
248	2,4-D ACID	584.47	251	000094-75-7
249	DIBROMOCHLOROMETHANE	580.59	252	000124-48-1
250	DIURON	579.16	253	000330-54-1
251	BUTYLATE	578.43	254	002008-41-5

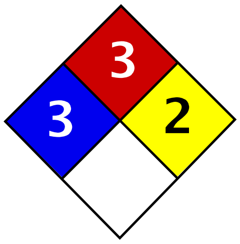
252	DIMETHYL FORMAMIDE	578.23	255	000068-12-2
253	PYRENE	577.95	256	000129-00-0
254	DICHLOROBENZENE	577.70	211	025321-22-6
255	ETHYL ETHER	572.47	257	000060-29-7
256	DICHLOROETHANE	570.46	258	001300-21-6
257	4-NITROPHENOL	567.79	259	000100-02-7
258	1,3-DICHLOROPROPENE, CIS-	561.82	184	010061-01-5
259	PHOSPHINE	559.74	260	007803-51-2
260	TRICHLOROBENZENE	557.96	261	012002-48-1
261	2,6-DINITROTOLUENE	555.20	262	000606-20-2
262	FLUORIDE ION	549.64	263	016984-48-8
263	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	547.90	264	035822-46-9
264	METHYL PARATHION	545.83	265	000298-00-0
265	PENTAERYTHRITOL TETRANITRATE	545.59	266	000078-11-5
266	1,3-DICHLOROPROPENE, TRANS-	543.37	267	010061-02-6
267	BIS(2-ETHYLHEXYL)ADIPATE	540.20	268	000103-23-1
268	CARBAZOLE	534.52	269	000086-74-8
269	METHYL ISOBUTYL KETONE	533.24	271	000108-10-1
270	1,2-DICHLOROETHENE, CIS-	533.15	270	000156-59-2
271	STYRENE	532.70	272	000100-42-5
272	CARBARYL	530.98	273	000063-25-2
273	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	529.45	274	067562-39-4
274	ACRYLONITRILE	528.28	275	000107-13-1
275	1-METHYLNAPHTHALENE	526.51	NEW	

Substances were assigned the same rank when two (or more) substances received equivalent total point scores.

CAS #= Chemical Abstracts Service Registry Number

This page was updated on 01/10/2008

ScienceLab.com
Chemicals & Laboratory Equipment



Health	3
Fire	3
Reactivity	2
Personal Protection	J

Material Safety Data Sheet
Calcium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Calcium

Catalog Codes: SLC2782

CAS#: 7440-70-2

RTECS: EV8040000

TSCA: TSCA 8(b) inventory: Calcium

CI#: Not available.

Synonym:

Chemical Formula: Ca

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Calcium	7440-70-2	100

Toxicological Data on Ingredients: Calcium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Flammable solid that, in contact with water, emits flammable gases.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep under inert atmosphere. Keep container dry. Do not breathe dust. Never add water to this product Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes Keep away from incompatibles such as acids, moisture.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 40.08 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 1484°C (2703.2°F)

Melting Point: 839°C (1542.2°F)

Critical Temperature: Not available.

Specific Gravity: 1.54 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Not available.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with acids.
Reactive with moisture.
The product reacts violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.3: Material that emits flammable gases on contact with water.

Identification: : Calcium : UN1401 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Calcium
Massachusetts RTK: Calcium
TSCA 8(b) inventory: Calcium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-6: Reactive and very flammable material.
CLASS E: Corrosive solid.

DSCL (EEC): R36/38- Irritating to eyes and skin.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 3

Reactivity: 2

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 3

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

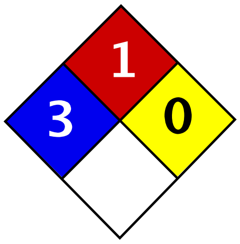
References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 11:30 AM

Last Updated: 11/06/2008 12:00 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	3
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Cadmium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Cadmium

Catalog Codes: SLC3484, SLC5272, SLC2482

CAS#: 7440-43-9

RTECS: EU9800000

TSCA: TSCA 8(b) inventory: Cadmium

CI#: Not applicable.

Synonym:

Chemical Name: Cadmium

Chemical Formula: Cd

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Cadmium	7440-43-9	100

Toxicological Data on Ingredients: Cadmium: ORAL (LD50): Acute: 2330 mg/kg [Rat.]. 890 mg/kg [Mouse]. DUST (LC50): Acute: 50 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant). Severe over-exposure can result in death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2 (Reasonably anticipated.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, liver.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact: No known effect on eye contact, rinse with water for a few minutes.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 570°C (1058°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Non-flammable in presence of open flames and sparks, of heat, of oxidizing materials, of reducing materials, of combustible materials, of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 (ppm)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 112.4 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 765°C (1409°F)

Melting Point: 320.9°C (609.6°F)

Critical Temperature: Not available.

Specific Gravity: 8.64 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity: Reacts violently with potassium.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 890 mg/kg [Mouse].
Acute toxicity of the dust (LC50): 229.9 mg/m3 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2 (Reasonably anticipated.) by NTP.
The substance is toxic to kidneys, lungs, liver.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: An allergen. 0047 Animal: embryotoxic, passes through the placental barrier.

Special Remarks on other Toxic Effects on Humans: May cause allergic reactions, exzema and/or dehydration of the skin.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification:

Identification:

Special Provisions for Transport:

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Cadmium
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Cadmium
Pennsylvania RTK: Cadmium
Massachusetts RTK: Cadmium
TSCA 8(b) inventory: Cadmium
SARA 313 toxic chemical notification and release reporting: Cadmium
CERCLA: Hazardous substances.: Cadmium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R26- Very toxic by inhalation.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

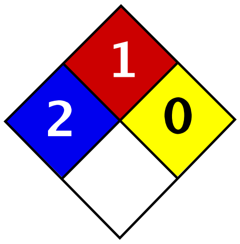
References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 04:29 PM

Last Updated: 11/06/2008 12:00 PM



Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Copper MSDS

Section 1: Chemical Product and Company Identification

Product Name: Copper

Catalog Codes: SLC4939, SLC2152, SLC3943, SLC1150, SLC2941, SLC4729, SLC1936, SLC3727, SLC5515

CAS#: 7440-50-8

RTECS: GL5325000

TSCA: TSCA 8(b) inventory: Copper

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: Cu

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Copper	7440-50-8	100

Toxicological Data on Ingredients: Copper LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH [1990]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 63.54 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 2595°C (4703°F)

Melting Point: 1083°C (1981.4°F)

Critical Temperature: Not available.

Specific Gravity: 8.94 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion.
Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Human: passes through the placenta, excreted in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Copper
Massachusetts RTK: Copper
TSCA 8(b) inventory: Copper
CERCLA: Hazardous substances.: Copper

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent. Wear appropriate respirator

when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

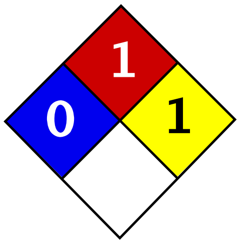
References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 04:58 PM

Last Updated: 11/06/2008 12:00 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	1
Fire	3
Reactivity	2
Personal Protection	E

Material Safety Data Sheet

Magnesium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Magnesium

Catalog Codes: SLM4408, SLM2263, SLM3637

CAS#: 7439-95-4

RTECS: OM2100000

TSCA: TSCA 8(b) inventory: Magnesium

CI#: Not applicable.

Synonym: Magnesium ribbons, turnings or sticks

Chemical Name: Magnesium

Chemical Formula: Mg

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Magnesium	7439-95-4	100

Toxicological Data on Ingredients: Magnesium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at

least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat.
Flammable in presence of acids, of moisture.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Explosive in presence of acids, of moisture.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Magnesium turnings, chips or granules, ribbons, are flammable. They can be easily ignited. They may reignite after fire is extinguished. Produces flammable gases on contact with water and acid. May ignite on contact with water or moist air.
Magnesium fires do not flare up violently unless moisture is present.

Special Remarks on Explosion Hazards: Reacts with acids and water to form hydrogen gas with is highly flammable and eplosive

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid.
Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage:
Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Moisture sensitive. Dangerous when wet.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 24.31 g/mole

Color: Silver-white

pH (1% soln/water): Not applicable.

Boiling Point: 1100°C (2012°F)

Melting Point: 651°C (1203.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.74 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Very slightly soluble in hot water.
Insoluble in cold water.
Insoluble in chromium trioxides, and mineral acids, alkalies.
Slightly soluble with decomposition in hot water.
Soluble in concentrated hydrogen fluoride, and ammonium salts.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, incompatible materials, water or moisture, moist air.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent chemical reaction with oxidizing agents.
Reacts with water to create hydrogen gas and heat. Must be kept dry.
Reacts with acids to form hydrogen gas which is highly flammable and explosive.
Magnesium forms hazardous or explosive mixtures with aluminum and potassium perchlorate; ammonium nitrate; barium nitrate, barium dioxide and zinc; beryllium oxide; boron phosphodiiodide; bromobenzyl trifluoride; cadmium cyanide; cadmium oxide; calcium carbide; carbonates; carbon tetrachloride; chlorine; chlorine trifluoride; chloroform; cobalt cyanide; copper cyanide; copper sulfate(anhydrous), ammonium nitrate, potassium chlorate and water; cupric oxide; cupric sulfate; fluorine; gold cyanide; hydrogen and calcium carbonate; hydrogen iodide; hydrogen peroxide; iodine; lead cyanide; mercuric oxide; mercury cyanide; methyl chloride; molybdenum trioxide; nickel cyanide; nitric acid; nitrogen dioxide; oxygen (liquid); performic acid; phosphates; potassium chlorate; potassium perchlorate; silver nitrate; silver oxide; sodium perchlorate; sodium peroxide; sodium peroxide and carbon dioxide; stannic oxide; sulfates; trichloroethylene; zinc cyanide; zinc oxide.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation by mechanical action. May get mechanical injury or embedding of chips/particles in skin. The particles that are embedded in the wounds may retard healing.
Eyes: May cause eye irritation by mechanical action. Mechanical injury may occur. Particles or chips may embed in eye and retard healing.
Inhalation: Low hazard for ususal industrial handling. It may cause respiratory tract irritation. However, it is unlikely due to physical form. When Magnesium metal is heated during welding or smelting process, Metal Fume Fever may result from inhalation of magnesium fumes. Metal Fume Fever is a flu-like condition consisting of fever, chills, sweating, aches, pains, cough, weakness, headache, nausea, vomiting, and breathing difficulty. Other symptoms may include metallic taste, increased white blood cell count. There is no permanent ill-effect.
Ingestion: Low hazard for usual industrial handling. There are no known reports of serious industrial poisonings with Magnesium. Ingeston of large amounts of chips, turnings or ribbons may cause gastrointestinal tract irritation with nausea, vomiting, and diarrhea. Acute ingestion may also result in Hypermagnesia.
Hypermagnesia may cause hypotension, bradycardia, CNS depression, respiratory depression, and impairment of neuromuscular transmission (hyporeflexia, paralysis).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Magnesium UNNA: 1869 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Magnesium
Rhode Island RTK hazardous substances: Magnesium
Pennsylvania RTK: Magnesium

Massachusetts RTK: Magnesium
Massachusetts spill list: Magnesium
New Jersey: Magnesium
TSCA 8(b) inventory: Magnesium

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid.
CLASS B-6: Reactive and very flammable material.

DSCL (EEC):
R11- Highly flammable.
R15- Contact with water liberates extremely flammable gases.
S7/8- Keep container tightly closed and dry.
S43- In case of fire, use dry chemical. Never use water.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 3

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

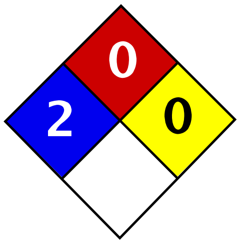
Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 06:00 PM

Last Updated: 11/06/2008 12:00 PM



Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: QR5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot; Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer).
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to skin.
The substance may be toxic to kidneys, lungs, liver, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion.
Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode.
Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion.
Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 0.5 (mg/m3) [United Kingdom (UK)]
TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Insoluble in Ammonia.
Soluble in dilute Nitric Acid.
Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate + titanium powder + indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
Causes damage to the following organs: skin.
May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:

Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Rat] - Route: Oral; Dose: 5000 mg/kg
LDL [Guinea Pig] - Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Nickel dust and fume can irritate skin.
Eyes: Nickel dust and fume can irritate eyes.
Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis.
Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation).
Chronic Potential Health Effects:
Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis.
Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count).
Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy. Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis.
Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal
Connecticut hazardous material survey.: Nickel metal
Illinois toxic substances disclosure to employee act: Nickel metal
Illinois chemical safety act: Nickel metal
New York release reporting list: Nickel metal
Rhode Island RTK hazardous substances: Nickel metal
Pennsylvania RTK: Nickel metal
Michigan critical material: Nickel metal
Massachusetts RTK: Nickel metal
Massachusetts spill list: Nickel metal
New Jersey: Nickel metal
New Jersey spill list: Nickel metal
Louisiana spill reporting: Nickel metal
California Director's List of Hazardous Substances: Nickel metal
TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R43- May cause sensitization by skin contact.
S22- Do not breathe dust.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

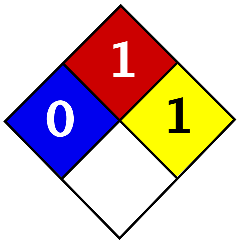
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:42 PM

Last Updated: 11/06/2008 12:00 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	1
Fire	1
Reactivity	1
Personal Protection	E

Material Safety Data Sheet

Zinc Metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc Metal

Catalog Codes: SLZ1054, SLZ1159, SLZ1267, SLZ1099, SLZ1204

CAS#: 7440-66-6

RTECS: ZG8600000

TSCA: TSCA 8(b) inventory: Zinc Metal

CI#: Not applicable.

Synonym: Zinc Metal Sheets; Zinc Metal Shot; Zinc Metal Strips

Chemical Name: Zinc Metal

Chemical Formula: Zn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc Metal	7440-66-6	100

Toxicological Data on Ingredients: Zinc Metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat, of oxidizing materials, of acids, of alkalis, of moisture.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Zinc + NaOH causes ignition.
Oxidation of zinc by potassium proceeds with incandescence.
Residues from zinc dust /acetic acid reduction operations may ignite after long delay if discarded into waste bins with paper.
Incandescent reaction when Zinc and Arsenic or Tellurium, or Selenium are combined.
When hydrazine mononitrate is heated in contact with zinc, a flamming decomposition occurs at temperatures a little above its melting point.
Contact with acids and alkali hydroxides (sodium hydroxide, postasium hydroxide, calcium hydroxide, etc.) results in evolution of hydrogen with sufficient heat of reaction to ignite the hydrogen gas.
Zinc foil ignites if traces of moisture are present.
It is water reactive and produces flammable gases on contact with water. It may ignite on contact with water or

moist air.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Flammable solid that, in contact with water, emits flammable gases.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, alkalis, moisture.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Keep from any possible contact with water. Do not allow water to get into container because of violent reaction.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid. Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 65.39 g/mole

Color: Bluish-grey

pH (1% soln/water): Not applicable.

Boiling Point: 907°C (1664.6°F)

Melting Point: 419°C (786.2°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, moisture

Incompatibility with various substances:
Reactive with oxidizing agents, acids, alkalis.
Slightly reactive to reactive with moisture.
The product may react violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with acids, halogenated hydrocarbons, NH_4NO_3, barium oxide, $Ba(NO_3)_2$, Cadmium, CS_2, chlorates, Cl_2, CrO_3, F_2, Hydroxylamine, $Pb(N_3)_2$, $MnCl_2$, HNO_3, performic acid, $KClO_3$, KNO_3, N_2O_2, Selenium, $NaClO_3$, Na_2O_2, Sulfur, Te, water, $(NH_4)_2S$, As_2O_3, CS_2, $CaCl_2$, chlorinated rubber, catalytic metals, halocarbons, o-nitroanisole, nitrobenzene, nonmetals, oxidants, paint primer base, pentacarbonoyliron, transition metal halides, seleninyl bromide, HCl, H_2SO_4, (Mg +$Ba(NO_3)_2$ +BaO_2), (ethyl acetoacetate +tribromoneopentyl alcohol.
Contact with Alkali Hydroxides(Sodium Hydroxide, Potassium Hydroxide, Calcium Hydroxide, etc) results in evolution of hydrogen.
Ammonium nitrate + zinc + water causes a violent reaction with evolution of steam and zinc oxide.
May react with water.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation. Dermal exposure to zinc may produce leg pains, fatigue, anorexia and weight loss.
Eyes: May cause eye irritation.
Ingestion: May be harmul if swallowed. May cause digestive tract irritation with tightness in throat, nausea, vomiting, diarrhea, loss of appetite, malaise, abdominal pain. fever, and chills. May affect behavior/central nervous system and autonomic nervous system with ataxia, lethargy, staggering gait, mild derrangement in cerebellar function, lightheadness, dizzness, irritability, muscular stiffness, and pain. May also affect blood.
Inhalation: Inhalation of zinc dust or fumes may cause respiratory tract and mucous membrane irritation with cough and chest pain. It can also cause "metal fume fever", a flu-like condition characterized appearance of chills, headached fever, maliase, fatigue, sweating, extreme thirst, aches in the legs and chest, and difficulty in breathing. A sweet taste may also be be present in metal fume fever, as well as a dry throat, aches, nausea, and vomiting, and pale grey cyanosis.
The toxicological properties of this substance have not been fully investisgated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

New York release reporting list: Zinc Metal
Rhode Island RTK hazardous substances: Zinc Metal
Pennsylvania RTK: Zinc Metal
Florida: Zinc Metal
Michigan critical material: Zinc Metal
Massachusetts RTK: Zinc Metal
New Jersey: Zinc Metal
California Director's List of Hazardous Substances: Zinc Metal
TSCA 8(b) inventory: Zinc Metal
TSCA 12(b) one time export: Zinc Metal
SARA 313 toxic chemical notification and release reporting: Zinc Metal
CERCLA: Hazardous substances.: Zinc Metal: 1000 lbs. (453.6 kg)

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not Available

DSCL (EEC):
R15- Contact with water liberates
extremely flammable gases.
R17- Spontaneously flammable in air.
S7/8- Keep container tightly closed and dry.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 12:18 AM

Last Updated: 11/06/2008 12:00 PM

Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

Home > CABS > Lead

ToxFAQs™: Chemical Agent Briefing Sheets (CABS)

Email this page
Printer-friendly version

Lead

January 2006

PDF Version

What is lead?

Lead is a heavy, bluish-gray metal that has a low melting point. It occurs naturally in the Earth' s crust, but it is not a particularly abundant element. It is rarely found naturally as a metal, but rather in its divalent (2+) oxidative state in ore deposits widely distributed throughout the world. The most important lead containing ores are galena (PbS), anglesite ($PbSO_4$), and cerussite ($PbCO_3$). Natural lead is a mixture of four stable isotopes: ^{208}Pb (51%–53%), ^{206}Pb (23.5%–27%), ^{207}Pb (20.5%–23%), and ^{204}Pb (1.35%–1.5%).

What are the forms of lead?

- Metallic lead
- Inorganic lead and lead compounds (or lead salts)
- Organic lead (containing carbon)

What are the common uses of lead?

The largest use for lead is in storage batteries in cars and other vehicles. Lead may be used as a pure metal, alloyed with other metals, or as chemical compounds.

Lead used by industry comes from mined ores ("primary") or from recycled scrap metal or batteries ("secondary"). However, most lead today is obtained from recovery of recycled scrap, mostly lead-acid batteries.

Human activities, such as lead mining and smelting operations and manufacturing and use of lead products (*e.g.*, leaded gasoline, lead-based paint), have resulted in the contamination of many industrial and residential areas with lead.

Form	Uses
Metallic lead **Lead and lead compounds (or lead salts), such as** • **lead acetate** • **lead chloride** • **lead nitrate** • **lead oxide** • **lead phosphate** • **lead acetate**	Certain uses of lead, such as leaded gasoline, lead-based paints for domestic use, lead-based solder in food cans and water pipes, lead sinkers, and ammunition, have been reduced or banned to minimize lead's harmful effects on people and animals. • **Cosmetics and hair dye** - Some hair dyes and some non-Western cosmetics, such as kohl and surma, contain lead. • **Fishing equipment** - Most fishing weights and sinkers are made from lead. • **Folk remedies** - Many non-Western folk remedies used to treat diarrhea or other ailments may contain substantial amounts of lead. Examples of these include alarcon, ghasard, alkohl, greta, azarcon,

lead sulfate **lead sulfide**	liga, bali goli, pay-loo-ah, coral, and rueda. **Glazing** - Applied to some ceramicware can contain lead. **Lead based paint** - Although the sale of residential lead-based paint was banned in the United States in 1978, it remains a major source of lead exposure for young children residing in older houses. **Lead batteries** - Production of lead-acid batteries is the major use of lead. **Lead-based solder** - Has been banned for use in water distribution systems, but many buildings and homes contain lead pipes or lead-based solder. Lead-based solder also is used for electrical circuitry applications. **Lead-shot** and **ammunition** - It is the second highest production use of lead. Other uses of lead include the production of lead alloys, soldering materials, shielding for x-ray machines, and manufacturing of corrosion- and acid-resistant materials used in the building industry.
Organic **tetraethyl lead** **tetramethyl lead**	The use of lead in gasoline was phased out in the 1980s, and has been banned since January 1, 1996. The use of lead in gasoline has contributed to its dispersion throughout the environment. During the combustion of gasoline containing these alkyllead compounds, significant amounts of inorganic lead can be released to the surrounding areas. **Current Uses** Gasoline for off-road vehicles, farm equipment, and airplanes **Past Uses** Gasoline additives (to increase octane rating)

What are the routes of exposure for lead?

People are most likely to be exposed to lead by consuming contaminated food and drinking water. Exposure can also occur by inadvertently ingesting contaminated soil, dust, or lead-based paint.

Form	Routes of Exposure
Metallic lead **Lead and lead compounds (or lead salts), such as** **lead acetate** **lead chloride** **lead nitrate** **lead oxide** **lead phosphate** **lead subacetate** **lead sulfate** **lead sulfide**	Ingestion is the primary source of exposure to the general population. Lead paint is a major source of environmental exposure for children who ingest flaking paint, paint chips, and weathered powdered paint (mostly from deteriorated housing units in urban areas). Lead paint can also contribute to soil/dust lead which can be inadvertently ingested via hand-to-mouth activity of young children. Lead can leach into drinking water from lead-based solder used in water pipes. Lead can leach into foods or liquids stored in ceramic containers made with lead glazing. Engaging in hobbies such as casting ammunition, making fishing weights, and stained glass can result in exposure to lead. Exposure by inhalation can result during activities such as soldering with lead solder or sanding or sandblasting lead-based paint.
Organic **tetraethyl lead** **tetramethyl lead**	Inhalation Dermal studies in animals have shown that organic lead is well absorbed through the skin

Who are the populations most at risk and how are they usually exposed?

People living near hazardous waste sites, lead smelters or refineries, battery recycling or crushing centers, or other industrial lead sources may be exposed to lead and chemicals that contain lead. Workers in occupations that have sources of lead exposure (*e.g.*, plumbers, miners, mechanics, and lead smelter or refinery workers).

Certain hobbies, folk remedies, home activities, and car repairs (*e.g.*, radiator repair) can contribute to lead exposure. Smoking cigarettes or breathing second-hand smoke increases exposure because tobacco smoke contains small amounts of lead.

Pregnant women, the developing fetuses, and young children are particularly vulnerable to the effects of lead. Young children are more likely to play in dirt and to place their hands and other objects in their mouths, thereby increasing the opportunity for exposure via ingestion of lead-contaminated soil and dust.

What are the possible toxic effects of lead?

The most sensitive targets for lead toxicity are the developing nervous system, the hematological and cardiovascular systems, and the kidney. However, because of lead's many modes of action in biological systems, lead could potentially affect any system or organs in the body. The effects are the same whether it is breathed or swallowed.

Blood Lead Concentrations Corresponding to Adverse Health Effects

Life Stage	Effect	Blood lead (µg/dL)
Children	Depressed ALAD* activity	<5
	Neurodevelopmental effects	<10
	Sexual maturation	<10
	Depressed vitamin D	>15
	Elevated EP**	>15
	Depressed NCV***	>30
	Depressed hemoglobin	>40
	Colic	>60
Adults	Depressed GFR****	<10
	Elevated blood pressure	<10
	Elevated EP (females)	>20
	Enzymuria/proteinuria	>30
	Peripheral neuropathy	>40
	Neurobehavioral effects	>40
	Altered thyroid hormone	>40
	Reduced fertility	>40
	Depressed hemoglobin	>50
Elderly adults	Depressed ALAD*	<5
	Neurobehavioral effects	>4

*aminolevulinic acid dehydratase (ALAD)

**erythrocyte porphyrin (EP)

***nerve conduction velocity (NCV)

****glomerular filtration rate (GFR)

Source: ATSDR Toxicological Profile for Lead (Draft for Public Comment), 2005.

How can I reduce the risk of exposure to lead?

- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint (homes built before 1978).
- If you have a water lead problem, the U.S. Environmental Protection Agency (EPA) recommends that you flush your cold water pipes if they have not been used in over 6 hours by running water until it is cold (5 seconds to 2 minutes) before drinking or cooking with it.
- Avoid some types of paints and pigments that contain lead and are used as make-up or hair coloring; keep these kinds of products away from children.
- Hire a professional contractor, who is required to follow certain health safety requirements for remediation or renovation involving lead-based paint, (www.epa.gov/lead/pubs/leadinfo.htm#remodeling).
- Wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

What are the safety guidelines for lead exposure?

Air

- National Institute for Occupational Safety and Health (NIOSH)

  Recommended exposure limit (REL) time-weighted average (TWA) - 0.05 mg/m^3
  Immediately dangerous to life or health (IDLH) - 100 mg/m^3

- Occupational Safety and Health Administration (OSHA)

  Air - workplace 50 µg/m^3
  Action level - 40 µg/100 g of whole blood

- The American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit values (TLV)/(TWA) - 0.05 mg/m^3
TLV/TWA guideline for lead arsenate - 150 µg/m^3
TLV/TWA guideline for other forms of lead - 50 µg lead/m^3

- U.S. Environmental Protection Agency (EPA)

  National Primary and Secondary Ambient Air Quality Standards - 1.5 µg/m^3

- World Health Organization (WHO)

  Air quality guidelines -- 0.5 µg/m^3

Water

- EPA

  Maximum contaminant level (MCL) - action level 0.015 mg/L
  Action level for public supplies - 15 µg/L

- WHO

  Drinking Water Quality Guidelines - 0.01 mg/L

Blood

- Centers for Disease Control and Prevention (CDC)

  Level of concern for children - 10 µg/dL

- OSHA

  Cause for written notification and medical exam - 40 µg/dL
  Cause for medical removal from exposure - 50 µg/dL

- ACGIH

  Advisory; biological exposure index - 30 µg/dL

Food

- Food and Drug Administration (FDA)

  Bottled drinking water - 0.005 mg/L

Other

- ACGIH

  Biological exposure indices (lead in blood) - 30 µg/100 mL

- Consumer Product Safety Commission

  Paint - 600 ppm

- FDA

  Ceramicware (µg/mL leaching solution) - 0.5-3.0 µg/mL

µg/m^3: micrograms per cubic meter
µg/dL: micrograms per deciliter
µg/L: micrograms per liter
g: gram
mg/L: milligrams per liter
mL: milliliter
ppm: parts per million

What are the most important or common mediating factors?

Factors that determine the severity of the health effects from lead exposure include

- Dose
- Age of the person exposed
  - the developing nervous system is the most sensitive system to the effects of lead
  - the efficiency of lead absorption from the gastrointestinal tract is greater in children than in adults
- Life stages of women (childbirth, lactating, menopause)
- Occupational exposures
- Duration of exposure
- Health and lifestyle of the person exposed
- Nutritional status of the person exposed
  - a diet adequate in calcium and iron may decrease lead absorption

The toxic effects of lead exposure may be worse in individuals with inherited genetic diseases or gene polymorphisms such as thalassemia, individuals with glucose-6-phosphate dehydrogenase (G6PD) deficiency, and carriers of certain gene polymorphic forms (*e.g.*, ALAD and vitamin D receptor). Research continues about this topic.

Is there a test to see if my child or I have been exposed to lead?

Blood	• The screening test of choice is blood lead levels. • Blood tests are commonly used to screen children for lead poisoning. • Analysis of lead in whole blood is the most common and accurate method of assessing lead exposure. • Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (µg/dL).
Bone and Teeth	• X-ray fluorescence techniques have been used to determine lead concentration in bones and teeth. It is not widely available and is used mostly in research. • Lead partitions to bone over a lifetime of exposure; therefore, bone lead measurements may be a better indicator of cumulative exposure than blood lead.
Urine	• Measurements of urinary lead levels have been used to assess lead exposure. • The measurement of lead excreted in urine following chelation with calcium disodium EDTA (EDTA provocation) has been used to detect elevated body burden of lead in adults and children.
Hair and Nails	• These are not reliable for testing due to errors external contamination. They are relatively poor predictors of blood lead, particularly at low concentrations.

Future Research Needs

To close current gaps in the scientific database on the health effects of lead, a long–term resear ch program is needed that might include the following:

- Further short-term studies or studies in vitro designed to clarify mechanisms of action for the various toxicities might be useful.
- Studies identifying exposures during different developmental periods can help identify critical periods of vulnerability for immunocompetence, development of sex organs, or neurobehavioral parameters.
- Chronic-duration exposure studies in animals would expand information on the toxicity of lead. Special studies that examine biochemical and morphological effects of lead may provide new information on mechanisms of action of lead, particularly for the effects of greatest concern such as neurobehavioral changes in children.
- Development of new and more sensitive tests of specific neuropsychological functions.
- Further investigation of links between lead and amyotrophic lateral sclerosis, essential tremor, schizophrenia, and Parkinson's disease.
- Epidemiological studies designed in a manner that permits more rigorous assessments of effect modification.
- Studies about the long-term consequences of lead-related neurobehavioral deficits detected in infants and children and the manifestation of chronic neurobehavioral problems in adolescence and adulthood.
- Further characterization of bone lead concentration as a biomarker of exposure for various effect end points (*e.g.*, blood pressure and renal effects).
- Studies of the potential prevalence of elevated bone lead stores in women of reproductive age and the associated risk that this poses to fetal development by mobilization of maternal bone stores during pregnancy.
- Further clarification of the role of some genetic polymorphisms.
- Evaluation of cohorts from prospective studies into adulthood for potential late-appearing effects including cancer.

For more information

- Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Lead

  http://www.atsdr.cdc.gov/toxprofiles/tp13.html

- ATSDR ToxFAQs™ for Lead

  http://www.atsdr.cdc.gov/tfacts13.html

- ATSDR Case Studies in Environmental Medicine Lead Toxicity

  http://www.atsdr.cdc.gov/csem/lead/

- ATSDR Interaction Profile for Chemical Mixtures for Arsenic, Cadmium, Chromium, and Lead

  http://www.atsdr.cdc.gov/interactionprofiles/ip04.html

- ATSDR Interaction Profile for Chemical Mixtures for Lead, Manganese, Zinc, and Copper

  http://www.atsdr.cdc.gov/interactionprofiles/ip06.html

- ATSDR Interaction Profile for Chemical Mixtures for Chlorpyrifos, Lead, Mercury, and Methylmercury

  http://www.atsdr.cdc.gov/interactionprofiles/ip11.html

- Centers for Disease Control and Prevention Lead Web Page

  http://www.cdc.gov/lead/

- U.S. Environmental Protection Agency Lead Web Page

  http://www.epa.gov/lead/

- U.S. Department of Labor, Occupational Safety & Health Administration

  http://www.osha.gov/SLTC/lead/

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-800-CDC-INFO (800-232-4636)
TTY 888-232-6348

FAX: (770)-488-4178
Email: CDCINFO@cdc.gov

This page was updated on 01/04/2008

Mercury

Mercury is a naturally occurring metal found in air, water, and soil. It exists in several forms, including elemental (or metallic) mercury, inorganic mercury compounds, and organic mercury compounds:

- **Elemental mercury** is liquid at room temperature and is used in thermometers, fluorescent light bulbs, some electrical switches, and some industrial processes.
- **Inorganic mercury** compounds are formed when mercury combines with other elements to form salts, which are usually powders or crystals. Inorganic mercury compounds are found naturally in the environment. Some forms of inorganic mercury have been used in antiseptic creams, ointments, and preservatives.
- **Organic mercury** compounds are formed when mercury combines with carbon. Microscopic organisms can produce organic mercury compounds (methylmercury) in contaminated water and soil, which can accumulate in the food chain. Other special types of organomercurials have been used as medical preservatives and medicines.

How People Are Exposed to Mercury

- Eating fish or shellfish that is contaminated with methylmercury, which is the main source of general human exposures to mercury;
- Breathing air contaminated with elemental mercury vapors (e.g., in workplaces such as dental offices and industries that use mercury or in locations where a mercury spill or release has occurred);
- Having dental fillings that contain mercury; and
- Practicing cultural or religious rituals that use mercury.

How Mercury Affects People’s Health

- Short-term exposure to extremely high levels of elemental mercury vapors can result in lung damage, nausea, diarrhea, increases in blood pressure or heart rate, skin rashes, eye irritation, and injury to the nervous system.
- Prolonged exposure to lower levels of elemental mercury can permanently damage the brain and kidneys.
- The developing brain of a fetus can be injured if the mother is exposed to methylmercury.

Levels of Mercury in U.S. Population

Scientists tested levels of mercury in the blood of 16,780 participants who took part in CDC's national study known as the National Health and Nutrition Examination Survey (NHANES). These findings are based on total blood mercury levels in the U.S. general population for persons aged 1 year and older who participated in NHANES during 2003-2006, as well as trends in the total mercury of children aged 1–5 and females aged 16–49 during 1999–2006.

- In the total population during 2003–2006, the total blood mercury levels for non–Hispanic blacks and non–Hispanic whites were higher than those for Mexican Americans.
- Across the age groups in the total population during 2003-2006, total blood mercury levels increased with age, peaked at the fifth or sixth decade, depending on race/ethnicity, and then declined.
- In the most recent survey period of 2005–2006, the 95th percentile levels for total blood mercury in children aged 1-5 years and females aged 16-49 years were 1.43 µg/L and 4.48 µg/L, respectively. The 95th percentile means that 95 percent of the U.S. population's exposure is below this estimated level. Conversely, only 5 percent of the population will have values at this level or higher.
- Over the four survey periods from 1999-2006, blood mercury levels increased slightly for non–Hispanic white children and decreased slightly for non–Hispanic black and Mexican American children. Female children had slightly higher blood mercury levels than male children.

For More Information

- Agency for Toxic Substances and Disease Registry
  Detailed information about mercury and public health is available at
  http://www.atsdr.cdc.gov/alerts/970626.html and
  http://www.atsdr.cdc.gov/cabs/mercury/index.html
- CDC Emergency Preparedness and Response
  Case definitions of mercury, toxicology FAQs, and toxicological profile at
  http://emergency.cdc.gov/agent/mercury/

May 2009

The Centers for Disease Control and Prevention (CDC) protects people's health and safety by preventing and controlling diseases and injuries; enhances health decisions by providing credible information on critical health issues; and promotes healthy living through strong partnerships with local, national, and international organizations.

ATSDR Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

ATSDR Home › ToxFAQs™ Arsenic

ToxFAQs™

ToxFAQs™
for
Arsenic
(*Arsénico*)
August 2007

PDF Version, 92 KB

CAS#: 7440-38-2

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

Highlights

Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth’s crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make “pressure-treated” lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of “pins and needles” in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small “corns” or “warts” on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How does arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce their risk for exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

Is there a medical test to show whether I've been exposed to arsenic?

There are tests available to measure arsenic in your blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict whether the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

The EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or cancelled many of the uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic *(Update)*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE, Mailstop F-62
Atlanta, GA 30333
Phone: 1-800-CDC-INFO • 888-232-6348 (TTY)
FAX: 770-488-4178
Email: cdcinfo@cdc.gov

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

This page was updated on 10/05/2007

APPENDIX B:

COMMUNITY AIR MONITORING PLAN

COMMUNITY AIR MONITORING PLAN (CAMP)

152 Graham Avenue
Block 3062; Lot 2
Brooklyn, New York 11206

1. Introduction

The Community Air Monitoring Plan (CAMP) has been prepared to monitor the air quality during the intrusive activities proposed as a part of the Remedial Investigation Work Plan (RIWP) at the property located at 152 Graham Avenue in Brooklyn, New York. Levels of VOCs and dust in the air will be monitored continuously and periodically utilizing a Photo Ionization Detector (PID) and Real-Time Particulate Dust Tracker, respectively. For this investigation, the PID will be calibrated at the beginning of each day to the compound isobutylene, which is published by the manufacturer. The PID has a minimum detection limit of 0.1 parts per million (ppm). The Dust Tracker provides real-time measurement based on 90° light scattering. The Dust Tracker has a minimum detection limit of 0.001 mg/m^3.

Continuous real-time air monitoring for VOCs and particulate levels at the perimeter of the exclusion zone or work area will be performed for all ground intrusive activities. Ground intrusive activities include the installation of soil borings, monitoring wells and soil vapor probes.

Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of soil samples, the collection of groundwater samples from monitoring wells. For instance, periodic monitoring during sample collection will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC and recorded in a field daily log. A summary of daily logs/reports will be provided in the Remedial Investigation Report (RIR).

2. VOCs Monitoring, Response Levels And Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during invasive work. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a PID, which will be calibrated at least daily for to the compound isobutylene. The PID will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200-feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20-feet - is below 5 ppm over background for the 15-minute average.

Activities will be shut down if the organic vapor level at the perimeter of the work area is above 25 ppm.

All 15-minute readings must be recorded in a daily field log. Instantaneous readings, if any, used for decision purposes will also be recorded.

3. PM Monitoring, Response Levels And Actions

Particulate concentrations will be monitored continuously at the downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using a Dust Tracker real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels are not 150 mcg/m^3 or greater above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are 150 mcg/m^3 or greater above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration. All readings will be recorded in a daily field log.

APPENDIX C:

SAMPLE BORING LOG

Hydro Tech Environmental, Corp.

Main Office
2171 Jericho Turnpike, Suite 240
Commack, New York 11725
T (631) 462-5866 · F (631) 462-5877

NYC Office
15 Ocean Avenue, 2nd Floor
Brooklyn, New York 11225
T (718) 636-0800 · F (718) 636-0900

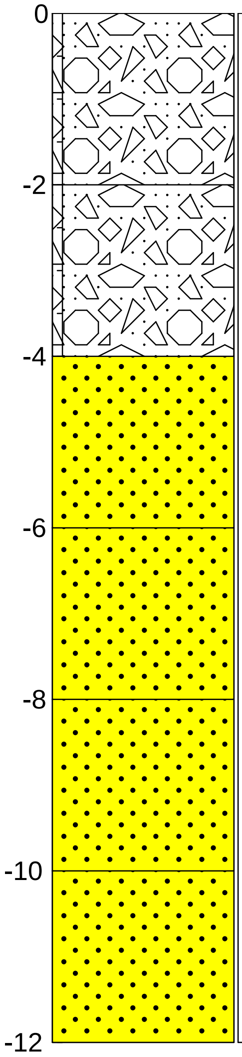
www.hydrotechenvironmental.com

Soil Probe Log

Job No: xxxxxx
Date: xx/xx/xxxx
Page: 1 of 1
Location: ABCD, EF, GH
Sampling Interval: 2 feet
Boring No.: SP-x
Sampling Method: Grab
Drilling Method: Direct Push
Driller:
Total Depth: 12 feet
Depth to Water:

USCS SYMBOLS

- GW - Well Graded Gravel
- GP - Poorly Graded Gravel
- GM - Silty Gravel
- GC - Clayey Gravel
- SW - Well Graded Sand
- SP - Poorly Graded Sand
- SM - Silty Sand
- SC - Clayey Sand
- ML - Inorganic Silt / Sandy Silt
- CL - Inorganic Clays/Sandy Clay
- OL - Inorganic Silts/Organic Silty Clay
- MH- Elastic Silts
- CH - Inorganic Clay, High Plastic
- OH - Organic Silt / Clay
- PT - Peat/High Organics

Depth Below Grade and Lithology	PID Reading (ppm)	USCS	Soil Description
	0.0	SP	concrete/dark brown, med grained sandy loam with brick and pebble sized clasts
	0.0	SP	dark brown, med grained sandy loam with brick and pebble sized clasts
	0.0	SP	brown, med grained sand
	0.0	SP	brown, med grained sand
	0.0	SP	brown, med grained sand
	0.0	SP	brown, med grained sand

APPENDIX D:

SAMPLE GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

HYDRO TECH ENVIRONMENTAL CORP.

MAIN OFFICE:
2171 JERICHO TURNPIKE, SUITE 345
COMMACK, NEW YORK 11725

NYC OFFICE:
1111 FULTON STREET, SECOND FLOOR
BROOKLYN, NEW YORK 11238

PHONE: (631) 462-5866 FAX: (631) 462-5877

WELL CONSTRUCTION LOG

Job No:

Date:

Page: 1 OF 1

Location:

Well Number: MW-1

Drilling Method: DIRECT PUSH

Total Depth: 28'

Depth to Water: 14.71"

Manhole Size: 5"

Screen Size: 0.010"

Screen Interval: 20.00'

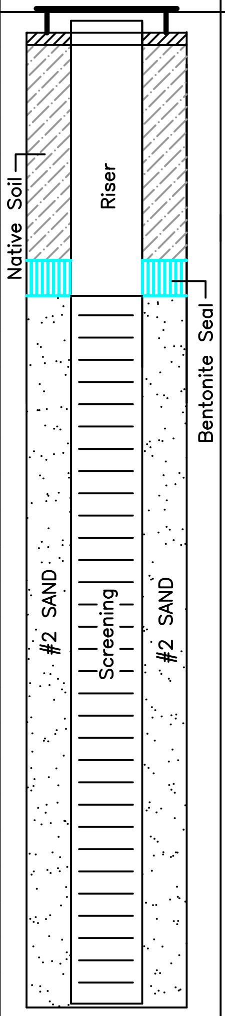
Diameter: 1"

Riser Length: 8'

Sand Size: #2

Depth Below Grade (ft.)	Sample Interval (ft.)
2	
4	
6	
8	
10	
12	
14	
16	
18	
20	
22	
24	
26	
28	
30	
32	
34	
36	

Well Construction



Description

5" Manhole Cover

0' – 7.00' – Native Soil

7' – 8.00' – Bentonite Seal

8' – 28.00' – #2 Sand

0' – 8.00' – Riser

8' – 28.00' – Screen

APPENDIX E:

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

152 Graham Avenue

Block 3062; Lot 2

Brooklyn, New York 11206

Table of Content

Figure

Tables

Attachments

1.0 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared for the samples to be collected in accordance with the Site Characterization Work Plan (SC WP) developed for the property located at 152 Graham Avenue in Brooklyn, NY. The intent of the QAPP is to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete.

All related portions of the fieldwork will be performed, at a minimum, in accordance with acceptable industry standards. These acceptable industry standards include, but are not limited to, the ASTM Standard Guide for Phase II Environmental Site Assessments (E 1903-97) and the New York State Department of Environmental Conservation (NYSDEC) Bureau of Spill Prevention & Response Sampling Guidelines and Protocols, March 1991 and NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation, May 2010, 6 NYCRR Subpart 360.

2.0 Project Objective and Scope of Work

The objective of the site characterization as set forth in the SC WP is to address the requirements presented by the New York State Department of Environmental Conservation (NYSDEC) under an Order on Consent and Administrative Settlement (Consent Order) to characterize potential contamination relating to dry cleaning operations at the Site and to provide a mechanism to implement necessary interim remedial measures and associated site management. This investigation will be performed in accordance to the New York State Department of Environmental Conservation (NYSDEC) requirements in compliance with the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010), New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006) and other acceptable industry standards.

To meet the above objectives, two (2) soil probes, three (3) permanent wells, and five (5) soil vapor probes will be installed and sampled during this investigation along with five (5) indoor air samples and six (6) existing monitoring wells. Soil probes and monitoring well installation, construction, and development shall conform to NYCRR Part 360.

3.0 Sampling Procedures, Decontamination Methods and Data Quality Usability Objectives

3.1 Soil Sampling

Soil samples will be collected from soil borings SB-3 and SB-4. All soil samples will be obtained at 2-foot intervals utilizing a 1 ¾ -inch diameter 4-foot long Macro Core sampler fitted with dedicated acetate liners. The location of the soil probes is provided in Figure 6 of the RIWP.

Three (3) soil samples will be collected for lab analysis from each of the soil probes which will consist of the 2-foot interval with the highest PID reading, from the 2-foot interval just above groundwater and from the 2-foot clean interval.

Each soil sample will be placed directly into pre-cleaned containers provided by the laboratory samples from select soil probes. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory, York Analytical Laboratories, Inc. for analysis. **Table 1** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for soil samples. The location of the soil borings is provided in **Figure 1 – Site Plan**.

3.2 Groundwater Sampling

Groundwater samples will be obtained from each of the newly installed three (3) permanent wells and six (6) existing monitoring wells utilizing a low flow pump fitted with dedicated polyethylene tubing. Initially, each monitoring well will be purged prior to sampling. Purging and sampling of the monitoring wells will be conducted according to USEPA's Low Stress/Flow Groundwater Sampling Protocol (EQASOP-GW4, September 19, 2017, Rev. 1996) utilizing a portable water quality meter YSI-6820, which utilizes an in-line flow cell for water quality indicator measurements (the USEPA low flow sampling protocol and monitoring well purge/sampling form is provided in **Attachment A**).

Groundwater will be purged at a low flow rate of less than 500 milliliter per minute (mL/min) until water quality indicator parameters including pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen and turbidity are stabilized within the specified confidence limits for three consecutive readings:

- pH (±1 unit),
- Dissolved Oxygen (10% for values exceeding 5 mg/L or considered stabilized if less than 5 mg/L),
- Specific Conductance (3%),

- ORP (±10 millivolts),
- Temperature (3%), and
- Turbidity (10% for values exceeding 5 NTU or considered stabilized if less than 5 NTU).

During this low flow sampling from each monitoring well, the use of any equipment, materials or sampling jars that are known to contain Perfluorinated Compounds (PFCs) or polytetrafluoroethylene (PTFE) such as Teflon tubing, low density polyethylene (LDPE) tubing or sample bottle cap liners should be prevented. Besides any contact with PFC waterproofed cloths or PFC containing materials such as aluminum foils and many food and drink packaging materials and should be avoided (**Attachment B** provides sampling guidelines and protocols for PFAS dated October 2020). The sampling of each well will be performed once groundwater purging is completed. **Attachment C** provides a sample Groundwater Sampling/Purge Log.

Each groundwater sample will be placed directly into pre-cleaned containers provided by the laboratory. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory, York Analytical Laboratories, Inc. for analysis. **Table 2** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for the groundwater samples. The location of the monitoring wells is provided in **Figure 1 – Site Plan**.

3.3 Soil/Sub-slab soil vapor sampling points

The soil vapor probes SV-4 through SV-8 and five indoor air samples, designated IA-3 through IA-7 will be sampled utilizing in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York October 2006. The soil vapor sample will be collected utilizing a 6 liter pre-cleaned, passivated, evacuated whole air Summa® Canister. A 60-cm^3 plastic syringe will be used to purge approximately 1 to 3 implant volumes (i.e. the volume of the sample probe and tube) prior to collecting the soil vapor sample. The sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 8 hours at a rate of less than 0.2 liter per minute.

The vapor sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory, York Analytical Laboratories, Inc. for analysis. **Table 3** provides the sample container, volumes, test methods, reporting limits and holding times for the vapor sample. The location of the soil vapor sampling location is provided in **Figure 1 – Site Plan**.

3.4 Decontamination Methods/ Quality Assurance and Quality Usability Objectives

A Hydro Tech Quality Assurance (QA) officer (Anusha Agnoor) will adopt this QAPP during the collection of soil and groundwater samples in order to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete. **Attachment D** provides resumes of key personnel involved with this project. The key personnel include:

1. Tarek Z. Khouri, P.E. – Principal Environmental Engineer
2. Mark E. Robbins, P.G. – Senior Geologist
3. Dorina Aliu, P.E. – Project Manager
4. Donald C. Anne – Senior Chemist
5. Anusha Agnoor – QA Officer

During the field sampling, Hydro Tech QA officer will be responsible for monitoring the decontamination procedure of every piece of sampling equipment prior to each use by field personnel. The following procedure will be implemented during the decontamination process:

- Wipe clean and wash with Alconox®
- Potable water rinse
- Methanol rinse
- Deionized water rinse
- Air dry

All decontamination procedures will be performed in an area segregated from any sampling areas. Any rinsate from the decontamination area will be contained and placed in 55-gallons drums and properly disposed of. The following Quality Assurance (QA) and Quality Control (QC) samples will also be collected and analyzed.

- One trip blank per trip will be analyzed via EPA Method 8260
- One field blank (rinsate blank) for soil will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.
- One field blank (rinsate blank) for groundwater will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.
- One equipment blank (rinsate blank) for soil will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.
- One equipment blank (rinsate blank) for groundwater will be analyzed via EPA

Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.

Duplicate samples will also be collected and analyzed.

- One duplicate soil sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.
- One duplicate groundwater sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) samples will also be collected and analyzed.

- One MS soil sample and one MSD soil sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.
- One MS groundwater sample and one MSD groundwater sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081/8151, EPA Method 8082, EPA Method 6010/7473 and Modified EPA Method 537.

Field duplicate samples will be collected and analyzed for all matrices to check laboratory reproducibility of analytical data. One set of field duplicate samples will be collected as part of the site characterization and will include, 1 soil sample, 1 groundwater sample, and one indoor air sample. **Table 1**, **Table 2** and **Table 3** provide the sampling and analytical Method Requirements for soil, groundwater and soil vapor.

3.5 General QA/QC Considerations

The soil and groundwater samples and the soil vapor samples will be managed as per the following protocols:

- HydroTech PM (Dorina Aliu, P.E.) and QAO (Anusha Agnoor) shall perform field audits to verify compliance with the RIWP and identify corrective measures where problems are identified. A resume for Dorina Aliu, P.E. is included in **Attachment D**
- Samples will be labeled and logged in a monitor notebook and Chain of Custody upon collection including sampler name, sampling identification, date and time of sample collection and sampling depth, sampling methods and devices.
- In the field, samples will be the responsibility of, and will stay with the HydroTech PM (Dorina Aliu, P.E.) and/or QAO (Anusha Agnoor).

- Once samples have been collected, they are returned to HydroTech office and logged in for temporary storage under a proper Chain of Custody. **Attachment E** provides a sample chain of custody form.
- Soil samples will be refrigerated to maintain a temperature at a maximum 4 degrees Celsius.
- HydroTech staff will be then responsible for transporting samples to State-certified (ELAP) laboratory for analysis under a proper Chain of Custody.
- Laboratory personnel will record the date and time of samples arrival at the lab and ensure that all holding times for each matrix and analysis will be met.
- After samples are analyzed, laboratory information is added to the label.
- The Sample Chain of Custody form will be used to record all transport and storage information.
- Samples analytical data report will undergo QA/QC performed by a laboratory QA officer who checks each data sheet for precision, missing or illegible information, errors in calculation and values outside of the expected range. A minimum of five percent of the total of a given type of sample shall be devoted to internal QC checks. These checks are designed to ensure accuracy in the sampling procedure and the analytical methods and include blanks, duplicates, matrix spikes reference standards and performance evaluation samples. **Attachment F** provides a conventional lab QA/QC procedures associated with soil samples and analysis.
- The Laboratory data packages will conform to the Analytical Services Protocols (ASP) Category B Deliverables in accordance to NYSDEC DER-10 Appendix 2B.
- To ensure that data quality objectives are met, HydroTech QAO will assess data precision, accuracy, degree of representation, comparability and completeness of samples and data. This is primarily accomplished in the evaluation of data together with field notes and sampling logs. In order to ensure that cross-contamination between sampling locations did not occur, each piece of detection and reporting limits shall allow for comparison with soil quality standards.
- All deficiencies identified by HydroTech PM during the performance of field audits or evaluation of the data will be immediately reported to the field Geologist, and the NYSDEC. In addition to identifying deficiencies, the HydroTech PM is responsible for recommending corrective actions.
- The analytical data generated from this project will be provided in an electronic format in accordance with NYSDECs DER-10 Section 1.15. Specifically, the final reports shall be in an electronic format that complies with the NYSDEC's Electronic Document Standards (EDS).
- A Category B deliverable is required and a Data Usability Summary Report

(DUSR) will be prepared. The DUSR will include all data and answer the following questions:

1. Is the data package complete as defined under the requirements for the most current DEC ASP Category B or USEPA CLP data deliverables?
2. Have all holding times been met?
3. Do all the QC data; blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
4. Have all of the data been generated using established and agreed upon analytical protocols?
5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
6. Have the correct data qualifiers been used and are they consistent with the most current DEC ASP?
7. Have any quality control (QC) exceedances been specifically noted in the DUSR and have the corresponding QC summary sheets from the data package been attached to the DUSR?

- All validated data will be reviewed by Donald C. Anné, an independent QAO of the laboratory who is responsible of generating a data usability analysis. This analysis shall consist of (1) an assessment to determine if the data quality objectives were met; (2) evaluation of field duplicate results to indicate the samples are representative; (3) comparison of the results of trip blanks and methods blanks with full data sets to provide information concerning contaminants that may have been introduced during sampling, shipping or analyzing; (4) evaluation of matrix effects to assess the performance of the analytical method with respect to sample matrix, and determine whether the data have been biased high or low due to matrix effects. A Data Usability Summary Report (DUSR) will be prepared and provided in an electronic format in accordance to NYSDEC DER-10 Appendix 2B and in compliance with the NYSDEC's Electronic Document Standards (EDS). A resume for Donald C. Anné is included in **Attachment D.**
- Field investigation will be performed under the full oversight of Tarek Z. Khouri, a NYS registered professional engineer. A resume for Tarek Z. Khouri is included in **Attachment D**.

3.6 Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS)

The soil and groundwater PFAS sampling, analysis and assessment procedures will follow October 2020 NYSDEC guidance included in the **Attachment B.**

PFAS and PFOS Standards in Soil

- Soil Cleanup Objectives for PFOA and PFOS are established in Table below and these standards can be used to determine whether PFOA and PFOS are contaminants of concern for the site:

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Restricted	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater2	1.1	3.7

PFAS and PFOS Standards in Groundwater and Surface Water

- If PFOA or PFOS is detected > 10 ng/L (ppt) in groundwater or surface water samples results, and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below, then PFAS becomes a contaminant of concern in groundwater or surface water.
- If any other individual PFAS (not PFOA or PFOAS) is detected in water > 100 ng/L, then further assessment in water is warranted.
- If Total PFAS (21 compounds including PFOA or PFOAS) is detected in water > 500 ng/L, then further assessment in water is warranted.

PFAS and PFOS Standards for Backfill

- Testing of backfill for PFAS should be included any time full ATL/TCL analyte list is required.
- Backfill results for PFOA or PFOS should be compared to the applicable soil guidance values.
- Backfill should be rejected if PFOA or PFOS concentrations exceed guidance values or their concentrations in leachate is above > 10 ppt.
- To minimize project delay, it is recommended to test for both PFAS and also PFAS SPLP.
- Composite samples are appropriate for these compounds to test in backfill and CategoryB deliverables are needed but DUSR is not required.

Points to Remember During Sampling:

- Field sampling for PFAS performed under DER remedial programs will follow the appropriate procedures outlined for soils, sediments or other solids (Appendix B of

NYSDEC guidance) and sampling protocols for PFAS in monitoring wells (Appendix C of NYSDEC guidance).

- PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1.
- PFAS compounds to be analyzed (PFAS Analyte List) is included in Appendix G of NYSDEC guidance.
- **Attachment G** provides York Analytical Laboratories, Inc PFAS SOP
- Standard two step decontamination using detergent (Alconox) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination will be verified in advance to be PFAS-free through laboratory analysis or certification.
- PFOA, PFOS and 1,4-dioxane are considered semi-volatile compounds. When sampling for backfill import, composite samples shall be collected for these compounds in accordance with DER-10, Table 5.4(e)10. In addition, Category B deliverables will be submitted for backfill samples, though a DUSR is not required.
- During sampling, avoid contact with aluminum foils, waterproof field books or clothing, food packaging, tools with coatings or paint, soda cans, low density polyethylene (LDPE) tubing, Teflon-based materials including sample bottle cap, liners. Cloth worn by field personnel should be washed and clean.
- Materials that can be used during sampling include: High density polyethylene (HDPE) tubing, PVC, silicone, nitrile gloves, acetate liners and propylene.
- Avoid use of sunscreen or any spray-on perfume or insect repellant that contain PFAS, unless site warrants use of shipment protective measures that contain PFAS, and such use should be documented in field notes.
- Regular ice only will be used
- Equipment blanks will be collected at a minimum frequency of 1 per day per site for each matrix

Table 1: Sampling & Analytical Method Requirements – Soil Samples

Soil Matrix (1) Sample ID	Parameters	Minimum Sample Volume	Sample Container	Sampling Frequency	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
SB-3 & SB-4 & Matrix Spike /Matrix Spike Duplicate & Field Duplicate & Field Blank & Equipment Blank	TCL VOCs	120 ml + 2 OZ	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	7	Cool to 4 °C(2)	EPA Method 8260	Compound Specific (0.001-0.05 mg/Kg)	14 days
	TCL SVOCs	8 OZ	8 oz. clear wide-mouth glass with Teflon lined septum	7	Cool to 4 °C	EPA Method 8270	Compound Specific (0.065-0.250 mg/Kg)	14 days to extraction, 40 days following extraction
	TAL Metals	8 OZ	8 oz. clear wide-mouth glass with Teflon lined septum	7	Cool to 4 °C	EPA Method 6010/EPA 7473 for Mercury	Compound Specific (0.05-10 mg/Kg)	6 months/ Chromium Hexavalent 30 days to extraction, 7 days following extractions/Mercury 28 days
	Herbicides/ Pesticides	8 OZ	8 oz. clear wide-mouth glass with Teflon lined septum	7	Cool to 4 °C	EPA Methods 8081/8151	Compound Specific (0.005-0.02 mg/Kg)	14 days to extraction, 40 days following extraction
	PCBs	8 OZ	8 oz. clear wide-mouth glass with Teflon lined septum	7	Cool to 4 °C	EPA Method 8082	Compound Specific (0.025 mg/Kg)	14 days
	1,4-Dioxane	4 OZ	4 oz. clear glass	7	Cool to 4°C	EPA Method 8270D SIM	0.1 mg/Kg	14 days
	21 Target PFOAs	5g	(1) 250ml HDPE containers	7	Cool to 4°C	Modified EPA Method 537M	5 µg/Kg	14 days
Field Blank & Equipment Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
	TCL SVOCs	1 liter	Amber glass with Teflon lined cap	1	Cool to 4 °C	EPA Method 8270	Compound Specific (2-20 µg/L)	7 days
	TAL Metals	500 ml	500 ml Poly cup with Teflon lined cap	1	HNO3 to pH<2 Cool to 4 °C	EPA Method 6010/EPA 7473 for Mercury	Compound Specific (2-20 µg/L)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	1 liter	Amber glass with Teflon lined cap	1	Cool to 4 °C	EPA Methods 8081/8151	Compound Specific (0.01-0.1 µg/L)	7 days
	PCBs	1 liter	Amber glass with Teflon lined cap	1	Cool to 4 °C	EPA Method 8082	Compound Specific (0.05 µg/L)	7 days
	1,4-Dioxane	500 ml	Amber glass with Teflon lined cap	1	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.35 µg/L)	7 days
	21 Target PFOAs	250 ml	(1) 250ml HDPE container	1	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Compound Specific (0.2-10 µg/L)	14 days

((1)….Analytical Services Protocols (ASP) Deliverables Package Category B.

(2)…If samples are not delivered to the lab with 48 hours after collection, the 40 ml DI Water vials should be preserved in a frozen condition following sampling

Table 2: Sampling & Analytical Method Requirements – Groundwater Samples

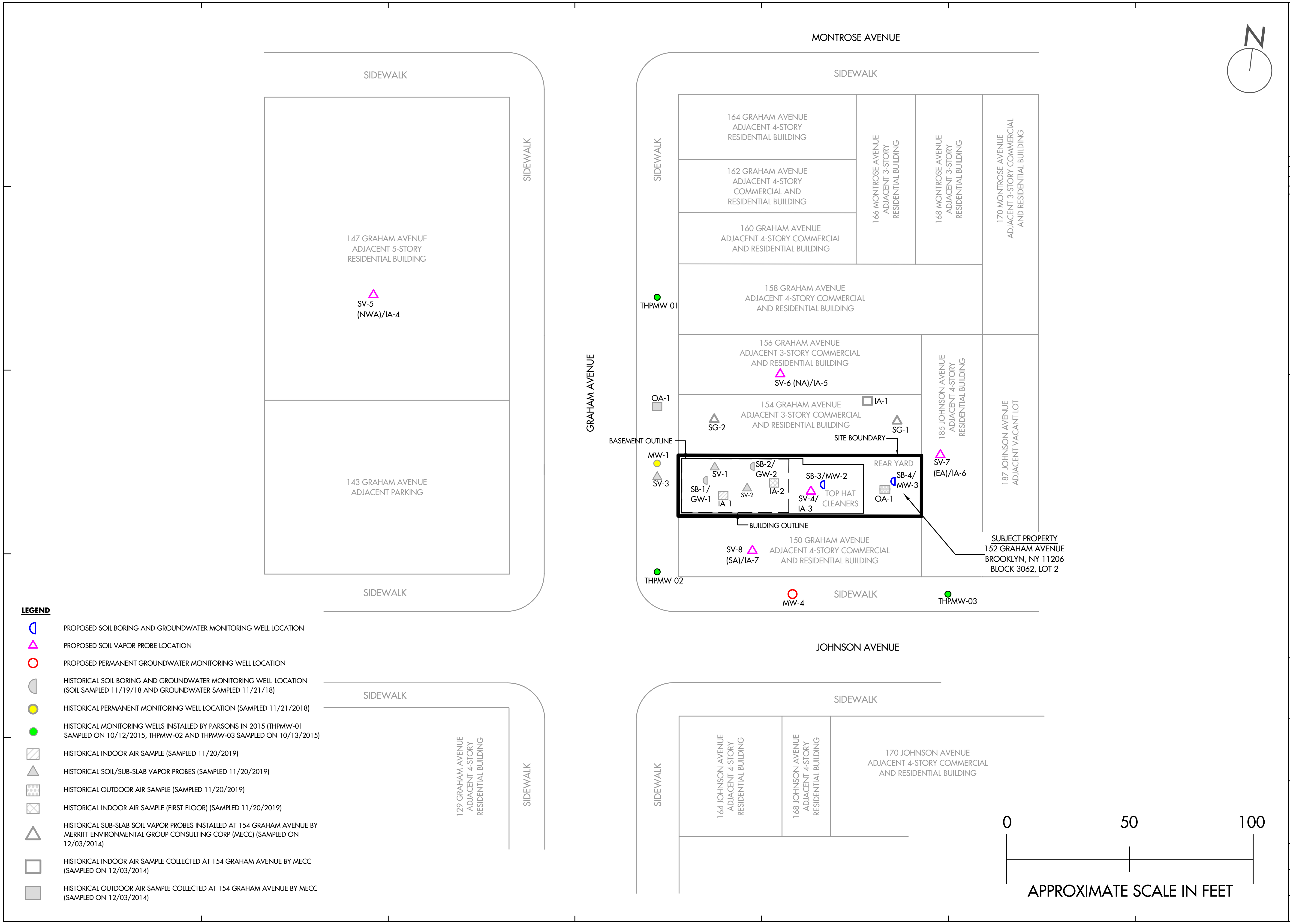
Groundwater Matrix (1)	Parameters	Minimum Sample Volume	Sample Container	Sampling Frequency	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID								
MW-2, MW-3, MW-4 MW-1, GW-1, GW-2, THPMW-01, THPMW-02 and THPMW-03 & Matrix Spike /Matrix Spike Duplicate & Field Duplicate & Field Blank & Equipment Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	7	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 μg/L)	14 days
	TCL SVOCs	1 liter	Amber glass with Teflon lined cap	7	Cool to 4 °C	EPA Method 8270	Compound Specific (2-20 μg/L)	7 days to extraction, 40 days following extraction
	TAL Metals	500 ml	500 ml Poly cup with Teflon lined cap	7	HNO3 to pH<2 Cool to 4 °C	EPA Method 6010/EPA 7473 for Mercury	Compound Specific (2-20 μg/L)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	1 liter	Amber glass with Teflon lined cap	7	Cool to 4 °C	EPA Methods 8081/8151	Compound Specific (0.01-0.1 μg/L)	7 days to extraction, 40 days following extraction
	PCBs	1 liter	Amber glass with Teflon lined cap	7	Cool to 4 °C	EPA Method 8082	Compound Specific (0.05 μg/L)	7 days
	1,4 Dioxane	500 ml	Amber glass with Teflon lined cap	7	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.28 μg/L)	7 days
	Perfluorooctanoic acid (PFOA) and other perfluorinated compounds (PFCs)	250 ml	(2) 250ml HDPE containers	7	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Field Blank & Equipment Blank	1,4 Dioxane	500 ml	Amber glass with Teflon lined cap	7	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.28 μg/L)	7 days
	Perfluorooctanoic acid (PFOA) and other perfluorinated compounds (PFCs)	250 ml	(1) 250ml HDPE container	7	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.5-20 μg/L)	14 days

((1)….Analytical Services Protocols (ASP) Deliverables Package Category B.

Table 3: Sampling & Analytical Method Requirements – Vapor/Air Samples

Vapor/Air Matrix	Parameters	No. of Samples	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID								
SV-4/IA-3	VOCS	3	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 μg/m^3)	30 days
SV-5/IA-4	VOCS	3	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 μg/m^3)	30 days
SV-6/IA-5	VOCS	3	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 μg/m^3)	30 days
SV-7/IA-6	VOCS	3	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 μg/m^3)	30 days
SV-8/IA-7	VOCS	3	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 μg/m^3)	30 days

Figure 1 - Site Plan



LEGEND

◖	PROPOSED SOIL BORING AND GROUNDWATER MONITORING WELL LOCATION
△	PROPOSED SOIL VAPOR PROBE LOCATION
○	PROPOSED PERMANENT GROUNDWATER MONITORING WELL LOCATION
◖	HISTORICAL SOIL BORING AND GROUNDWATER MONITORING WELL LOCATION (SOIL SAMPLED 11/19/18 AND GROUNDWATER SAMPLED 11/21/18)
●	HISTORICAL PERMANENT MONITORING WELL LOCATION (SAMPLED 11/21/2018)
●	HISTORICAL MONITORING WELLS INSTALLED BY PARSONS IN 2015 (THPMW-01 SAMPLED ON 10/12/2015, THPMW-02 AND THPMW-03 SAMPLED ON 10/13/2015)
▨	HISTORICAL INDOOR AIR SAMPLE (SAMPLED 11/20/2019)
▲	HISTORICAL SOIL/SUB-SLAB VAPOR PROBES (SAMPLED 11/20/2019)
▩	HISTORICAL OUTDOOR AIR SAMPLE (SAMPLED 11/20/2019)
☒	HISTORICAL INDOOR AIR SAMPLE (FIRST FLOOR) (SAMPLED 11/20/2019)
△	HISTORICAL SUB-SLAB SOIL VAPOR PROBES INSTALLED AT 154 GRAHAM AVENUE BY MERRITT ENVIRONMENTAL GROUP CONSULTING CORP (MECC) (SAMPLED ON 12/03/2014)
□	HISTORICAL INDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)
■	HISTORICAL OUTDOOR AIR SAMPLE COLLECTED AT 154 GRAHAM AVENUE BY MECC (SAMPLED ON 12/03/2014)

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

77 ARKAY DRIVE, SUITE K
HAUPPAUGE, NY 11788

TEL: (631) 462-5866

FAX: (631) 462-5877

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS

152 GRAHAM AVENUE
BROOKLYN, NY 11206

PROJECT FIGURE

FIGURE 1- SITE PLAN

PROJECT NO. 200040	DATE 10/19/20
DRAWN BY A.R.	REVIEWED BY D.A.
SCALE (11X17) AS NOTED	APPROVED BY T.K.

ATTACHMENT A
USEPA LOW FLOW SAMPLING PROTOCOL

United States Environmental Protection Agency
Office of Research and Development
Office of Solid Waste and Emergency Response
EPA/540/S-95/504
April 1996

Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

For further information contact: Robert Puls, 405-436-8543, Subsurface Remediation and Protection Division, NRMRL, Ada, Oklahoma.

I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

---

[1] National Risk Management Research Laboratory, U.S. EPA
[2] University of Michigan

Superfund Technology Support Center for Ground Water

National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
Robert S. Kerr Environmental Research Center
Ada, Oklahoma

Technology Innovation Office
Office of Solid Waste and Emergency Response, US EPA, Washington, DC

Walter W. Kovalick, Jr., Ph.D.
Director

chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

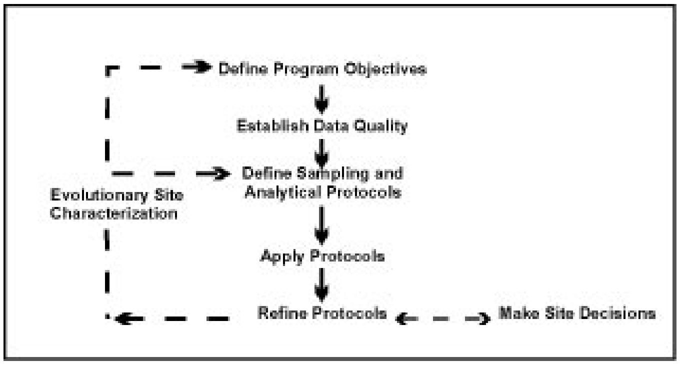


Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer’s recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. “portable or non-dedicated mode” - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. “dedicated mode” - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining “representative” samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most “representative” samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in “dedicated mode” or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and “Ground Water Sampling Workshop -- A Workshop Summary” (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the “useability” of the sampling data.

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

VIII. References

Backhus, D,A., J.N. Ryan, D.M. Groher, J.K. McFarlane, and P.M. Gschwend. 1993. Sampling Colloids and Colloid-Associated Contaminants in Ground Water. *Ground Water*, 31(3):466-479.

Barcelona, M.J., J.A. Helfrich, E.E. Garske, and J.P. Gibb. 1984. A laboratory evaluation of groundwater sampling mechanisms. *Ground Water Monitoring Review*, 4(2):32-41.

Barcelona, M.J. and J.A. Helfrich. 1986. Well construction and purging effects on ground-water samples. *Environ. Sci. Technol.,* 20(11):1179-1184.

Barcelona, M.J., H.A. Wehrmann, and M.D. Varljen. 1994. Reproducible well purging procedures and VOC stabilization criteria for ground-water sampling. *Ground Water*, 32(1):12-22.

Buddemeier, R.W. and J.R. Hunt. 1988. Transport of Colloidal Contaminants in Ground Water: Radionuclide Migration at the Nevada Test Site. *Applied Geochemistry*, 3: 535-548.

Danielsson, L.G. 1982. On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters. *Water Research*, 16:179.

Enfield, C.G. and G. Bengtsson. 1988. Macromolecular Transport of Hydrophobic Contaminants in Aqueous Environments. *Ground Water,* 26(1): 64-70.

Gschwend, P.M. and M.D. Reynolds. 1987. Monodisperse Ferrous Phosphate Colloids in an Anoxic Groundwater Plume, *J. of Contaminant Hydrol.,* 1: 309-327.

Herzog, B., J. Pennino, and G. Nielsen. 1991. Ground-Water Sampling. In **Practical Handbook of Ground-Water Monitoring** (D.M. Nielsen, ed.). Lewis Publ., Chelsea, MI, pp. 449-499.

Horowitz, A.J., K.A. Elrick, and M.R. Colberg. 1992. The effect of membrane filtration artifacts on dissolved trace element concentrations. *Water Res.,* 26(6):753-763.

Laxen, D.P.H. and I.M. Chandler. 1982. Comparison of Filtration Techniques for Size Distribution in Freshwaters. *Analytical Chemistry*, 54(8):1350.

McCarthy, J.F. and J.M. Zachara. 1989. Subsurface Transport of Contaminants, *Environ. Sci. Technol.*, 5(23):496-502.

McCarthy, J.F. and C. Degueldre. 1993. Sampling and Characterization of Colloids and Ground Water for Studying Their Role in Contaminant Transport. In: Environmental Particles (J. Buffle and H.P. van Leeuwen, eds.), Lewis Publ., Chelsea, MI, pp. 247-315.

Parker, L.V. 1994. The Effects of Ground Water Sampling Devices on Water Quality: A Literature Review. *Ground Water Monitoring and Remediation*, 14(2):130-141.

Penrose, W.R., W.L. Polzer, E.H. Essington, D.M. Nelson, and K.A. Orlandini. 1990. Mobility of Plutonium and Americium through a Shallow Aquifer in a Semiarid Region, *Environ. Sci. Technol.*, 24:228-234.

Puls, R.W. and M.J. Barcelona. 1989. Filtration of Ground Water Samples for Metals Analyses. *Hazardous Waste and Hazardous Materials,* 6(4):385-393.

Puls, R.W., J.H. Eychaner, and R.M. Powell. 1990. Colloidal-Facilitated Transport of Inorganic Contaminants in Ground Water: Part I. Sampling Considerations. EPA/600/M-90/023, NTIS PB 91-168419.

Puls, R.W. 1990. Colloidal Considerations in Groundwater Sampling and Contaminant Transport Predictions. *Nuclear Safety*, 31(1):58-65.

Puls, R.W. and R.M. Powell. 1992. Acquisition of Representative Ground Water Quality Samples for Metals. *Ground Water Monitoring Review,* 12(3):167-176.

Puls, R.W., D.A. Clark, B.Bledsoe, R.M. Powell, and C.J. Paul. 1992. Metals in Ground Water: Sampling Artifacts and Reproducibility. *Hazardous Waste and Hazardous Materials*, 9(2): 149-162.

Puls, R.W. and C.J. Paul. 1995. Low-Flow Purging and Sampling of Ground-Water Monitoring Wells with Dedicated Systems. *Ground Water Monitoring and Remediation,* 15(1):116-123.

Ryan, J.N. and P.M. Gschwend. 1990. Colloid Mobilization in Two Atlantic Coastal Plain Aquifers. *Water Resour. Res.*, 26: 307-322.

Thurnblad, T. 1994. Ground Water Sampling Guidance: Development of Sampling Plans, Sampling Protocols, and Sampling Reports. Minnesota Pollution Control Agency.

U. S. EPA. 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance. Office of Solid Waste, Washington, DC EPA/530/R-93/001, NTIS PB 93-139350.

U. S. EPA. 1995. Ground Water Sampling Workshop -- A Workshop Summary, Dallas, TX, November 30 - December 2, 1993. EPA/600/R-94/205, NTIS PB 95-193249, 126 pp.

U. S. EPA. 1982. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846. Office of Solid Waste and Emergency Response, Washington, D.C.

Figure 2. **Ground Water Sampling Log**

Project ________________ **Site** ________________ **Well No.** ______________ **Date** ___________________________

Well Depth _____________ **Screen Length** ___________ **Well Diameter** __________ **Casing Type** _____________

Sampling Device ________________ **Tubing type** ______________________ **Water Level** ___________________

Measuring Point ____________________ **Other Infor** ____

____

Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project ________________ **Site** ________________ **Well No.** ______________ **Date** __________________________

Well Depth _____________ **Screen Length** ___________ **Well Diameter** __________ **Casing Type** ____________

Sampling Device ________________ **Tubing type** ______________________ **Water Level** __________________

Measuring Point ____________________ **Other Infor** ____

____

Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $\mathrm{Vol}_{cyl} = \pi r^2 h$, $\mathrm{Vol}_{sphere} = 4/3\pi\ r^3$

ATTACHMENT B
GUIDELINES and PROTOCOLS FOR PFOA SAMPLING

NEW YORK STATE OF OPPORTUNITY.
Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

October 2020

www.dec.ny.gov

Table of Contents

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
	part of the remedy selection process in accordance with Part 375 and DER-10.		
Soil Sample Results, page 10	“The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase.”	“Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. “ [Guidance Value Table] “PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. ”	9/15/2020
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
	If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020

October 2020

New York State of Opportunity | Department of Environmental Conservation

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

---

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected.

Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix F) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER's Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids). Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist.

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below. In addition, further assessment of water may be warranted if either of the following screening levels are met:

a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or
b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values.

---

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

---

[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP-approved lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an “Analytical Methods/Quality Assurance Summary Table” specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment

- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification.   Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled “General Fish Handling Procedures for Contaminant Analysis” (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **<u>The Bureau of Ecosystem Health will supply the bags.</u>** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **<u>The Bureau of Ecosystem Health will supply the larger bags</u>.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

    No materials containing Teflon.
    No Post-it notes.
    No ice packs; only water ice or dry ice.
    Any gloves worn must be powder free nitrile.
    No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
    No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
    Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
    Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
    Wear clothing washed at least six times since purchase.
    Wear clothing washed without fabric softener.
    Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

page ______ of ______

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ____ DEC Region ____________

Collections made by (include all crew) ____

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________________

Preservation Method: ☐Freezing ☐Other ________________ Notes (SWFDB survey number): ____________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ____________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ___________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of _____________________________________, in _______________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on __________________________________, 20______.

____ __________________________
Signature Date

I, _________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

_____________________________________ __________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

Appendix I - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 14 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of five standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%. Linear fit calibration curves should have an R^2 value greater than 0.990.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and non-detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

ATTACHMENT C
GROUNDWATER SAMPLING/PURGE LOG

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC

Monitoring Well Sampling Log Sheet

Job No.: _______________ **Well No.:** _______________ **Date:** __/__/__

Well Depth: _____________ **Screen Length:** ________________ **Well Diameter:** ____________ **Casing Type:** ____________

Sampling Device: _________________ **Tubing Type:** _______ **Initial DTP:** _______________ **Initial DTW:** _____________

Well Volume: _____________________ **Total Volume Purged:** ______________

Sampling Personnel:____

Low Flow Sampling required ? Yes : _________ No: _____________

Order of stabilization			a	b	c	e	f	d	
Deviation			±1		± 3%	± 10%	± 10%	± 10 mv	
Time	**DTP (ft)**	**DTW (ft)**	**pH**	**Temp (ºF)**	**Cond. (S/Cm)**	**Dis.O2 (mg/L)**	**Turb.(NTU)**	**ORP (mV)**	**Notes**

ATTACHMENT D
RESUME OF KEY PERSONNEL

TAREK Z. KHOURI, P.E.

PRINCIPAL
ENVIRONMENTAL ENGINEER

Education

M.S. Environmental Engineering, University of Central Florida

B.S. Chemistry, University of Central Florida

Certifications/Training

OSHA: 40 Hour HAZWOPER; 8 Hour Supervisor Management; 10 Hour Construction Safety

USACE Construction Quality Management

Professional Licenses

Professional Engineer (P.E.)
Connecticut # 0031583
D.C. # 908711
Maryland # 49155
Massachusetts # 52601
New Jersey # 24GE04697200
New York # 086611
Pennsylvania # PE084919
Rhode Island # 12059
Texas # 125442
Virginia # 0402056415

Summary of Experience

Mr. Khouri has more than 25 years of experience in the real estate development, construction and engineering industries.

He has been a trusted partner, providing environmental consulting services to public and private sector clients including developers, real estate owners, investors, facility managers and city, state and federal agencies and municipalities.

Mr. Khouri has participated and managed the remediation and reuse of contaminated properties for over 20 years. He has performed, directed, and overseen environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, fuel farms, refineries, former manufactured gas, landfills, and a variety of residential, commercial and industrial settings.

Mr. Khouri integrates environmental risk management with land use planning and sustainable development to meet the needs and objectives of diverse clients and stakeholders for residential, commercial, and industrial real estate, in urban and rural environment. Mr. Khouri utilizes his technical expertise as well as his leadership and management skills to direct and oversee teams of professionals for the successful completion of these complex projects.

Relevant Experience

Emergency Operation for Development Project (EODP-RF-/C6), Iraq – Tarek is currently the Senior Environmental Technical Auditor working to assess quality of works and goods supply services funded under the Emergency Operation for Development Project (EODP-RF-/C6). The Government of Iraq, through REFAATO, has engaged a Technical Auditor (Consultant) to carry out technical audits on all projects. The focus of the Environmental Technical Audit is the verification of compliance with relevant environmental Iraqi laws and guidelines provided by the World Bank. As part of the environmental and social management audit team, HydroTech team is responsible for reviewing Environmental Site Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), and checklist ESMPs prepared by the various ministries and auditing implementation of these environmental and social management instruments, via the review of monthly progress reports, field site reports, field site inspections, and correspondences issued by the local management teams and the corresponding ministries, to assess compliance and provide recommendations.

VIP Hotel, Manama, Bahrain – Led a team of multi services designers and construction managers to provide constructability design review (environmental, structural, electrical, architectural and civil) for a 30-story five stars hotel. Also provided construction management services during the development of the hotel. Construction Cost: $20 Million

Waste Management and City Cleaning, Doha, Qatar – Ran Averda Environmental Services as a Managing Director to manage the Qatari market from business development, administrative, operational, technical, and financial responsibilities. The company services included solid and liquid waste collection, transportation, sorting, and recycling. Additionally, the work included city cleaning, facility management, and sustainable design services all over Qatar. During my tenure at Averda, Mr. Khouri managed to increase the revenues of the Qatar operation from $3 Million to $12 Million, double its fleet, and grow its resources from 70 to 165 employees.

OQYANA World First, Dubai, UAE – Provided geotechnical and waterfront/marine engineering evaluations of the island's perimeter seawalls and ground improvement schemes, as well as seismic slope stability analysis at the edge of the islands. The proposed design effort and creative approach led to enormous budget and schedule savings for the client. Hudson Yards, Proposed New York Jets Stadium, New York, NY – Client: NY Jets - Served as the environmental project manager for the due diligence, investigation, and preliminary design phases of the proposed Jets Stadium. The work included subsurface investigation for soil, groundwater, and soil gas, and required close interaction with multiple entities including the MTA, LIRR, NYCTA, NYCDOS, NYSDEC, and Amtrak. Construction Cost: $1+ Billion

Beach Restoration, Al Athaiba Beach (Muscat, Oman) - Provided environmental engineering and site civil support for erosion control and restoration of the beach. Fees: $500,000

Beach Restoration, Saint Germain sur Ay Beach (La Manche, France) - Provided environmental engineering and site civil support for erosion control and restoration of the beach. Fees: $500,000

Normandy Landfill Treatment Project, Beirut, Lebanon - Managed the remediation program of a 60 acres' landfill reclamation project. Additionally, Mr. Khouri corresponded with management, owners, developers, and government representatives, and his involvement with the project from the design stage throughout the full remediation led to the project ultimate success with regard to the remediation design and schedule and budget compliance. Construction Cost: $65 Million

Global Infrastructure Project, Harare, Zimbabwe – Provided owner representation services for conducting due diligence and feasibility studies for multibillion dollars infrastructure development projects. Projects are BOT and included a 120,000-bbd oil refinery, 300 Km oil pipeline, 20,000 unit's housing project, resorts, telecommunication improvement, and assessing mining concessions. Construction Cost: $7.2 Billion

USA Representative Projects

Environmental Impact Assessments, Phase I ESAs, and Phase II ESIs - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, and Insurance Firms - Conducted 100s of environmental assessments for various entities specializing in urban renewal: Mixed use, residential, commercial, warehouses, manufacturing facilities, gas stations and vacant lands. I also designed and executed subsurface investigations for soil, groundwater, and soil gas.

Remedial Investigation, Remedial Design and Associated Remediation Projects - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, Insurance Firms - Managed myriads of environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, former manufactured gas and a variety of other commercial and industrial settings. Constituents of concern have included LNAPLs and DNAPLs, petroleum hydrocarbons, chlorinated solvents, soil vapor, coal tar, creosote, PCBs, and metals. Managed and participated in historical research, sample collection and data evaluation, synthesis of information to determine site-specific cleanup levels, remedial technology evaluation, design of treatment systems, site cleanup, installation and operation of treatment systems, optimizing systems, and performance monitoring.

LIRR/MTA East Side Access Project, New York, NY - Client: MTA - The project involves the construction of new metro tunnels system in densely developed areas of midtown Manhattan, new tunnels system construction beneath active Amtrak, Metro North and NYCTA facilities, construction of new terminals, ventilation facilities, off street entrances, and yards development. In addition to establishing the guidelines of the project specific environmental management system, I provided direct and extensive public and community relations outreach, educational and awareness programs, as well technical support for the design engineering and construction teams, inspectors, and environmental sub consultants, so that construction of the project proceeds in compliance with environmental commitments, be conducted under budget and on time, while maintaining the utmost quality. Another key component of the project success was the direct and constant coordination between the environmental department and the multiple agencies and operators/owners of the project, such as USEPA, NYSDEC, NYSDOH, NYCDOT, NYCDEP, NYCDOB, MTA, LIRR, NYCTA, Amtrak, and Metro North. Construction Cost: $8.4 Billion

Hudson Yards, Proposed New York Jets Stadium, New York, NY – Client: NY Jets - Served as the environmental project manager for the due diligence, investigation, and preliminary design phases of the proposed Jets Stadium. The work included subsurface investigation for soil, groundwater, and soil gas, and required close interaction with multiple entities including the MTA, LIRR, NYCTA, NYCDOS, NYSDEC, and Amtrak. Construction Cost: $1.4 Billion

Columbia University Manhattanville Expansion Project, New York, NY – Client: Columbia University - Columbia University new campus will be built within a 17-acre area and will be comprised of academic and research facilities, housing, as well as commercial retail stores and open space areas. As the senior environmental project manager, I oversaw all environmental engineering related activities, including site assessment prior to the development, pre-construction support for demolition, recycling, soil and groundwater management, air quality controls, and LEED certification support. Construction Cost: $2+ Billion

Potable Water System Testing for Lead, New York, NY – Client: NYCSCA - Directly managed the emergency work for the sampling, testing, evaluation and reporting of lead in the potable water of approximately 300 public schools in New York City. HAKS was one of the main consultants working for NYCSCA to implement a potable water system testing protocol which included coordination with school facilities, field work encompassing flushing and sampling, laboratory testing, analyzing, and reporting sample results. The project was conducted on a tight 24/7 timetable. The project was completed successfully under the direct supervision and daily coordination with the NYCSCA, with limited to no disturbance to schools' schedule and extracurricular activities, on time and on budget.

City University of New York, Tank Rehabilitation, Remediation and Closure Program, New York, NY – Client: DASNY - Served as the project manager for the technical assessment, remediation design, and oversight of the Underground Storage Tank (UST) facilities at seven City University campuses. Tanks sizes ranged from 550 Gal to 50,000 Gal. The work included design drawings and construction documents for the tanks and dispensing systems for vapor recovery, fire suppression, electronic monitoring/sensing, pumping/delivery, storage tank details, site restoration, subsurface investigation, and spill remediation. Construction Cost: $5 Million

Active Fuel Oil Terminal, Brooklyn, NY – Client: Bayside Fuel Oil Depot Corporation - Managed the remedial investigation in connection with petroleum releases at an active fuel oil terminal located on Gravesend Bay. Developed and executed a strategy to manage client's liability relating to light non-aqueous phase liquid (LNAPL). Negotiated an alternative remedial action which benefitted the adjacent property and NYSDEC while eliminating client from liabilities at the adjacent property. Investigated and evaluated storm water infrastructure, and included an updated storm water management plan, as part of a sustainable groundwater remedy. Fees: $1.1 Million

54 Rutledge St, Insitu Bio-Remediation, Brooklyn, NY – Client: Fortis Property Group -Managed the implementation of a remedial action for major petroleum and gasoline spills. The remedial action consisted of a multi-phased approach to site cleanup, which included excavation and removal of contaminated soil and groundwater, removal of underground storage tanks, injection of chemical oxidation compounds into the groundwater table, installation of permanent remedial injection and monitoring points, installation of a soil vapor mitigation system, and delineation of off-site contamination. Fees: $1.0 Million

Circuitron Corporation Superfund Site, Ground Water Treatment System, East Farmingdale, NY – Client: USACE - Served as the Project Engineer and the Health and Safety Officer providing technical direction for on-site staff, guidance in hazardous waste/material management, and performing technical review of reports and contract deliverables. Coordinated with USEPA and USACE for the day-to-day operations and quality control matters. Fees: $1.6 Million

Constructability Review – Justice Sonia Sotomayor Houses, Bronx, NY – Client: NYCHA - Constructability Review for the upgrading/rehabilitation of the Justice Sonia Sotomayor Houses in the Bronx for the New York City Housing Authority (NYCHA). The scope of work includes such repairs as Local Law 11 Brick Facade repair/waterproofing for areas of significant disrepair (including brick masonry, window sills/lintels, and brick parapet replacement with metal railing); roof replacement (asbestos abatement, 4-ply insulated roofing, roof drains); interior repairs/sheet rock/painting to apartments with water damage, new window installation at all locations; replacement of the water tanks, pumps, and repairs to the water tank structures in particular buildings; repairs to the property's main loop and improvements to entrances, lobbies and security. Construction Cost: $102 Millions

LCP Chemicals Inc. Superfund Site, Linden, NJ – Client: LCP Chemicals Inc. - Served as the Project Manager and the Health and Safety Officer for the interim removal action program for mercury clean up and removal, petroleum contaminated soil excavation, storage tanks and steel structure demolition. The job also included a drum landfill investigation, done in level B PPE. Awarded the 74th Annual Governor's Occupational Safety & Health Award Citation of Merit of the State of New Jersey in 2002. Fees: $1.1 Million

FAA Technical Center, PCB Soil Remediation at Area 20A Superfund Site, Atlantic City, NJ – Client: USACE - Served as a Laboratory Manager for the PCB contaminated soils removal project at FAA Technical Center. Responsibilities included the development of sampling and analysis plans, establishment of project data quality objectives, evaluation and selection of laboratories for testing programs, data quality assessment, and reports preparation. Fees: $3.2 Million

FAA Technical Center, Area D Jet Fuel Farm Superfund Site, Atlantic City, NJ – Client: USACE - Served as the Quality Control Manager, supervising laboratory prequalification, fieldwork, and laboratory analysis. Evaluated and optimized the operation of the groundwater treatment system, CEM, and SVE bioremediation system, and prepared quarterly reports deliverables to the USEPA and the USACE. Also performed quality assurance audit and review for the pre-excavation sampling results performed by FAA subcontractors, using field test kits for PCB and TPH. Fees: $2.1 Million

Publications

Reductive Dehalogenation of Tetrachloroethylene by Soil Sulfate Reducing Microbes Under Various Electron Donor Conditions (2000).

The Effect of Organic Substrates on Enhanced Biological Phosphorus Removal in Continuous Culture and Batch Experiments (1998).

Comparison of Enhanced Biological Phosphorus Removal Populations under Ten Different Environmental Conditions (1998).

Observations From Steady State and Batch Experiments Concerning the Effect on Enhanced Biological Phosphorus Removal of Volatile Fatty Acids and Glucose (1997).

Single Stage Anaerobic and Aerobic Sequencing Biotransformation and Mineralization of Tetrachloroethylene (PCE) for the Remediation of Contaminated Soils and Groundwater (1996).

Mark E. Robbins, P.G., CPG, CEI

VICE PRESIDENT

Education

B.S., Geology,
State University of New York,
Oneonta, 1991

Certifications/Training

OSHA 30 Hour, Construction

Professional Licenses

NYS PG #000087
C.P.G. # 10527
C.E.I. # 73383

Summary of Experience

Mr. Robbins has over twenty-eight (28) years' experience in geology and hydrogeology, involving such activities as Phase I Environmental Site Assessments, Phase II Environmental Site Assessments, Subsurface Investigations, Remedial Actions, data acquisition, evaluation and contouring, and geotechnical investigations. Mr. Robbins has performed over 800 Phase I Assessments involving residential through heavy industrial properties and over 400 Subsurface Investigations throughout the United States. Mr. Robbins has also designed and implemented over 30 remediation systems for both public and private sectors.

Relevant Experience

Environmental Site Assessments – Conducted Phase I and II Environmental Site Assessments, analysis of site investigation reports, identifying contamination locations and sources. Soil, soil-vapor and water sampling, analyzing laboratory results for QA/QC, magnetometer and Ground-Penetrating Radar surveys for locating buried drums and underground storage tanks (USTs), estimating UST and other subsurface leaks, monitoring well logging, Project Management, liability assessments and estimating costs to attain compliance.

Remedial Investigation and Feasibility Studies - Oversight/planning of site investigations; data analysis, including statistical analysis and geostatistical contouring utilizing SURFER; performance of feasibility studies, including technology evaluations, alternatives development and evaluation and cost estimations.

Due-Diligence Programs – Designed and implemented due-diligence programs (ranging from Phase I Assessment to Comprehensive Hydrogeologic Investigations) to assess environmental liabilities for numerous land development clientele.

Delineation of Chlorinated Organic Plumes – Supervised the delineation of a dissolved chlorinated organic plume from underground tank loss. Developed a remedial action program in accordance with New York State regulatory guidelines to abate soil and groundwater contamination.

Remedial Action – Prepared numerous Remedial Action Plans. Designed and implemented hydrocarbon and chlorinated solvent remediation systems for soil and groundwater.

Pump Test Aquifer Analysis – Conducted several pump tests and pump test analysis and field coordination in relation to dewatering permit requirements for Keyspan Energy and the private sector.

DORINA ALIU
PROJECT MANAGER

Education

M.E., Chemical Engineering,
The Cooper Union for the
Advancement of Science and Art,
New York, NY, 2016

B.E., Chemical Engineering,
The Cooper Union for the
Advancement of Science and Art,
New York, NY, 2012

Certifications/Training

OSHA 40 Hour HAZWOPER
OSHA 30 Hour Construction
OSHA 10 Hour Construction

Professional Licenses

LEED Green Associate
Engineer in Training (EIT)

Summary of Experience

Ms. Aliu provides multifaceted environmental engineering support services to the firm's private and public client base. These services include Phase I and II ESAs; remedial investigation, design, and oversight; and community air monitoring. Ms. Aliu is also working with several governmental agencies such as the NYSDEC, NYCDEP, and NYCOER, to facilitate project flows and approvals. Ms. Aliu is also responsible for the review and preparation of RFP's, reporting activities, remedial investigation, design, and oversight for commercial and industrial sites in the New York City region, and coordination and communication with regulatory agencies.

In her current role, Ms. Aliu also oversees all marketing functions including strategy, branding, positioning and messaging, and social media and website publications, to continue building the company's brand and executing strategies to support business development and strategic growth objectives. Ms. Aliu has been instrumental to enhancing revenue and profitable growth, increasing company visibility, and strengthening leadership objectives.

Relevant Experience

Emergency Operation for Development Project for Technical Audit Consulting Services, Salah Al-Din Governorate & Diyala Governorate, Iraq, Client: ReFAATO – To assess quality of works and goods supply services funded under the EODP, the Government of Iraq, through REFAATO, has engaged a Technical Auditor (Consultant) to carry out technical audits on all projects. HydroTech Environmental Engineering and Geology, DPC is working for AFGI and is serving as the Environmental Consultant tasked with performing a Technical Audit for all the project sectors in order to verify that goods supply services already carried out have been performed in compliance with applicable technical standards and specifications included in respective contracts. The focus of HydroTech's Technical Audit will be the verification of compliance with Iraqi laws and guidelines provided by the World Bank. As part of the environmental and social management audit team, Ms. Aliu is reviewing Environmental Site Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), and checklist ESMPs prepared by the various ministries and auditing implementation of these environmental and social management instruments to assess compliance and provide recommendations.

Groundwater Injections and Site Remediation for Commercial Redevelopment in Sunnyside, NY – Client: Kingston

Developers, LLC – Currently providing environmental engineering services in support of the remediation and redevelopment of a 12,000 square foot property in Sunnyside, Queens. As the Project Manager, Ms. Aliu managed the environmental due diligence, including the Phase I ESA and Phase II ESI, preparation of a remedial action plan to address impacts identified in groundwater, implementation of the selected remedial strategy, groundwater injections, and oversight of the remedial elements throughout the construction of a mid-rise commercial building.

NYC OER "E-Designation Program" Remediation Oversight for Mixed-use Development in Bronx, NY – Client: Altmark Group, LLC – Provided environmental engineering oversight and support services for the remediation of a 7,500 square foot property in Bronx, New York as part of the NYC OER E-Designation Program. Ms. Aliu managed the environmental due diligence, including the Phase I ESA and Phase II ESI, preparation of a remedial action plan to address impacts to soil, design of engineering controls including a vapor barrier and Sub-slab Depressurization System, implementation of the selected remedial strategy including soil removal and installation of engineering controls, removal and registration of nine (9) 550-gallon underground storage tanks, and oversight of the remedial elements throughout the construction of a 5-story mixed use building. The project included close coordination with NYC OER and NYSDEC.

Brownfield Cleanup Program Remediation of Chlorinated Solvent Discharges at Dry Cleaner, Brooklyn, NY – Client: Top Hat Cleaners, LLC – Currently providing environmental engineering support and managing the cleanup of an active dry cleaner enrolled in the NYSDEC Brownfield Cleanup Program. The remedial program is aimed at remedying the impact of chlorinated solvents in the soil and groundwater and to mitigate on-site exposure.

Water Testing for Lead in New Jersey School Districts, Various Townships, NJ – Client: Hunterdon County Educational Services Commission and Educational Services Commission of New Jersey – Managed water testing efforts for various school districts in townships throughout New Jersey. Testing was mandated by the New Jerseys Board of Education according to regulations adopted in July of 2016. In response to this mandate, HAKS was one of the key consultants providing consulting and sampling services to help address the possible presence of lead in potable water systems at these schools. The project scope included sampling, reviewing analytical results, and providing guidance on effective remedial measures.

Potable Water Supply System Testing for Lead in NYCDOE Facilities, New York, NY – Client: NYCSCA - Played a vital role in the emergency work for the sampling, testing, evaluation and reporting of lead in the potable water of approximately 300 public schools in New York City. HAKS was one of the main consultants working for NYCSCA to implement a potable water supply system testing protocol which included coordination with school facilities, field work encompassing flushing and sampling, laboratory testing, analyzing, and reporting sample results. The project was conducted on a tight 24/7 timetable. The project was completed successfully under the direct supervision and daily coordination with the NYCSCA, with limited to no disturbance to school's schedule and extracurricular activities, on time and on budget.

Remediation Program for Waterfront Residential Development, Whitestone, NY – Client: Edgestone Group LLC – The project involved remediation of a 12.5-acre waterfront property which entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation. As the environmental engineer on the project, Ms. Aliu provided direct oversight over remediation activities which included soil excavation and sampling and implementation of storm water controls, dust controls, and community air monitoring.

Remediation Mitigation Design and Environmental Permitting – Brooklyn, NY, Client: Glacier Global Partners, LLC – Project involved renovation of an existing waterfront historic 10-story commercial building. The scope of work for this project included certification of a sub-slab depressurization system (SSDS) design, supervision of the installation of the SSDS, preparation and certification of the closure report, preparation and filing of a Quality and Quantity Dewatering Permit with NYCDEP, and regulatory coordination to secure approvals from NYCOER and NYCDEP. As environmental engineer on this project, Ms. Aliu was involved in the design of the engineering controls and SSDS system. Ms. Aliu also provided oversight during implementation of the SSDS system.

Department of Homeless Services – Shelter Violations, New York City, NY, Client: Department of Homeless Services – Project involved the assessment, mitigation and removal of more than 4,500 violations issued to over 270 Privately Owned Homeless Shelters throughout the five boroughs of New York City. The scope of work included scheduling the physical construction work at each site to complete work in the most timely and efficient manner to close out outstanding violations and to verify compliance with all laws resulting in violations being closed out by the respective governmental agencies. As part of the project team, Ms. Aliu’s responsibilities included cataloguing records of existing non-compliances in a database system, tracking work as it was completed and providing progress reports, as well as cataloging each non-compliance and violation by type, recommending methodologies, and determining the timeframe and workforce required to address each.

Companywide Assessment of Water Quality Standards, New York, NY, Client: Consolidated Edison - Conducted companywide assessment of water quality standards to ensure continued compliance with state and federal regulations and to prevent millions of dollars in potential non-compliance fines. Developed corrective actions for existing water discharge vulnerabilities, prepared cost estimates for alternative system improvements and summarized recommendations and financial analysis in a report.

ANUSHA AGNOOR
ENVIRONMENTAL ENGINEER

Education

M.S. Chemical Engineering, University of Pittsburgh, PA - 2017

B.S. Chemical Engineering, Indian Institute of Technology, Bombay (IIT Bombay) - 2016

Certifications/Training

- OSHA: 40 Hour HAZWOPER
- OSHA: 8 Hour HAZWOPER Refresher
- OSHA: 30 Hour, Construction & General Industry
- Construction Finance - Columbia University
- Successful Negotiation: Essential Strategies & Skills – University of Michigan
- NYCT Track Safety Training (2018-2020)

Summary of Experience

Ms. Agnoor has two (2) years of experience in ACE (Architecture, Engineering and Construction) industry and provides environmental services for private clients. These services include site assessments, soil and groundwater remediation, NYC E-Designation investigation, hazardous waste management, remedial design, environmental compliance, field and analytical data management and report preparation.

Ms. Agnoor is working on multiple NYC E-Designation sites under the oversight of The New York City Mayor's Office of Environmental Remediation (NYC OER). The major responsibilities include guiding the client through the environmental petition process, facilitating the client to obtain related environmental approvals/permits, reporting to responsible agencies and ensure the compliance with regulatory requirements.

She is well versed in relevant environmental regulatory standards, laws, compliance and enforcement protocols at the city, state and federal level; her knowledge and experience with environmental agencies includes work with: USEPA, NYSDEC, NYCDEP, NYC OER and others.

Work Experience

Environmental Site Assessments – Perform Phase I/II Site Assessments, analyze site investigation reports, identify contaminated locations and sources. Perform soil, soil-vapor and groundwater sampling for voluntary cleanup program (VCP) and brownfield cleanup program (BCP) sites, analyze laboratory results for QA/QC, prepare remedial investigation reports, remedial action work plans and closure reports.

Remediation at a Residential Development Site, Bronx, NY – Client: Leguci Piping & Heating LLC– Project involves development of a 6,000 square foot property into a 4-story residential building with 16 units, driveway, rear yard and a full cellar. Currently assisting the client with remedial investigation and remedial design in pursuing NTP (notice to proceed) from NYC OER required for pulling construction permits. Responsible for upcoming site supervision tasks such as waste characterization, excavation oversight, engineering controls oversight and obtaining final signoff from NYC OER. (2020 – Present)

Remediation at a Residential Development Site, Bronx, NY – Client: The Stagg Group– Project involves the development of a 10,884 square foot site into a 7-story residential building containing 54 units with a full basement. Currently assisting the client with remedial investigation and remedial design in pursuing NTP (notice to proceed) from NYC OER required for pulling construction permits. Responsible for upcoming site supervision tasks such as waste characterization, excavation oversight, engineering controls oversight and obtaining final signoff from NYC OER. (2020 – Present)

Remediation at a Residential Development Site, Bronx, NY – Client: The Stagg Group– Project involves the development of a 28,650 square foot site into a 7-story residential building containing 116 units with a partial basement, outdoor parking and a rear yard. The site is currently undergoing remediation and I performed remedial investigation, remedial design, waste characterization, and construction oversight for the excavation. Services remaining include engineering controls oversight and obtaining final signoff from NYC OER. (2019 – Present)

Remediation at a Residential Development Site, Bronx, NY – Client: A2Z Construction – Project involves development of a 5,250 square foot property into a two (2) 4-story residential buildings with 10 units each in building and a cellar. Helped the client with remedial design and in pursuing NTP (notice to proceed) from NYC OER required for pulling construction permits. Responsible for upcoming site supervision tasks such as waste characterization, excavation oversight, engineering controls oversight and obtaining final signoff from NYC OER. (2019 – Present)

Remediation at Landmark, Brooklyn, NY – Client: Mckissack & Mckissack The Site is located in an urban area predominately comprised of low-rise commercial structures and residential apartment buildings in Brooklyn, New York. The Site is a triangular block of approximately 8,500-square feet and currently is developed as a park that has been closed to visitors for at least the past ten years due to subsurface conditions that have caused settling and movement of the existing paths within the park. Development consists of redesign and redevelopment of BAM Park into an operational park safe for recreation. Services include waste characterization, engineering controls supervision such as composite cover, planting and fencing and obtaining final signoff from NYC DEP. (2019 -Present)

Spill Delineation and Remediation at a Residential/Dormitory Redevelopment Site, Bronx, NY – The project involves renovating a 2-story commercial building with an existing partial basement into a two story residential/dormitory building to be used as sleeping rooms for homeless individuals with accessory offices and support spaces, a cellar and an elevator pit. I was responsible for remedial investigation, remedial design and facilitated with the client to pursue Notice to Proceed from NYC OER. In addition, performed spill delineation at the site by installing soil probes and monitoring wells. Coordinated with NYSDEC with the findings of spill delineation and suggested implementation of oxygen-releasing compound (ORC) socks in monitoring wells to reduce VOC concentrations over time. (2019)

Site Management at multiple Residential Development Sites, Bronx and Brooklyn, NY – Performed annual inspection of the engineering controls (ECs) at various residential sites where remediation and construction were completed and reported the results to NYC OER. The development of these sites included 6- story, 7-story and 8-story residential buildings. (2019 – Present)

Info Tran Engineers, P.C., NJ - Worked on technical proposals and projects related to various federal agencies of NY & NJ. Provided technical and non-technical proposal content to the proposal team for RFP's and RFQ's of various agencies like MTA, PANYNJ, NYCSCA, NYCHA, NYSDOT, NYCDDC, GOSR, NJDOT, NJ Transit, RGRTA, NYSDOH, DSNY, NYS Parks and others of NY & NJ. Acted as liaison for communication and resolved issues between client and sub-consultants during task order assignments for accomplishing SBE/MBE/DBE/WBE goals. Assisted project team with shop drawings, as-built drawings, communication procedures, development plans and work schedules. Assisted the senior project managers, principle-in-charge and project managers in finalizing the as-builts, preliminary designs, final designs and also developed quality plans, technical reports, technical specifications, contract specifications etc. Developed strong understanding of project management processes towards developing project charter, identifying stakeholders, risks, assumptions, constraints, project plans etc. per the PMBOK best practices. Developed cost proposals and master schedules for proposals taking all aspects of the project phases into consideration. Accrued strong documentation, analytical and organizational skills. (2018)

DONALD C. ANNÉ
SENIOR CHEMIST

EDUCATION:	M.S., Chemical Oceanography, Florida Institute of Technology, 1981 B.A., Earth Sciences, Millersville University of Pennsylvania, 1975
SPECIAL TRAINING:	Certified 40-Hour OSHA Health and Safety Certified 8-Hour OSHA Supervisory Course Ground Water Geochemistry (NWWA) Ground Water Pollution and Hydrology (Princeton Associates) Quality Assurance Programs for Environmental Monitoring Data (Stat-A-Matrix)
PROFESSIONAL AFFILIATIONS:	American Chemical Society (AFS), 1979-Present

EXPERIENCE SUMMARY:

Mr. Anné has more than 27 years of environmental chemistry experience specializing in data validation, environmental sampling, analytical methodologies, petroleum fingerprinting, laboratory audits, field sampling audits, and preparing Quality Assurance Project Plans and Quality Assurance Manuals. Mr. Anné's experience includes analytical laboratory work with gas chromatography, atomic absorption, infrared spectrometry and wet chemistry methods.

PROJECT EXPERIENCE:

Quality Assurance/Quality Control of Chemical Data

Mr. Anné has more than 20 years experience as a data validator and quality assurance officer. Mr. Anné has validated data for most EPA Regions and under several independent state programs, including the NYSDEC. He has performed laboratory and field audits as well as written Quality Assurance Project Plans. Mr. Anné has written, reviewed, and initiated laboratory Quality Assurance Manuals for laboratories to maintain their regulatory compliance. Typical project experience includes:

- Senior Chemist responsible for data validation. Reviewed chemical data for several projects under the New Jersey ISRA regulations. The clients included industry and utilities.

- Supervising Environmental Scientist responsible for data validation. Reviewed chemical laboratory data for adherence to QA/QC protocols for several key projects, including National Priorities List sites and RCRA Corrective Actions located in EPA Regions I, II, III, IV, V, and IX. Validated analytical data, outlined problems and actions to be taken, and qualified all affected data. Consulted with project managers on data usability, and recommended corrective actions to support project goals. Responded to comments made by regulators regarding data quality.

- Supervising Environmental Scientist recognized by the New York State Department of Environmental Conservation (NYSDEC) to perform third party data validation. Attended NYSDEC workshop on data validation as part of the requirements set forth by NYSDEC. Performed data validation in support of NYSDEC STARS and ASP programs as well as data in support of the NYSDEC Part 360 Regulations for landfills. Validated data for an Albany area municipal landfill.

- Supervising Environmental Scientist responsible for developing and preparing Quality Assurance Project Plans (QAPPs) for several state and federal Superfund sites and federal RCRA corrective action sites. Negotiated with regulators for the acceptance of the QAPPs. The sites were located throughout the eastern United States.

- Environmental Chemist responsible for developing a laboratory QA/QC program which fulfilled requirements of the EPA and agencies from the States of Texas and Louisiana. Implemented and managed the program throughout DOE's SPR Environmental laboratories. Received verbal commendations from EPA and the Texas Water commission on the QA/QC Program.

Environmental Chemistry

Mr. Anné is experienced in sampling soil, water, air, and wastes in accordance with federal and state guidelines. He has performed field sampling audits and prepared sampling plans for numerous projects in accordance with applicable programmatic requirements. Mr. Anné is familiar with the geochemical aspects of fate and transport of contaminants. Mr. Anné's typical project experience includes:

- Data manager for the Pennwalt Corporation's RCRA Corrective Action RFI Phase I program. The project included quantifying and characterizing soil contamination and hydrogeologic flow systems of 12 SWMUs at a flourochemicals plant in Thorofare, New Jersey. Validated and prepared QA/QC reports for data generated during the project. Qualified all data in preparation of the final report. Work was performed under the direction of NJDEP.

- Project Chemist in charge of field sampling activities, including coordinating and scheduling all subcontracted laboratory work for more than 25 sites in Connecticut. Trained field teams in sampling techniques for soil, groundwater, and surface water; chain of custody requirements; sampling QA/QC protocols; and analytical requirements. Work was performed under the scrutiny of ConnDEP.

- Field Team Leader for a major hazardous waste drum excavation project. Supervised all field activities including site safety; excavation; removal, sampling, and over packing of drums; staging and sampling of contaminated soil; and preparation of samples. Coordinated excavation and laboratory subcontractors. Work was performed under the scrutiny of ConnDEP.

- Created an environmental monitoring program for the Bryan Mound site of DOE's Strategic Petroleum Reserve for testing ground water and surface water. Developed sampling protocols, frequency of sampling, and lists of target analytes. This program was designed to provide baseline data for pre-spill conditions in the event of a release. The site was under scrutiny by EPA Region V and the Texas Water commission.

- Project Chemist responsible for developing analytical QA/QC program that included sampling and chemical analyses of surface water, groundwater, soil, and sediment matrices as part of a Remedial Investigation/Feasibility Study (RI/FS). The RI/FS involved more than 25 sites throughout the State of Connecticut. Work was under the guidance of ConnDEP.

Analytical Chemistry

Mr. Anné has experience working in both fixed-base and mobile laboratories. His experience includes the use of gas chromatography, atomic absorption spectrometers, infrared spectrometers, and numerous wet chemistry and preparation equipment methods. He has served in the laboratory as an analyst, laboratory advisor, and QA officer. He has interfaced with regulators in the area of analytical chemistry and has experience in petroleum fingerprinting techniques and methods. Typical projects include:

- Performed bench scale experiments for St. Lawrence Zinc in order to obtain the optimum level of Phlotec necessary to treat discharged water to resolve an N.O.V. for the SPDES outfall. The optimum level of Phlotec would precipitate enough dissolved zinc for the water to meet the discharge requirement. Also performed routine analyses of samples after implementing the treatment, to insure that the proper concentration was being used.

- Environmental Chemist in charge of project to design updates for the DOE's laboratories at its SPR facilities. Evaluated IR and FT-IR instrumentation and personal computers to link with existing and future instrumentation. Wrote procedures for the acceptance of an alternative oil & grease method for NPDES permit

monitoring by EPA Region V. Coordinated all site activities necessary for implementing upgrades.

- Environmental Chemist in charge of replacing obsolete total organic carbon (TOC) analyzers for the SPR laboratories. Evaluated state-of-the-art TOC analyzers and recommended replacement TOC analyzer. Negotiated with supplier and wrote technical specification for the bid process required by DOE. Supervised installation and set-up of all new TOC analyzers.

- Analytical Chemist for Berkley Products Company responsible for product development. Analyzed competitor's products and formulated new coatings with equal or better quality. Responsible for solvent operations which included managing the waste solvent recovery operations, solvent formulation, and manufacturing QA/QC. Worked with sales and manufacturing staff to address and resolve client complaints. Received two cash bonuses for suggestions on the manufacture of products which saved the company money.

- Analytical Chemist for the mobile laboratory responsible for sample preparation in support of several projects for a range of clients located in three EPA regions and in conjunction with several state agencies. Extracted, concentrated, and prepared water and soil samples for analyses by GC/FIND, GC/ECD, GC/PID, and GC/MS. Samples were prepared for PCB, pesticide, polynuclear aromatic hydrocarbon, and petroleum hydrocarbon analyses.

EMPLOYMENT:

2005- present, Alpha Geoscience
1998-2005, Alpha Environmental Consultants, Inc.
1990-1998, McLaren/Hart
1986-1990, Fred C. Hart Associates
1985-1986, Boeing Petroleum Services
1982-1985, Petroleum Operations and Support Services
1981-1982, Dravo Utility Constructors
1979-1981, Florida Institute of Technology
1975-1979, Berkley Products Company

Z:\ALPHA\RESUMES\DCA\DCA-DATA VAL.DOC

ATTACHMENT E
SAMPLE CHAIN OF CUSTODY FORM

YORK
ANALYTICAL LABORATORIES, INC.
120 RESEARCH DR. STRATFORD, CT 06615
(203) 325-1371 FAX (203) 357-0166

Field Chain-of-Custody Record

Page____ of ____

NOTE: York's Std. Terms & Conditions are listed on the back side of this document.
This document serves as your written authorization to York to proceed with the analyses requested and your signature binds you to York's Std. Terms & Conditions unless superseded by written contract.

York Project No.________________

Client Information	**Report To:**	**Invoice To:**	**Client Project ID**	**Turn-Around Time**	**Report Type/Deliverbles**
Company:	Company:	Company:		**24 hr** ________	Summary ______QA/QC Summary______ Results Only
Address:	Address:	Address:	**Purchase Order No.**	**48 hr** ________	RCP Package______ASP B Pkg ________
Phone No.	Phone No.	Phone No.		**72 hr** ________	ASP A Pkg______Excel format________
Contact Person:	Attention:	Attention:		**5 Day** ________	EDD ________OTHER_______________
E-Mail Address:	E-Mail Address:	E-Mail Address:		**Standard**______	

Print Clearly and Legibly. All Information must be complete. Samples will NOT be logged in and the turn-around time clock will not begin until any questions by York are resolved.

Samples Collected/Authorized By (Signature)

Name (printed)

Matrix Codes
S - soil
Other - specify(oil, etc.)
WW - wastewater
GW - groundwater
DW - drinking water
Air-A - ambient air
Air-SV - soil vapor

Volatiles		**Semi-Vols.**	**Pest/PCB/Herb**	**Metals**	**Misc. Org.**	**Full Lists**	**Miscellaneous Parameters**		
8260 full	TICs	8270 or 625	8082PCB	RCRA8	TPH GRO	Pri.Poll.	Corrosivity	Nitrate	Color
624	Site Spec.	STARS	8081Pest	PP13	TPH DRO	TCL Organics	Reactivity	Nitrite	Phenols
STARS	SPLP or TCLP	BN Only	8151Herb	TAL	CT ETPH	TAL Met/CN-	Ignitability	TKN	Cyanide-T
BTEX	Benzene	Acids Only	CT RCP	CT15	NY 310-13	Full TCLP	Flash Point	Tot. Nitrogen	Cyanide-A
MTBE	Nassau Co.	PAH	App. IX	Total	TPH 418.1	Full App. IX	Sieve Anal.	Ammonia-N	BOD5
TCL list	Suffolk Co.	TAGM	Site Spec.	Dissolved	Air TO14A	Part 360-Routine	Heterotrophs	Chloride	CBOD5
TAGM	Ketones	CT RCP	SPLP or TCLP	SPLP or TCLP	Air TO15	Part 360-Baseline	TOX	Phosphate	BOD28
CT RCP	Oxygenates	TCL list	TCLP Pest	**Indiv. Metals**	Air STARS	Part 360-Expanded No Dioxins/Furans	BTU/lb.	Tot. Phos.	COD
Arom.	TCLP list	TICs	TCLP Herb	Hg, Pb, As, Cd	Air VPH	Part 360-Expanded Full List	Aquatic Tox.	Oil&Grease	TSS
Halog.	524.2	App. IX	Chlordane	Cr, Ni, Be, Fe,	Air TICs	NYCDEP Sewer	TOC	F.O.G.	Total Solids
App.IX	502.2	SPLP or TCLP	608 Pest	Se, Tl, Sb, Cu,	Methane	NYSDEC Sewer	Asbestos	pH	TDS
8021B list	5035	TCLP BNA	608 PCB	Na, Mn, Ag, etc.	Helium	TAGM	Silica	MBAS	TPH - IR

Special Instructions
Field Filtered ☐
Lab to Filter ☐

Sample Identification	**Date Sampled**	**Sample Matrix**	**Choose Analyses Needed from the Menu Above and Enter Below**							Container Description(s)

Comments

Preservation **Check those Applicable**	**4ºC____ Frozen____** **HCl MeOH**	**4ºC____**	**4ºC____**	**HNO_3___** **4ºC**	**4ºC____** **H_2SO_4___**	**4ºC____** **Other**	**4ºC____ H_2SO_4____ NaOH____** **ZnAc Ascorbic Other**

Samples Relinquished By Date/Time

Samples Received By Date/Time

Samples Relinquished By Date/Time

Samples Received in **LAB** by Date/Time

Temperature on Receipt

_____ºC

ATTACHMENT F
CONVENTIONAL LABORATORY QA/QC

YORK
ANALYTICAL LABORATORIES INC

120 Research Drive
Stratford, CT 06615
203-325-1371

Quality Manual

Laboratory Director: **Ben Gulizia**

Quality Manager: **Teresa V. Weikel** Teresa V. Weikel

Date of Issue: **April 12, 2013**

Revision: **2.4**

Controlled Copy #: ______

Quality Manual

This Quality Manual meets the requirements of ISO 17025, ISO 9001 and NELAC. This Quality Manual is confidential and assigned as outlined below.

Issued to: ____________________________

Revision History

Revision 2.0	04/30/2010	First issue rewritten quality manual
Revision 2.1	11/13/2011	Updated Org Chart and Master List of Documents
Revision 2.2	06/29/2012	Updated Org Chart and Master List of Documents
Revision 2.3	12/26/2012	Added Data Integrity Plan, Reformatted document
Revision 2.4	04/12/2013	Added Aquatic Toxicity information

Controlled Copy in Canary Yellow only

Table of Contents

Page(s)

1. Introduction

Purpose

This Quality Manual contains all the requirements that our laboratory uses to demonstrate our quality management system, technical competence, and valid results.

Analytical data are used for many purposes, including: compliance with regulatory requirements; determination for the presence, concentration, and movement of hazardous materials in the environment; potential effects upon or protection required for persons; and the actions necessary for disposal of treatment of hazardous materials.

Analytical data may be used to support a broader-based project involved with: site characterization and/or remediation; on-site treatment; treatment and/or disposal or health and safety protection of York personnel and the public. Data may also be produced for outside commercial testing and submitted directly to clients for their decision making. In all cases, data must be of known quality.

It is the purpose of the York Quality Assurance Program, as expressed in this Quality Systems Manual, to provide all data which are of known quality. To achieve this, a system is described which controls:

- Preservation of samples
- Receipt and handling of samples
- Processing and analyses of samples
- Analytical instrumentation
- Data verification
- Data reporting

Section 4 specifies how we demonstrate sound management and maintain client satisfaction.

Section 5 specifies how we demonstrate technical competence in our laboratory.

In addition, this Quality Manual outlines how York complies with:

- ISO 17025
- ISO 9001
- NELAC

All personnel are to take an active role in establishing, implementing, and maintaining our quality management program. We do not separate quality from our daily business. Quality cannot be something that we do just to pass audits. Quality is integrated into every facet of the decision-making process in the management of our laboratory and the science that we practice.

Distribution List

The Quality Assurance Officer (QAO) maintains the distribution list for this Quality Manual.

2. Scope

This Quality Manual facilitates:

- Recognition of technical competence for standardized methods, non-routine methods, and laboratory-developed methods we perform
- Inspection and product certification capabilities and/or services we provide
- Total quality for our administrative and technical systems
- Audits by clients, regulatory authorities and accreditation bodies
- Meeting the requirements of NELAC, ISO 17025, and ISO 9001
- Client satisfaction

3. Normative References

Reference List

ISO/IEC 17000, Conformity assessment – Vocabulary and general principles

VIM, International vocabulary of basic and general terms in metrology, issued by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.

ISO 9001:2008 – Quality Management Systems – Requirements.

ISO 17025:2005 – General Requirements for the Competence of Testing and Calibration Laboratories.
NELAC 2003-Quality Systems

4. Management Requirements

4.1 Organization

This section discusses general positions and quality-related responsibilities which provide for the implementation of the Quality Assurance Program and completion of quality control activities. Also discussed is the role of the York Quality Assurance Officer.

4.1.1 Legal Identification / Registration

York Analytical Laboratories, Inc.
120 Research Drive
Stratford, Connecticut 06615
203-325-1371
Fax 203-357-0166
E-mail: ClientServices@yorklab.com

State of Connecticut Department of Health (CTDOH) License no. PH-0723
New York State Department of Health (NYSDOH) ELAP/NELAP License no. 10854
State of New Jersey Dept. of Environmental Protection (NJDEP) License no. CT-005
State of Pennsylvania Registration No. 68-04440
EPA ID NO. CT-005

4.1.2 Laboratory Requirements

The departments of York Analytical Laboratories, Inc. have been organized to satisfy the needs of the Client and regulatory authorities and to meet the NELAC and international standards ISO 17025 and ISO 9001. York Analytical Laboratories, Inc. is comprised of the following Departments or Groups:

Laboratory Director’s Office
Quality Assurance Group
Client Services/Sales Groups
Sample Control Group

Classical Chemistry Group
Organic Preparations Group
Atomic Spectroscopy Group
Gas Chromatography Group
Gas Chromatography/Mass Spectrometry Groups (Volatiles and Semi-Volatiles)
Aquatic Toxicity Group
Report production/Data Mangement Group

4.1.3 Scope of Management System

The management system covers activities in the laboratory's permanent facility at 120 Research Drive, Stratford, CT 06615. The fields of activities include:

Analysis of environmental samples (water, wastewater, soil, sludge, and air) for Federal and State regulated contaminants.

The laboratory's scope of tests is listed in the our specific licenses and encompasses volatile organics, semi-volatile organics, pesticides, herbicides, PCBs, metals, Aquatic Toxicity and various general chemistry parameters.

4.1.4 Potential Conflicts of Interest

York has no potential conflicts of interest since it is independently owned and operated and provides only environmental laboratory analysis services. The ownership of York does not have any other interest that would be considered a potential conflict of interest.

4.1.5 Organization

A) Management and Technical Personnel

Policy:
The laboratory managerial and technical personnel, irrespective of other responsibilities, have the necessary authority and resources needed to meet the mandates assigned to their areas.

Details:
Responsibilities are detailed in 4.1.5 (F).

Departures from the organizational and management policies in this manual can only be approved by the Laboratory Director.

Departures from quality management system procedures can only be approved by the Quality Assurance Officer or the Laboratory Director.

Departures from test methods or technical standard operating procedures (SOPs) can only be approved by the Laboratory Director.

See also section 5.2.

B) Undue Pressure

Policy:
Management and personnel are to be free from any undue internal and external commercial, financial and other pressures that may adversely affect the quality of their work. The integrity of test results is the responsibility of all personnel. Management ensures that employees are never instructed or forced to alter or falsify data.

Details:
The following list provides some guidelines on how employees avoid conflict of interest situations. Employees shall not:

- falsify records, prepare fraudulent reports, or make false claims
- seek or use privileged or confidential company information, or data from any Client, for any purpose beyond the scope of employment
- conduct non-laboratory business on laboratory time, or use company facilities or instrumentation to conduct outside interests in business, unless prior approval has been obtained
- solicit business on their own behalf (rather than the laboratory) from a Client
- be employed by, or affiliated with, organizations whose products or services compete with laboratory products or services
- have employment that negatively affects or interferes with their performance of laboratory duties
- compete with the laboratory in the purchase, sale, or leasing of property or goods
- allow association, family, or friends to influence business decisions to their benefit - decisions must be made on a strictly business basis, always in the best interest of the laboratory
- make any decision that provides gains or benefits to the employee and/or others
- have personal financial dealings with an individual or company that does business with the laboratory which might influence decisions made on the laboratory’s behalf

Firm adherence to this code of values forms the foundation of our credibility. Personnel involved in dishonest activities are subject to a range of disciplinary action including dismissal.

C) Client Confidentiality

Policy:
It is the policy of our laboratory to protect the confidential information and proprietary rights of our Client including the electronic storage and transmission of results.

Details and Procedures:
All employees sign an Employee Confidentiality Agreement. The signed agreement is retained in each employee's Human Resources file.

Test results are only released to the Client. Release to someone other than the Client requires the express permission of the Client, except when the situation contravenes State or Federal Legislation and the results must be provided to the appropriate agency. The release of test results to anyone other than the Client requires the permission of the Client and management. Laboratory reports are reviewed for accuracy and completeness prior to release.

D) Operational Integrity

Policy:
The laboratory will avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity.

Details and Procedures:
To ensure confidence in laboratory operations a formal quality assurance program is implemented. Technical competence is ensured through check sample programs. Impartiality is assessed through audits and approvals. Judgment is ensured through the hiring of qualified personnel and by continuously refining, upgrading, and improving his or her skills. Operational integrity is reviewed by management on a regular basis at management review meetings to ensure continued suitability and effectiveness of laboratory policies and procedures. Any problems are acted on immediately through corrective action procedures.

E) Organizational Structure

Policy:
The organization and management structure of the laboratory and the relationships between management, technical operations, support services, and the quality management system is defined through the aid of an organizational chart.

Details:
Senior management keeps the most current organizational chart on file. An organizational chart is available with this manual as a reference record-ATTACHMENT A and is considered the official record on the date it is marked in the lower right corner.

F) Responsibility and Authority

Laboratory Director

- develops primary goals, operating plans, policies, and short and long range objectives for the laboratory; implements these following Board of Directors' approval
- directs and coordinates activities to achieve profit and return on capital
- establishes organizational structure and delegates authority to subordinates
- leads the laboratory towards objectives, meets with and advises other executives, and reviews results of business operations
- determines action plans to meet the needs of stakeholders
- represents organization to major Clients, government agencies, shareholders, and the public
- is knowledgeable of the scope of all processes under supervision
- provides the necessary resources (personnel, instrumentation, supplies) for the quality assurance program, in order to ensure confidence in the laboratory's results
- ensures instrumentation is maintained and calibrated, reporting all deficiencies (e.g., instrumentation malfunctions) in the appropriate manner
- ensures personnel are trained for the duties they perform - includes substitutes when regular personnel are absent
- maintains current job descriptions
- maintains records and manages all aspects of testing activities

Quality Assurance Officer (QAO)

- ensures that the Quality Management System is established, implemented and maintained in accordance with the ISO 9001, ISO 17025 and NELAC standards
- manages the internal audit program
- coordinates laboratory accreditation activities
- handles the maintenance and distribution of the Quality Manual and associated documents

- maintains a master list of current versions of quality documentation
- trains personnel on Quality Management System activities
- monitors the Quality Management System
- reports on the performance of the Quality Management System to senior management for review and as a basis for improvement of the Quality Management System
- supervises the laboratory's double-blind proficiency testing program

Group Leaders

- responds to York Client Servies Group inquiries and provides professional advice
- hires personnel
- orientates new personnel
- determines technical training needs of personnel
- conducts employee performance reviews
- schedules vacation and coverage
- ensures that all health and safety regulations are followed
- ensures that all Human Rights Legislation are complied with
- prioritizes workload
- facilitates operational concerns in their area
- ensures accurate and consistent testing procedures through the validation of all current procedures and by developing, validating and implementing new procedures
- coordinates purchasing requests
- ensures that the operational needs are within budget and advising management of any discrepancies

Analysts and Technicians

- maintains records of all quality activities as documented in SOPs and test methods
- handles samples and performing analyses according to SOPs and test methods
- provide input and assists in preparation of SOPs and test methods
- maintain and calibrate instrumentation and instrumentation
- reports deficiencies or malfunctions to the Group Leader
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and recording potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities
- improves laboratory and/or quality activities on a continuous basis

Client Services Managers

- provides vision and direction for analysis activities
- Responds to Clients' and provides professional advice
- develops and reviews proposals/Quotations
- Reviews Quality Assurance Project Plans for Clients
- monitors the progress of Work-in-Process

- reviews reports for selected Clients
- oversees, standard pricing, customized quotations, and invoicing for tests performed
- controls the flow of communication between the Client and the laboratory

Administrative/Data Management Personnel
- performs work functions and keeps records as per approved SOPs and/or laboratory policies
- generate final reports, invoices and data packages for transmittal to Clients
- assist in preparation of SOPs
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and records potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities
- improves laboratory and/or quality activities on a continuous basis

G) Laboratory Supervision

Policy:
Adequate supervision is provided in each area of the laboratory for all testing and calibration personnel, including trainees, by persons familiar with the methods and procedures.

Details:
Adequate supervision is ensured through designated supervisors as well as through documentation such as this Quality Manual, test methods and SOPs. A thorough orientation and training program is adhered to for all new employees. Ongoing training for regular personnel is required.

H) Technical Management

Policy:
A Group Leader is assigned to each major technical department of the laboratory. They have overall responsibility for the technical operations and the provision of resources needed to ensure the required quality and production of laboratory operations.

Details:
While the Group Leader may at times delegate duties to other personnel, the Group Leader is accountable for any nonconforming activities.

I) Quality Assurance Officer

Policy:
The Quality Assurance Officer is appointed by the highest level of management. The Quality Assurance Officer, who, irrespective of other duties and responsibilities, has defined responsibility and authority for ensuring that the management system related to quality is implemented and followed. The Quality Assurance Officer has direct access to the highest level of management where decisions are taken on laboratory policy or resources.

Details:
This statement notifies all laboratory personnel that Teresa Weikel is the Quality Assurance Officer as authorized by the Laboratory Director. Any change in this position requires the reissue of this section to all holders of controlled copies of the Quality Manual. The following signature also serves as approval for this Quality Manual and affirms senior management’s commitment to the policies and procedures set forth in this manual.

J) Managerial Substitutions

Policy:
Deputies for key personnel are appointed to fulfill the key personnel’s duties in their absence.

Details:
In the absence of the Quality Assurance Officer, the Laboratory Director will assume his/her responsibilities.

In the absence of the Group Leader, the Laboratory Director or other Group Leader will assume his/her responsibilities.

Management is responsible for ensuring that current and/or increased workload requirements are met. This includes making adjustments as a result of employee absence. Only fully trained employees are utilized to fulfill the duties of personnel who are absent. If sufficient human resources are not available, management will identify the best possible solution to meet operational requirements.

K) Awareness

Policy:

Management ensures that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.

Details:
Supervisors review the details of each employee's job description with the appropriate employee and how the overall Quality Policy Statement (Section 4.2.2) relates to their activities to achieve the objectives of the management system.

4.1.6 Communication Processes

Policy and Details:
Top management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	11/14/2011	Changed QA Officer name to Teresa Weikel

4.2 Management System

4.2.1 Policies and Procedures

Policy:
The Quality Management System is established, implemented, and maintained by management. It is applicable to all the fields of testing and activities in which the laboratory is involved and undertakes. All policies, systems, programs, procedures and instructions are documented to the extent necessary to enable the laboratory to assure the quality of results generated. These documents are communicated to, understood by, available to, and implemented by the appropriate personnel.

Details:
The purpose of our Quality Management System is to ensure that all services and products satisfy the Client's requirements and have been designed, manufactured, and delivered under controlled conditions.

The effectiveness of the Quality Management System is assessed in several ways:

- by a program of planned internal audits, covering all aspects of the operation of the quality management system
- by regular management reviews of the suitability and effectiveness of the quality management system
- by analysis of potential and actual problems as shown by Client complaints and supplier and subcontractor assessments
- by other methods approved from time to time by the Laboratory Director

This Quality Manual and associated documents (including procedures) and records serves as the quality plan for the laboratory. Other documents and records include:

- standard operating procedures
- quality control plans in test methods
- organizational charts
- proposals and Quality Assurance Project Plans (QAPP)
- project management schemes

4.2.2 Quality Policy Statement

Policy:
The policies and objectives for laboratory operations are documented in this Quality Manual. The overall objectives are set out in the Quality Policy Statement and reviewed during management review. The Quality Policy Statement is issued under the authority of the Laboratory Director on the effective date.

Quality Policy Statement:
To ensure accurate and timely environmental laboratory analysis services and to continuously meet or exceed the stated or implied expectations of our Clients through day-to-day interactions.

Effective Date: April 30, 2010

a) *Management commitment to good professional practice and quality of services provided to the Client*: analyses and calibrations are always carried out in accordance with stated standardized methods and Clients' requirements. Requests to perform tests that may jeopardize an objective result or have a low validity are rejected.

b) *Standards of service include*:
- Client Satisfaction
- Quality
- Timeliness

Excellence in the workplace is promoted by providing all employees with the knowledge, training, and tools necessary to allow for the completion of accurate and timely work.

c) *Purpose of management system related to quality*: to manage our business by meeting the needs of our Clients.

d) *Personnel*: familiarize themselves with quality documentation and implement the policies and procedures in their work.

e) *Management is committed to complying with NELAC, ISO 17025 and ISO 9001 international standards and to continually improve the effectiveness of the management system*: the objective of this Quality Manual is to document the compliant policies and associated procedures that are integrated into our daily activities. Continual improvements are established, implemented, and integrated into the management system.

Additional objectives include:

- to establish the level of the laboratory's performance

- to make test method changes to improve performance
- to participate in proficiency testing or quality evaluation programs with peer laboratories
- to ensure that all personnel are trained to a level of familiarity with the quality management system appropriate to the individual's degree of responsibility
- to improve and validate laboratory methodologies by participation in method validation collaborative tests
- to establish and report on quality savings

4.2.3 Commitment to the Management System

Policy:
Top management is committed to the development and implementation of the management system and continually improving its effectiveness.

Details:
The results of the management system are regularly reviewed during management review (see Section 4.15) and continual improvements are made as outlined in Section 4.10 – Improvements.

4.2.4 Communication of Requirements

Policy:
Top management communicates to the organization the importance of meeting Client requirements as well as statutory and regulatory requirements.

Details:
In general, the underlying message in all oral and written management communications involves meeting the aforementioned requirements. Meeting Client requirements ensures that ongoing business relationships secure the contracts that keep everyone employed. Meeting statutory and regulatory requirements ensures that laboratory operations will not be disrupted and the organization can continue to meet Client needs.

4.2.5 Quality Manual

Policy:
This Quality Manual outlines the structure of the documentation used in the quality management system. This Quality Manual makes reference to supporting procedures including technical procedures and is maintained up to date.

Details:
This quality management system is structured in three tiers of documentation. The tiers are as follows:

1. Quality Manual
2. Standard Operating Procedures and Test Methods
3. Records

For most Clients, this Quality Manual and the associated documents form a general Quality Plan. If necessary, specific Quality Assurance Project Plans (QAPP) will be prepared on a ‘per-Client’ basis. These QAPPs will modify the general requirements stated in the Manual and associated documents.

All of the above documents are controlled documents in yellow only.

The following records and directive documents are referenced in the Quality Manual, but maintained separately:

- organizational chart (section 4.1.5.E)
- copies of the Quality Policy Statement posted in the laboratory (section 4.2.2)
- identification of resources and management review (section 4.15.1)
- job descriptions (section 5.2.4)
- statistical techniques (section 5.9)
- test reports (section 4.13.2 and 5.10)
- identification of the laboratory’s approved signatures (section 5.10.2)
- laboratory’s scope of tests (section 4.1.3)
- instrumentation inventory and records (sections 5.5.4 and 5.5.5)
- calibration status indicators (section 5.5.8)
- reference standards inventory (section 5.6.3)
- verification records (section 5.9)
- quality control plan / criteria for workmanship (section 5.4.1)
- corrective action records (section 4.11)
- preventive action records (section 4.12)
- client complaint records (section 4.8.1)
- audit schedule and records (section 4.14.3)
- procurement and subcontracting records (sections 4.6 and 4.5.4)
- training records (section 5.2.5)
- master list of documentation (section 4.3.2)
- confidentiality agreements (section 4.1.5 C)
- contract review (section 4.4.2)
- validation of test methods (section 5.4.5)
- facility floor plan (section 5.3.1)

4.2.6 Technical Management and the Quality Assurance Officer

The roles and responsibilities for technical management (Group Leaders) and the Quality Assurance Officer are outlined in section 4.1.5 (F) of this manual.

Technical management (Group Leaders) ensures that section 5 of this manual is implemented and maintained. The Quality Assurance Officer ensures that section 4 of this manual is implemented and maintained.

4.2.7 Maintenance

Policy and Details:
Top management ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.3 Document Control

4.3.1 Policies and Procedures

Policy:
The SOP# ADMINDOC043010 is used to control all quality management system documents. These may include documents of external origin, such as regulations, standards, other normative documents, test and/or calibration methods, as well as drawings, specifications, instructions, and manuals.

Details:
Document means any information or instructions including policy statements, procedures, specifications, calibration tables, charts, text books, posters, notices, memoranda, software, drawings, and plans. These may be in various media, whether hard copy or electronic and they may be digital, analog, photographic or written.

The documents to be controlled include:
- Quality Manual
- Standard Operating Procedures
- Forms
- Standards

The control of data related to testing and calibration is covered in section 5.4.7. The control of records is covered in section 4.13.

4.3.2 Document Approval and Issue

4.3.2.1 Review / Approval / Master List

Policy and Details:
All documents issued to personnel in the laboratory as part of the quality management system are reviewed and approved for use by authorized personnel prior to issue (i.e., reviewed by personnel knowledgeable in the documented activity and then approved by management). A master list identifying the current revision status and distribution of documents in the quality management system is readily available in order to preclude the use of invalid and/or obsolete documents (see SOP# ADMINDOC043010). A revision history of documents is also maintained. Documents are formally reviewed on a biennial basis to ensure their continuing suitability. APPENDIX B contains a current Master List of Documents.

4.3.2.2 Availability and Obsolete Documents

Policy and Details:
The master list includes all current controlled documents. The master list document is organized with the following information:

- Description
- SOP Number
- Date of Issue (effective date of each procedure)
- Revision Number
- Date of Revision (effective date of each current revision)

Controlled documents are approved before issue.

The SOP# ADMINDOC043010 for document control ensures that:
- authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed
- documents are periodically reviewed and where necessary revised to ensure continuing suitability and compliance with applicable requirements
- invalid or obsolete documents are promptly removed from all points of issue or use to assure against unintended use
- obsolete documents retained for either legal or knowledge preservation purposes are suitably marked (i.e., stamped "OBSOLETE" and dated)

4.3.2.3 Identification

Policy and Details:
All quality management system documentation is identified by:

- date of issue and/or revision number
- page numbering
- total number of pages (e.g., page 5 of 5)
- issuing authority (i.e., approval signature)

4.3.3 Document Changes

4.3.3.1 Review / Approval

Policy:
Changes to documents are reviewed and approved by the same function (i.e., personnel or position) that performed the original review unless specifically designated otherwise.

Details:
Developments in policies and procedures require documents to be changed from time to time. Changes to documents receive the same level of review and approval as the originals.

The Quality Manual is reviewed annually by the Quality Assurance Officer. Records are kept of this review.

Test methods and SOPs are reviewed on a biennial basis. Procedures for this are outlined in SOP# ADMINDOC043010.

Obsolete documents are withdrawn, but are retained for archive purposes and clearly labeled as obsolete.

4.3.3.2 Identification of Changes

Policy:
The nature of document changes is identified in the document.

Details:
As outlined in SOP# ADMINDOC043010.

In general, the nature of changes is described in the document. Revision history is recorded at the end of the document.

4.3.3.3 Amendments by Hand

Policy and Details:

Hand-written amendments are clearly marked, initialed, and dated by the Laboratory Director and/or the QA/QC Officer on all controlled yellow copies.

4.3.3.4 Computerized Documents

Policy and Details:
The SOP# ADMINDOC043010 details how changes in documents maintained in computerized systems are made and controlled.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	06/29/2012	Modified Master List information, and hand amendments

4.4 Review of Requests and Contracts

4.4.1 Policies and Procedures

Policy:
The SOP AMINCONTRACT043010 is used to review requests or contracts. This procedure ensures that:

a) the Client requirements including the methods to be used are adequately defined, documented and understood (see section 5.4.2)
b) the laboratory has the licensing, capability and resources to meet the requirements
c) the appropriate testing method is selected and capable of meeting the Client's requirements or data quality objectives (see section 5.4.2)

Any differences between the request and the contract are resolved before any work commences. Each contract must be acceptable by both the laboratory and the Client.

Details:
The request and contract review is conducted in a practical and efficient manner, and the effect of financial, legal, and time schedule aspects are taken into account.

The review of capability establishes that the laboratory possesses the necessary physical, personnel, and information resources, and that the laboratory's personnel have the skills and expertise necessary for the performance of the tests in question. The review may also encompass results of earlier participation in inter-laboratory comparisons or proficiency testing and/or the running of trial test using samples or items of known value in order to determine uncertainties of measurement, limits of detection, and confidence limits.

The contract review ensures that each Client's requirements are adequately defined and documented before the service or product is ordered or dispatched. This should ensure that any order, once accepted, can be completed without delay, and that the Client's requirements including delivery date, technical specification, and cost can be met.

If the contract review highlights any ambiguities or uncertainties then the Client will be contacted and the problem resolved before the order is accepted.

The SOP AMINCONTRACT043010 also describes the activities that take place should there be a subsequent amendment to a Client's order.
Typical types of contracts include:

- approved service quotations
- confidentiality agreements
- non-disclosure agreements
- sample submission requests
- memorandum of agreement
- memorandum of understanding
- research proposals and contracts
- verbal orders (oral agreements)
- activity plans

4.4.2 Records of Review

Policy:
Records of request and contract review, including significant changes, are maintained. Records of pertinent discussions with a Client relating to the Client's requirements or the work during the period of execution of the contract are also maintained.

Details:
For review of routine and other simple tasks, the date and the identification (e.g., initials) of the person in the laboratory responsible for carrying out the contracted work are considered adequate. For repetitive routine tasks, the review need be made only at the initial enquiry stage or on grant of the contract for on-going routine work performed under a general agreement with the Client, provided that the Client's requirements remain unchanged. For new, complex or advanced testing tasks, a more comprehensive record is maintained.

4.4.3 Review of Subcontracted Work

Policy:
Request and contract review also includes work that is subcontracted by the laboratory.

Details:
Subcontractor laboratories are reviewed as described in section 4.5.

4.4.4 Notification of Client

Policy and Details:
Clients are informed of deviations from the contract. This is typically communicated to the Client prior to the performing the deviation.

4.4.5 Contract Amendment

Policy and Details:
If a contract needs to be amended after the work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.5 Subcontracting of Analyses and Calibrations

4.5.1 Subcontractor Competence

Policy:

Work that must be subcontracted due to:

- unforeseen circumstances
- workload
- large contracts
- contracts requiring some extra technical expertise
- Tests not performed in-house

is subcontracted to a technically competent laboratory.

Details:

The subcontracted laboratory demonstrates technical competence by possession or receipt of one or more of the following:

- recognized technical accreditation- NYSDOH NELAC or other NELAC accreditation body
- registration under the ISO 9001 standard
- satisfactory performance of appropriate quality control check samples, certified reference material, in-house reference material or replicate analysis
- Review of the subcontractor's quality management system by our QA Officer

It is the responsibility of the Quality Assurance Officer to assess and approve the competence level of subcontractor laboratories.

4.5.2 Client Approval

Policy:
Clients are advised of work (or any portion thereof) that is being subcontracted to another laboratory and their approval is obtained (preferably in writing). Upon log-in at the lab, a Subcontract Notification Form is generated by Sample Control and e-mailed immediately to the Client.

Details:
Clients are advised of subcontracted work through fee schedules or any type of contract listed in section 4.4.1.

4.5.3 Assurance of Subcontractor Competence

Policy:
The laboratory is responsible to the Client for the subcontractor's work. Technical competence of subcontractor laboratories is demonstrated through various records.

> **Note** – there may be circumstances where the Client specifies which subcontractor is to be used. In such cases we may not be able to demonstrate the competence of the subcontractor and therefore are not responsible for the results.

Details:
Records of subcontractor competence may include, but are not limited to, the following:
- accreditation certificates or documentation
- registration certificates
- check sample results
- audit results
- approval by the Quality Assurance Officer

4.5.4 Subcontractor Register

Policy:
A register of all subcontractors performing tests is maintained.

Details:
The approved register of subcontractors and all relevant records are maintained by the Quality Assurance Officer.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.6 Purchasing Services and Supplies

4.6.1 Policies and Procedures

Policy:
The SOP ADMINPURCHASESING043010 is used to select and purchase services and supplies. The SOP ADMINPURCHASESING043010 is used for procurement, reception, and storage of supplies.

Details:
Consumable materials are stored according to the appropriate test method, SOP, or work instruction.

4.6.2 Specifications

Policy:
Only services and supplies of the required quality are used. These quality requirements are detailed in laboratory SOPs under the "*Materials Required*" section and will identify the appropriate minimum specifications when necessary.

Details:
Packing slips are checked against package content labels and matched with the Purchase Order if accepted. Once accepted, the packing slip is dated and initialed as evidence of compliance. Certificates of analysis (COA) are maintained on file after the COA is checked to ensure the received item meets minimum specifications.

Chemicals are purchased with manufacturer's certificates where possible. Uncertified chemicals are purchased from ISO 9000 registered companies. Whatever the source, the laboratory verifies the quality of the standards by comparing the new batch of standards to the old. Due regard is paid to the manufacturer's recommendations on storage and shelf life.

Reagents are generally purchased from manufacturers who have a quality management system based on ISO 9000. The grade of any reagent used (including water) is stated in the method together with guidance on any particular precautions to be observed in its preparation or use.

Where no independent assurance of the quality of procured goods or services is available or the supplier's evidence is insufficient the laboratory ensures that purchased goods and services comply with specified requirements. Where possible and practical the laboratory ensures that goods are inspected, calibrated, or are otherwise in compliance with any standard specification relevant to the calibrations or tests concerned.

4.6.3 Purchasing Documents

Policy:
Purchasing requests are recorded on the Purchase Order form and contain data describing the product ordered. The Purchase Order is reviewed and approved for technical content prior to release.

Details:
The description may include type, class, grade, precise identification, specifications, drawings, inspection instructions, other technical data including approval of test results, quality required and quality management system standard under which they were produced.

The completion of the Purchase Order is the responsibility of the originator.

4.6.4 Approved Suppliers

Policy:
Suppliers of critical services are evaluated and approved before use. An approved supplier list is maintained.

Details:
Audits or tender evaluation is conducted to qualify suppliers of critical services prior to use. The criteria for evaluation may include, but is not limited to the following:

- references
- accreditation
- formal recognition

The records are maintained by purchasing personnel. SOPs detail the acceptable vendors for all materials.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.7 Service to the Client

4.7.1 Service

Policy:
Client requests are clarified for the Clients or their representatives. Furthermore the Client or their representative will be afforded the right to monitor the performance of the laboratory in relation to the work performed, provided that the laboratory ensures confidentiality to other Clients.

Details and Procedures:
Service to the Client includes:

- Affording the Client or the Client's representative reasonable access to relevant areas of the laboratory for the witnessing of work performed for the Client; it is understood that such access should not conflict with rules of confidentiality of work for other Clients or with safety.

- Preparing, packaging, and dispatching of test data needed by the Client for verification purposes.

- Maintaining of open contacts. The Client values advice and guidance in technical matters, and opinions and interpretations based on results. Contact with the Client, especially in large assignments, should be maintained throughout the work by Client Services personnel. The laboratory should inform the Client of any delays or major deviations or issues encountered during the performance of the tests.

4.7.2 Feedback

Policy and Details:
The laboratory seeks feedback from the Client. Positive and negative feedback can be obtained passively through ongoing communications with the Client (e.g., review of test reports with Clients) or actively through Client satisfaction surveys. The feedback is used to improve the quality management system, testing activities, and Client service.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.8 Complaints

4.8.1 Policies and Procedures

Policy:
The SOP ADMINCOMPLAINTS 04302010 is used for resolving complaints received from Clients or other parties. Records are maintained of all complaints and follow-up.

Details:
Records of complaints include the following information:

- details of the complaint
- investigation
- corrective action
- follow-up verification

See also section 4.11.

All personnel are responsible for recording and responding to complaints.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.9 Control of Nonconforming Analyses

4.9.1 Procedures to Control Nonconforming Work

Policy:
The SOP ADMINNONCONFORM 04302010 is used to control any aspect of testing, or the results of this work, when they do not conform with the test methods, SOPs or the agreed to requirements of the Client.

Details:
The procedure ensures that:
- Responsibilities and authorities for the management of nonconforming work are designated and actions (including halting of work and withholding of test reports as necessary) are defined and taken into consideration when nonconforming work is identified
- an evaluation of the significance of the nonconforming work is made
- correction is taken immediately, together with any decision about the acceptability of the nonconforming work
- where necessary, the Client is notified and the work is recalled
- the responsibility for authorizing the resumption of work is defined

Identification of nonconforming work or problems with the quality management system or with testing activities can occur at various locations within the quality management system and technical operations such as:
- Client complaints
- quality control
- instrument calibration
- checking of consumable materials
- staff observations or supervision
- test report review
- management reviews
- internal or external audits

4.9.2 Root Cause Analysis

Policy:
Where evaluation indicates that nonconforming work could recur or that there is doubt about the compliance of the laboratory’s operations with its own policies and procedures, the corrective action procedures given in 4.11 are followed to identify the root cause(s) of the problem and to eliminate cause(s).

Details:
The SOP ADMINCORRACTION043010 outlines the recording of the root cause analysis for investigating nonconforming work.

Situations warranting corrective action investigation include:
- failure to comply with test method including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- presentation of uncertain knowledge as to compliance with test methods including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- failure or suspected failure in method performance as demonstrated by results provided by quality control samples
- lack of relevant evidence provided by quality audit, proficiency testing, or Client feedback
- lack of relevant evidence provided by data validation
- neglect to check the inherent property of the sample that compromises the testing

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.10 Improvements

4.10.1 Policies and Procedures

Policy:
The laboratory continually improves the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective actions, and management review.

Details:
The laboratory has implemented a continual improvement philosophy within the management system. Every employee in the laboratory is encouraged to suggest new ideas for improving services, processes, systems, productivity, and the working environment.

Opportunities for improvement of operations and processes are identified by managers on a continual basis from ongoing feedback on operations and through management reviews. Opportunities for improvement of services are identified by anyone within the organization including Sales, Marketing and Client Services.

Inputs for improvement opportunities are obtained from the following sources:
- Client satisfaction surveys and any other Client feedback
- market research and analysis
- employees, suppliers, and other interested parties
- internal and external audits of the management system
- records of service nonconformities
- data from process and service characteristics and their trends

Opportunities for improvement may also be identified on a special project basis. The following are listed only as examples:
- improving usefulness of bench space
- reducing excessive inspection/analysis
- reducing excessive handling and storage
- reducing test/calibration failures

Opportunities for improvement from daily feedback on operational performance (i.e., internal audits, Client feedback, test/calibration failures) are evaluated by the Laboratory Director or Quality Assurance Officer. Typically, they are implemented through the corrective and preventive action system.

Opportunities for improvement from analysis of longer-term data and trends are evaluated and implemented through the management review process. They are prioritized with respect to their relevance for achieving quality objectives. When opportunities for improvement are no longer supported by the current policy and objectives, management will establish new quality objectives, and possibly change the policy. The process for this evaluation is described in Section 4.15. Longer-term improvement projects are initiated through the management review process, as well as the corrective and preventive action system.

Service improvement opportunities are evaluated by management. They are implemented through the supervisor of the laboratory who ensures that the improvements are validated as outlined in Section 5.4 of this manual and appropriate level of quality control is performed on an ongoing basis.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.11 Corrective Action

4.11.1 General

Policy:
The SOP ADMINCORRACTION043010 is utilized for implementing corrective action when nonconforming work or departures from policies and procedures in the quality management system or technical operations have been identified. The procedure requires that appropriate authority be designated for the implementation of corrective actions. The procedure includes cause analysis, selection and implementation of corrective action, and monitoring of actions.

Details:
Problems with the quality management system or technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feed-back from Clients, or staff observations.

Corrective action investigations are documented and required changes to operational procedures are implemented. The corrective action request (CAR), investigation and resolution are recorded on a CAR form.

4.11.2 Cause Analysis

Policy:
Corrective action always begins with an investigation to determine root cause(s) of the problem (see SOP ADMINCORRACTION043010).

Details:
Potential causes of the problem could include Client requirements, the samples, sample specifications, methods and procedures, personnel skills and training, consumable materials, or instrumentation and its calibration.

4.11.3 Selection and Implementation of Corrective Actions

Policy and Details:
After determining the cause(s) of the problem, potential corrective actions are identified. The most likely action(s) (this includes practical and/or reasonable) are selected and implemented to eliminate the problem and to prevent recurrence. It should be noted that any corrective actions taken to eliminate the cause(s) of nonconformities or other

departures are to a degree appropriate to address the magnitude of the problem and commensurate with the risks encountered (Note – in plain language, this means determine whether the benefit outweighs the cost). Controls are applied to prevent recurrence. The laboratory documents and implements the required changes resulting from corrective action investigations.

4.11.4 Monitoring of Corrective Action

Policy:
After implementing the corrective action(s), the laboratory monitors the results to ensure that the actions taken have been effective in overcoming the problems originally identified.

Details:
Monitoring is assigned to an appropriate individual such as the originator of the CAR or the originator's manager. Changes resulting from corrective action are documented.

4.11.5 Additional Audits

Policy:
Where the identification of nonconformities or departures casts doubts on compliance of policies, procedures, regulations, international quality standards, the appropriate areas of activity are promptly audited in accordance with section 4.14.

Details:
Special audits follow the implementation of corrective actions to confirm their effectiveness. A special audit is only necessary when a serious issue or risk to the business is identified. Special audits are carried out by trained and qualified personnel who are [whenever resources permit] independent of the activity to be audited. See section 4.14 for more details.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.12 Preventive Action

4.12.1 Preventive Action Identification

Policy:
Opportunities for needed improvement and potential sources of nonconformities, either technical or with the quality management system shall be identified. If action is required, action plans are developed, implemented and monitored, to reduce the likelihood of occurrence of such nonconformities and to take advantage of the improvement opportunities.

Details:

Records of preventive action include the following information:

- details of potential nonconformities
- investigation
- preventive action
- follow-up verification

These records are maintained in the Preventive Action Request (PAR) form/binder.

4.12.2 Preventive Action Plans

Policy:
The preventive action procedure includes the initiation of such actions and application of controls to ensure that they are effective.

Details:
Preventive action may result from the review of operational procedures and analysis of data. Analysis of data includes trend analysis, analysis of proficiency testing results, and risk analysis.

The SOP ADMINPREVACTION043010 is utilized to implement opportunities for needed improvement and prevent potential sources of nonconformities.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.13 Control of Records

The York Quality Assurance Program has been developed to provide analytical results of known quality. To demonstrate that quality has been achieved, York maintains a record management system that includes documents pertinent to the analytical performance of the laboratory. Laboratory records are maintained in two broad categories.

- Documents which are specific to a project or a group of samples within an ongoing project, such as chain-of-custody, and raw analytical data.
- Documents which demonstrate overall laboratory operation, such as instrument log books and control charts. These records will directly affect the data for a specific project, but in general their applicability is not limited to one project.

This procedure addresses identification, collection, indexing, access, file, store, maintain, protect, backup, and disposal of quality and technical records. To outline procedures for the protection and backup of data/records held on computers.

4.13.1 General

This procedure applies to all quality and technical records. Quality records include audit reports, management review, corrective action requests, and preventive action requests. Technical records include observations, calculations, derived data, calibration records, personnel records, and test reports.

4.13.1.1 Procedures

Policy:
The SOP ADMINRECORDS043010 is used to identify, collect, index, access, file, store, maintain, protect, backup, and dispose quality and technical records. Quality records include reports from internal audits and management reviews as well as corrective and preventive action records.

Details:
Records are available to demonstrate conformance to requirements and effective operation of the Quality Management System. Quality records from suppliers are also controlled.

All records, (electronic and hard copy) including test reports, are safely stored and held secure in locked areas, and in confidence to the Client. Records are maintained in the designated archival area for **five (5)** years.

4.13.1.2 PROJECT RECORDS

Separate files are maintained for each project. Filing of records for a specific project shall be by the unique project identification number assigned by the laboratory for that project. Within a project file, categories of information are filed separately. Upon completion of all projects (SDGs), the file contents are scanned to an unalterable image file (.pdf) and archived removable hard disk media. Such media are held for a period of 5 years. Paper copy is maintained for three months after data submission. Following is a brief discussion of each item that is maintained for each project file.

A - Correspondence

All correspondence pertinent to the analytical program shall be maintained. This includes letters to and from clients and internal memorandums. Correspondence should be filed chronologically.

B - Chain-of-Custody

Chain-of-custody records shall be maintained by the laboratory. The chain-of-custody forms should be filed for samples as received and should be placed in the project file immediately after they are signed by Sample Control personnel.

C - Request for Analysis

Analysis requests provided by the field personnel are maintained in this file. Also, any changes or additions to the analytical program should be documented in this file.

D - Calibration Records

In general, calibration records are maintained with laboratory operation records. However, if an analytical program requires a calibration which is performed solely for a project, the records shall be maintained in this file. If calibration is performed as an integral part of the analytical process, the calibration records should be maintained with the analytical data.

E - Analytical Data

Analytical data files should be complete for a group of samples. The file should contain raw analytical data, processing of the data and/or data reduction, and any data validation. It should be possible to use data files to completely demonstrate that the data have been adequately obtained, processed, and reviewed.

G - Quality Control Samples

If quality control samples, such as field blanks, are processed for a specific project, the data shall be maintained with the project file. The results of quality control samples processed on a general basis are included in the laboratory operations files. Statistical evaluation of quality control sample data for a project shall also be maintained in this file.

If quality control samples are processed as an integral part of a group of samples such that the data cannot be readily separated, the quality control sample data can be stored with the analytical data.

H - Data Reports

Complete copies of all reports issued by the laboratory are accessible on the Network and are not stored with the project files.

I - Project-Specific Requirements

If a project requires analytical procedures other than what is adopted in the York Quality Assurance Program, the requirements shall be included in this file. Specific requirements may be due to government regulations, specific contracts, or project need. Changes from stated practice can be, for example, frequency of QC sample analysis, test method, statistical data evaluation, and reporting format.

If it is necessary to adopt a new analytical procedure, a procedure different than conventionally used, or alter an existing procedure, the method used for the project must be documented. If the analytical procedure is developed by York as part of the analytical program, the procedure shall be documented and included. If an existing procedure is altered, the Analyst or Group Leader shall prepare a memorandum to the project file stating what the changes were and the justification for change.

J - Nonconformance

Nonconformances and subsequent corrective actions which are specific to a project are included in this file. The record should be in the form of a memorandum (or copy of other records discussed in this manual) with the nonconformance stated, how it was corrected, and the approval for the correction. A separate file for each incidence is not required, the file should be maintained chronologically.

K - QA Plan

If a specific Quality Assurance Project Plan, and revisions, are prepared for a project, they shall be stored in this file.

L - Miscellaneous

The miscellaneous file includes all records not applicable to the previous categories.

4.13.1.3 GENERAL LABORATORY OPERATIONS RECORDS

General laboratory records document overall laboratory performance and operations. These records are filed separately from project records and will be maintained so they can be referenced to project records if necessary. Examples of general records pertinent to project records are instrument log books and computer software verifications.

There are two types of general laboratory records:

- Documents which demonstrate laboratory performance
- Reference documents for laboratory operations

Records which demonstrate laboratory performance shall be filed in categories in a manner similar to project files. Reference documents are not indexed and their usage is not controlled.

Many of the laboratory operations records are in daily use, such as the Master Log Book, instrument calibration logs, and control charts. It is not intended that the records be stored daily while they are in use. However, when individual log books, etc. are filled, they shall be placed in the files.

Following is a brief discussion of the General Lab Operations records:

A - Sample Log Books

The Sample Log Books chronologically record all samples entering the laboratory, independent of project designation.

B - Instrument Calibration Logs

All calibration performed independent of a specific project shall be recorded by instrument. A separate file should be maintained for each instrument subject to calibration. These files are scanned and archived ot the network by instrument and date.

C - Instrument Maintenance Logs

Separate maintenance files should be kept for each instrument incorporated in the preventive maintenance program. The file shall include records of maintenance performed in-house or by outside groups.

D - Performance Evaluation Records

Laboratory participation in Performance Evaluation Programs shall be documented in this category. If performance standards are analyzed as part of the overall quality control sample program, the results should be included in Category G.

E - Certification Program (NY, CT, NJ , PA) Records

If the laboratory participates in certification programs, such as the NVLAP, ELAP, etc. program, the results shall be maintained in this category. Records should include all correspondence, analytical data, agency results, etc.

F - Control Charts

Control charts are generated and maintained on the Element LIMS.

G- Purchased Material Certificates

All information which verifies that purchased materials meet the requirements of the laboratory should be maintained. Certification may be supplied by a vendor or from in-house verification analysis. Separate files should be kept for chemicals, gases, water, glassware, etc.

4.13.1.4 RECORD CONTROL

The individual responsible for the records management system is part of the Data Management Group. This person shall:

- Initiate new project files including project index
- Add new records to existing files, initiate new files within a category, and update the index
- Assist laboratory personnel in withdrawing and returning records.

To maintain control of hard copy records within the laboratory, a Records Accession LOG is maintained. The LOG indicates:

- Project from which file is borrowed
- Date and person borrowing record

- Date returned to the record system

The dating format for records is MM/DD/YYYY.

4.13.2.1 Record Integrity

Policy:
All records are to be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.

Details:
The retention time for records is set at **five** years.

Records may be in the form of any type of media, such as hard copy or electronic media.

4.13.2.2 Record Security

Policy:
All records are held secure and in confidence.

Details:
Access to records is secured through limited access areas and computer access via user defined privileges.

4.13.2.3 Record Backup

Policy:
The SOP ADMINRECORDS043010 is followed to protect and backup data/records held on computers at all times and to prevent unauthorized access to or amendment of data/records on computers.

Details:
Data is password protected.

Backups ensure integrity and availability of data / information in the event of a system / power failure.

4.13.3 Technical Records

4.13.3.1 Record Information

Policy:
Original observations, calculations, derived data and sufficient information to establish an audit trail, calibration records, personnel records and a copy of each test report issued are retained for five years.

The records for each test shall contain sufficient information to facilitate, if possible, identification of factors affecting the test uncertainty and to enable the test or calibration to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for sampling, performing of each test and/or calibration and checking of results.

Details:
Technical records are accumulations of data (see 5.4.7) and information that result from carrying out tests and/or calibrations and which indicate whether specified quality or process parameters are achieved. They may include forms, contracts, work sheets, work books, note books, instrument printouts, magnetic media, check sheets, work notes, control graphs, test reports, calibration certificates, Client’s notes, papers and feedback, and test reports to Clients.

The records for each test contain sufficient information to permit its repetition. Records include:
- date of sampling
- sample receipt
- sample handling, storage, and disposal
- identification of personnel
- analyst proficiency
- instrumentation identification and performance
- calibration records
- media performance, where appropriate
- test batch # or lot #, where appropriate
- results
- reports (mailed, e-mailed, faxed)
- review

Note – the above records may be stored in separate locations. They are cross-referenced for easy retrieval.

4.13.3.2 Recording

Policy:
Observations, data, and calculations are clearly and permanently recorded and identifiable to the specific job at the time they are made.

Details:

Handwritten records must be legible and made with indelible ink immediately after an observation, after data is collected and/or after calculations are made.

4.13.3.3 Corrections to Records

Policy:
Changes to test data are made so as not to obscure or delete the previous data entry.

Details:
Mistakes are crossed out and the correct value entered alongside. Mistakes are not erased, made illegible, or deleted. All alterations to records are signed or initialed by the person making the correction. In the case of computer-collected data, similar measures are taken to avoid loss or change of original data.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.14 Internal Audits

4.14.1 Internal Audit Program

Policy:
The internal audit program involves periodic audits conducted according to a predetermined schedule for each year. This program is defined on an annual basis and conducted as outlined in this section with further details found in SOP ADMININTAUDIT043010. All elements of this Quality Manual will be audited each year and all relevant laboratory records are available to personnel conducting the audit. These audits are performed to verify operations continue to comply with the requirements of this Quality Manual and are effective.

Details:
The Quality Manual, test procedures, and laboratory results are verified for compliance. It is the responsibility of the Quality Assurance Officer to plan and organize audits as required by the schedule and requested by management. Audits are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel are not to audit their own activities except when it can be demonstrated that an effective audit will be carried out (see also 4.11.5). Audits are performed through the aid of a checklist prepared in advance to minimize the possibility of overlooking any details during the audit.

Generally, the types of audits include:
- quality management system
- processes and procedures
- services and reports

4.14.2 Corrective Action

Policy:
When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of test or calibration results, timely corrective action is taken and Clients are notified if investigations show that laboratory results may have been affected.

Details:
Nonconformities that can be resolved easily are to be corrected immediately, ideally during the audit. Records are made on the audit checklist. Nonconformities that require a more involved resolution are recorded on a CAR and resolved as described in section 4.11.

Corrective actions and Client modifications must be kept on record for each audit deviation that casts doubt as described in this section.

4.14.3 Records and Management

Policy:
Records are made of the activity being audited, the audit findings, and corrective actions that arise. Management ensures that corrective actions are discharged within an appropriate and agreed timeline.

Details:
A report is prepared by the auditors and distributed to those audited and/or the area manager/supervisor within an appropriate and agreed timeline. The audit report may include the following sections, as appropriate:

- audit objective and scope
- area or section audited
- personnel involved – auditors and auditees
- date of audit
- reference documents
- observations including nonconformities and commendations
- opening and closing meetings
- recommendations
- audit report distribution

The appropriate manager is responsible for ensuring that corrective actions are sufficiently recorded. Follow-up is performed by the auditor and recorded when corrective action is complete and deemed effective. The audit records are kept in the laboratory.

4.14.4 Follow-up Audits

Policy:
Follow-up audits are performed to verify and record the implementation and effectiveness of the corrective action taken.

Details:
The follow-up audit is performed at a mutually acceptable time between the area implementing corrective action and the auditor. This time is determined when the CAR is issued.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.15 Management Reviews

4.15.1 Review of Quality Management System and Testing

Policy:
Top management periodically (at least annually) and in accordance with a predetermined schedule and SOP ADMINMGMTREV043010, conduct a review of the laboratory's quality management system and testing activities to ensure their continuing suitability and effectiveness and to introduce any necessary changes or improvements.

Details:
The review takes account of:

- suitability of policies and procedures
- reports from managerial and supervisory personnel
- the outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of inter-laboratory comparisons or proficiency tests
- changes in the volume and type of work undertaken
- feedback from Clients, including complaints and Client satisfaction surveys
- recommendations for improvement
- other relevant factors, such as quality control activities, resources and personnel training

A minimum period for conducting a management review is once a year. Results of the review feed into the laboratory planning system and include goals, objectives and action plans for the coming year.

A management review can be supplemented by consideration of related subjects at regular management meetings.

4.15.2 Findings, Actions, and Records

Policy and Details:
Findings from management reviews and the actions that arise are recorded in the minutes of the meeting. Management will ensure that the actions are discharged within an appropriate and agreed upon timeline.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.16 Data Integrity Plan

4.16.1 Purpose

The purpose of the Data Integrity Plan is four-fold:

(a) to describe the laboratory's data integrity system,
(b) to emphasize the paramount importance of ethics in the performance of all analytical work,
(c) to obtain the commitment of laboratory staff to the principle that all analyses shall be performed in a controlled and documented manner, and
(d) to ensure that laboratory staff consistently meet the specific ethical requirements defined in this data integrity plan.

4.16.2 Scope

This procedure applies to all analyses and activities performed within the laboratory's scope of accreditation.

4.16.3 Responsibilities

Senior managers support and provide initial data integrity training and on-going annual training to laboratory managers and staff. Senior managers ensure that only staff who sign the ethics agreement are allowed to work in the laboratory.

The QAO shall maintain records of ethics/data integrity training and data integrity monitoring.

4.16.4 Procedure

Ethics Training

Ethics training is a required part of new employee orientation and is provided on an annual basis for all laboratory managers and staff by senior laboratory management. Initial training during orientation includes the overall organizational mission and its relationship to the absolute need for honesty and full disclosure in all analytical reporting and record-keeping. Resources where applicable ethics policy and law can be found are made available and copies are distributed. Examples are described that illustrate unethical behavior and ethical behavior related to laboratory data manipulation.

Laboratory standard operating procedures are reviewed with respect to proper procedure, data qualifiers, and adequacy of record keeping. Management will disclose that reports and the data generated to support them are subject to routine in-depth review.

The organizations response to infractions of the data integrity plan will be discussed and the trainee shall understand that infractions will be investigated in a detailed way. The consequences to an employee found to be in violation of the data integrity plan may result in immediate termination, debarment, and/or civil/criminal prosecution. Confidentiality is assured during this process.

Employee attendance or participation is documented.

Ethics Agreement

Following initial ethics training and on-going annual training for laboratory managers and staff, trainees shall sign a written ethics agreement. Senior managers who provide the training shall also sign the agreement. The agreement states that the signers will not engage in any unethical practices with respect to data integrity nor will they tolerate improper behavior in others if it is observed or suspected. By signing, senior managers acknowledge their duties in upholding the spirit and intent of the data integrity system and in effectively implementing the specific requirements of the plan.

Monitoring

Data integrity monitoring is accomplished by periodic data package and manual integration reviews by the QAO and/or Laboratory Director, annual internal audits, and monthly QC sample tracking. Therefore the QAO, shall have an in-depth understanding of typical inappropriate analytical behavior and be trained in the data integrity system. Refer to the laboratory’s SOP for data review.

Blind known reference samples may be submitted for analysis as real samples by the QAO, (blind to the analyst) as part of any project or event Data and results of the reference sample are reviewed by the QAO to verify that all data integrity requirements are met.

Documentation

All data integrity incidents must be documented, including investigative findings and disciplinary actions. Corrective actions are recorded. Confidentiality is critical and maintained by use of locked filing cabinets and password protected electronic files. If client disclosure is determined to be necessary by senior laboratory management, then such disclosures and outcomes are recorded.

All data integrity documents, plans, SOPs, personal records and records of investigations shall be maintained for a period of five years. Documents are subject to the document control system and records are subject to the records management system as described in the laboratory's quality manual and related SOPs.

4.16.5 References

Internal
York Data Integrity and Ethics Training SOP (ADMIN Ethics 040102)
York Internal Quality Audit SOP (ADMIN Audit 043010)
York Manual Integration Review SOP (ADMIN ManIntReview 043010)

External
NELAC Quality Systems, Chapter 5, Sections *5.4.2.3, 5.4.2.6, and 5.4.15*, June 5, 2003 and Module 2, *Sections 4.2.8.4, 4.2.8.1, 5.2.7, and 4.16*, August 24, 2009.

Revision History

Revision No.	Date	Responsible Person	Description of Change
1	12/26/12		Initial Release

4.16.6 Annual Review (The review is to be documented if the Quality Manual has not been revised in the past 12 months)

______________________ ____________________ _______
Signature Title Date

______________________ ____________________ _______
Signature Title Date

______________________ ____________________ _______
Signature Title Date

______________________ ____________________ _______
Signature Title Date

______________________ ____________________ _______
Signature Title Date

5.0 Technical Requirements

5.1 General

5.1.1 Correctness and Reliability

Policy and Details:
Correctness and reliability of the tests and/or calibrations performed have many contributing factors including:

- human factors (see section 5.2)
- accommodation and environmental conditions (see section 5.3)
- test and calibration methods and method validation (see section 5.4)
- instrumentation (see section 5.5)
- measurement traceability (see section 5.6)
- sampling (see section 5.7)
- handling of test and calibration items (see section 5.8)

5.1.2 Measurement Uncertainty

Policy:
When developing test and calibration methods and procedures, total measurement uncertainty must be accounted for in the training and qualification of personnel, and in the selection and calibration of instrumentation.

Details:
The extent to which the factors contribute to total measurement uncertainty differs between (types of) tests and between (types of) calibrations.

See section 5.4.6 for more details.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.2 Personnel

York recognizes that all laboratory personnel affect data quality. This manual has been prepared so that staff members will be cognizant of the procedures adopted by York for the production of analytical data, and so they will be aware of their responsibilities.

Staff are properly trained and qualified for their positions and specific procedures.

5.2.1 Competence and Qualification

Policy:
Management ensures the competency of all personnel charged with analysis and those evaluating results and signing test reports. Appropriate supervision is provided for employees undergoing training. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required.

In addition, personnel responsible for the opinions and interpretations included in test reports also have:
- relevant knowledge of the technology used for the analysis, materials
- knowledge of the general requirements expressed in the legislation and standards
- an understanding of the significance of deviations found with regard to the normal use of the data

Details:
Management defines the minimum levels of qualification and experience necessary for all posts within the laboratory. In some technical areas it may be required that the personnel performing certain tasks be certified. The laboratory is responsible for fulfilling specified certification requirements of personnel. The requirements for personnel certification might be regulatory, might be included in the standards for the specific technical field, or required by the client.

Continued competence is monitored and where this is not achieved, the need to retrain personnel is considered. Where a method or technique is not in regular use, verification of personnel performance prior to testing may be necessary.

5.2.2 Training Policies and Procedures

Policy:
Management will formulate the goals with respect to the education and the skills of the laboratory personnel. The training program is relevant to the present and anticipated tasks

of the laboratory. SOP# QSP 5-2-1 is utilized to identify training needs and providing the necessary training for personnel. The effectiveness of the training actions taken is evaluated.

Details:
The skills and knowledge are defined in the job description for each job function as described in section 5.2.4. Management compares the job description to the skills and knowledge of the new incumbent to determine the training needs.

Training in the laboratory must include all methods or parts of methods and techniques that personnel are asked to perform. Minimally, the analyst must demonstrate competency (Initial Demonstration of Capability) through observation by management and verification using replicate and/or check samples. For technicians who perform only parts of the method, confirmation of competency may be verified by observation only. Re-verification of all personnel must be performed annually on all methods or techniques pertinent to their job description.

In some cases it may be appropriate to define competence related to a particular technique or instrument rather then methods. If so, it will be necessary to define for each method, the necessary technique-based competence required together with any additional requirements.

5.2.3 Employees

Policy:
Competent permanent or part-time employees are employed in the laboratory. No contract labor is used. The Managing Director ensures that all technical employees, and key support personnel are supervised and work in accordance to the policies and procedures of this Quality Manual.

Details:
Testing must be either performed or supervised by an experienced person qualified to degree level. Personnel have relevant practical work experience and training before being allowed to perform accredited work.

5.2.4 Job Descriptions

Policy:
Current job descriptions for managerial, technical and key support personnel involved in laboratory analyses are maintained centrally on the Network with appropriate access.

Details:
Minimum contents of job descriptions include:

- the duty of performing preparation/analysis
- the act of planning analyses and evaluation of results
- the responsibility of developing and validating new methods as / when requested
- expertise and experience
- qualifications and training programs
- managerial duties if applicable

Job descriptions are dated and signed to demonstrate that each incumbent has read it and is in agreement. They are maintained current on the Network.

5.2.5 Authorized Personnel

Policy:
Management authorizes specific personnel to perform particular types of analysis, to issue test reports, to give opinions and interpretations and to operate particular types of instrumentation. Records of the relevant competence, educational and professional qualifications, training, skills and experience of all technical personnel and contracted personnel are maintained. This information is readily available and includes the date on which authorization and/or competence was confirmed and the criteria on which the authorization is based and the confirming authority.

Details:
The purpose of these records is to provide evidence that personnel have been adequately trained and their competence to perform particular tests has been assessed. In some cases it may be pertinent to state any particular limitations to competence. The records are maintained in a registry of skills and include:

- academic and professional qualifications
- external and internal courses attended
- relevant on-the-job training and retraining as necessary (i.e., demonstration of capability)
- skills and experience (i.e., resume-maintained in employee administration file)
- relevant authorizations

Records are held centrally in the Employee Training Records Log.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.3 Accommodation and Environmental Conditions

5.3.1 Facility

Policy:
Laboratory facilities are appropriate to attain correct performance of all analyses. This may include, but not limited to, energy sources, lighting, heating, ventilation and any other environmental conditions.

Appropriate care is taken to ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement. The technical requirements for accommodation and environmental conditions that can affect the results of tests and calibrations are documented.

Details:
This section deals with the test areas in the laboratory and premises for support such as sample receipt and storage. Central laboratory supplies and services, such as water purification systems, air supply, vacuum source, and sample storage, are appropriate to facilitate proper performance of analyses.

5.3.2 Monitoring

Policy:
Critical environmental conditions are monitored, controlled and recorded as required by the relevant specifications, methods, and procedures or where they may influence the quality of the results. Due attention is paid, for example, to the potential for cross contamination by methylene chloride, acetone and hexanes which are used in the Extractions processes, as appropriate to the technical activities concerned. Analyses are stopped when the environmental conditions jeopardize the results. O

Details:
Laboratories are ventilated to reduce the levels of contamination, lower humidity, and control temperature. Laboratories' test areas are air-conditioned. The relative humidity in test areas is 45-50 and the temperature is 20-25 °C. Volatiles analyses are conducted in a separate laboratory where the air conditioning system produces a positive pressure in the laboratory and the air intake (economizer) is disabled. In addition, samples for volatiles are stored in a separate Sample Control room in their own refrigerators to minimize potential for cross contamination.

Bench tops and floors are made of impervious, smooth easily cleaned materials. There is at least two linear meters workspace per analyst while working. Walls and ceilings are made of materials that are smooth and easily cleaned.

5.3.3 Separation of Incompatible Activities

Policy:
Effective separation between neighboring areas is made when the activities are incompatible. Measures are taken to prevent cross-contamination.

Details:
Reference materials and certified reference materials must be kept separated from samples (log-in and storage). Sample log-in and storage must are segregated, in separate areas from the testing laboratory, and include proper sanitation to exclude the possibility of cross-contamination. Segregation of activities is achieved through time and space allocations.

An example of space segregation would be for a trace volatiles analysis. Physical separation of the trace volatiles analysis from Extractions using solvents is achieved through the use of separate rooms.

An example of time segregation would be the coordination of activities at different times. It may be appropriate to perform work on “cleaner” samples first before starting “dirtier” type samples.

5.3.4 Controlled Access

Policy:
Access to and use of areas affecting quality of the analyses is defined and controlled.

Details:
Access to the laboratory is restricted to authorized personnel. The authorized personnel are made aware of the following items:

- ➢ the intended use of the area
- ➢ the restrictions imposed on working within such areas
- ➢ the reasons for imposing the restrictions

5.3.5 Good Housekeeping

Policy:
Measures are taken to ensure good housekeeping in the laboratory. Special procedures are prepared when necessary.

Details:
Controlled use of cleaning and pest control materials is exercised. The laboratory complies with the local health and safety requirements.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.4 Tests and Calibration Methods and Method Validation

5.4.1 General

Policy:
Methods and procedures used for all analyses are appropriate as per:
- courier handling, transport, storage, and preparation of items to be tested
- an estimation of the measurement of uncertainty as well as statistical techniques for analysis of test data where appropriate

Instructions on the use and operation of all relevant instrumentation and on the handling and preparation of items for testing are available. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and readily available to personnel. Deviation from SOP and test methods must be documented, technically justified, authorized, and accepted by the client.

Details:
There are SOPs for sample handling, transport, storage, preparation, QA/QC procedures, and standards for approving / rejecting results. These may be combined with or separate from the method. The content of a test method or SOP generally includes:
- scope
- description of test items
- holding times
- quantities to be tested
- materials and instrumentation required
- physical environmental conditions required (temperatures, pH requirements)
- description of procedures
- sample identification
- method of recording observations and results
- safety measures
- waste management/pollution prevention
- documentation
- method for data analysis and presentation
- sensitivity of method
- quality control plan

National or state standards or other recognized specifications that contain sufficient and concise information on how to perform the analyses are not necessarily supplemented or rewritten as an internal procedure when they are written in a way that can be used as published by laboratory staff. Consideration may need to be given to providing additional documentation for optional steps in the method.

5.4.2 Selection of Methods

Policy:
Preparation and analysis methods meet the needs of the client and are appropriate for the analysis undertaken. Preference is given to reference methods published as international, Federal, or State standards. The laboratory ensures that the latest edition of a standard is used unless it is not appropriate or possible to do so. When necessary, the standard is supplemented with additional details to ensure consistent application.

Details:
Methods that have been published either in international, Federal, or State standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer are selected when the client does not specify the method to be used. These methods may be adopted from the Environmental Protection Agency, ASTM, Standard Methods for the Examination of Water and Wastewater, Various State agencies, etc.

The ability of the laboratory to achieve satisfactory performance against documented performance characteristics is verified before samples are analyzed.

Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated. The client is informed as to the method chosen. The laboratory confirms that it can properly operate standardized methods before introducing the samples for analysis.

The client is informed when the method proposed by the client is considered to be inappropriate or out of date.

5.4.3 Laboratory-Developed Methods

Policy:
Introduction of test methods developed internally is a planned activity and is assigned to qualified personnel equipped with adequate resources. Plans are updated as development proceeds and ensure effective communication among all personnel involved.

Details:
Methods developed in-house are validated and authorized before use. Where available, Certified Reference Materials (CRMs) are used to determine any systemic bias, or where possible results are compared with other techniques, preferably based on different principles of analysis. Determination of uncertainty must be part of this validation process and is essential for ongoing quality control.

5.4.4 Non-Standard Methods

Policy:
Utilization of non-standard methods is subject to agreement with the client and includes a clear specification of the client's requirements and the purpose of the test. The developed method is validated appropriately before use.

Details:
Discussion and agreement for the use of non-standard methods is recorded as part of contract review procedures (see section 4.4).

All non-standard and new tests are validated for their intended purpose. Qualitative test methods must be validated to demonstrate estimated sensitivity and specificity, relative accuracy to official methods (if appropriate), positive and negative deviation, limit of detection, matrix effect, repeatability, and reproducibility.

Quantitative test methods are validated to demonstrate specificity, sensitivity, relative accuracy, positive and negative deviation, repeatability, reproducibility, and limit of determination.

For new methods where procedures are developing rapidly, especially for emergency situations, it may be necessary to circumvent normal validation procedures. Minimally, this must be a demonstrated recovery in replicate.

New test and/or calibration methods are documented prior to providing test and/or calibration results to clients and contain at least the following information:

- appropriate identification
- scope
- description of the type of item to be tested or calibrated
- parameters or quantities to be determined
- apparatus and instrumentation, including technical performance requirements
- reference standards and reference materials required
- environmental conditions required and any stabilization period needed
- description of the procedure, including:
  - affixing identification marks, handling, transporting, storing and preparing of items
  - ensuring checks are made before the work is started
  - checking that the instrumentation is working properly and, where required, calibrating and adjusting the instrumentation before each use
  - listing method of recording the observations and results
  - indicating any safety measures to be observed
- criteria and/or requirements for approval/rejection (quality control plan)

- data to be recorded and method of analysis and presentation
- uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods

5.4.5.1 Performance Characteristics

Policy:
Validation of a method establishes, by systematic laboratory studies, that the performance characteristics of the method meet the specifications related to the intended use of the test results.

Details:
The performance characteristics of a validation plan includes, as applicable:

- selectivity and specificity
- range
- linearity
- sensitivity
- limit of detection
- limit of quantitation
- ruggedness
- accuracy
- precision
- reporting limit
- repeatability
- reproducibility
- recovery
- confirmation techniques
- criteria for the number of samples tested to validate method as per defined scope of method
- action levels where defined by regulation
- quality control incorporating statistics as applicable
- interpretation of population results as applicable

Performance characteristics that are selected take into account the intended use of the method, whether for screening, confirmatory analysis, or quantitation.

The design, verification of the method and documentation procedures for validation are planned and conducted by qualified personnel, equipped with adequate resources.

This section lists a few acceptable validation procedures. The choice of the procedure depends on the extent of the deviation from the published method.

Validation of methodology is a value judgment in which the performance parameters of the method are compared with the requirements for the test data. A prerequisite for a valid method is that data produced by the method must attain a state of statistical control. Such a state is obtained when the mean value of a large number of individual values tends to approach a limiting value called the limiting mean.

Methods may be validated by one or more alternative procedures. Some of these procedures are described below. Apparent differences can be analyzed statistically to confirm their significance. In all cases, the reasons for choosing one or more alternatives must be documented.

- analysis of standard reference materials (SRM) that are identical or almost identical to the test samples
- in the absence of suitable SRMs, analysis of reference materials that are similar in all respect to the test samples; the use and validity of this reference material must be documented
- using an alternative method to measure the same parameter provides a very high level of confidence if results are confirmed
- recovery studies by the addition of a known concentration of the parameter of interest to some of the replicates being measured

The parameters to be determined include:

- the scope of the method and any known interference
- detection limit
- the range of concentration where the method is valid
- precision and bias
- intra-laboratory variations
- inter-laboratory variations

Judgment is required to determine if some or all of the above is required. Requirements will depend largely on the extent of deviation from the original method.

Developments in methodology and techniques require methods to be changed from time to time. The difference in performance between revised and obsolete methods is established so that it is possible to compare old and new data.

Where a change in method involves only minor adjustments, such as sample size, or different reagents, the amended method is validated and the changes brought to the attention of the accreditation body at the next accreditation audit. Where the proposed change involves technology or methodology, the laboratory seeks the approval of the accreditation body.

Records are kept on all validation activities. The records include any of the performance characteristics chosen, reference procedures or guidance documents followed to validate the method or custom validation procedure, and a final confirmation (memo to file) that the method validation results are acceptable for continued use of the method. An example statement would be "This memo serves as record that the validation of the XYZ Test Method has been approved for use by [name and title of approver]".

5.4.5.2 Fit for Use

Policy:
The laboratory validates non-standardized methods, laboratory-designed/developed methods, standardized methods used outside their intended range, and amplifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs in the given application or field of application (may include procedures for sampling, handling, and transportation). The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

Details and Procedure:
Validation records are kept as in section 5.4.5.1. Included in these records is the validation procedure. The procedure used for the validation is likely to vary between different methods. Therefore, the procedures included in the laboratory records are not as detailed as a typical SOP, but are sufficient enough to re-create how the method was validated.

The techniques used for the determination of the performance of a method, are one of, or a combination of, the following:

- calibration using reference standards or reference materials
- comparison of results achieved with other methods
- inter-laboratory comparisons
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience

When changes are made in the validated non-standard method, the influence of such changes carried out is documented and if appropriate a new validation is performed.

5.4.5.3 Client's Needs

Policy:
The range and accuracy of the values obtainable from validated methods (e.g., the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object) as assessed for the intended use is relevant to the client's needs.

Details:
Validation includes the specification of the requirements, determination of the characteristics of the methods, the comparison of the requirements with the values of the characteristics of the method, and a statement on the validity.

As method development proceeds, regular review is required to verify that the needs of the client are still being fulfilled. Changing requirements requiring modifications to the development plan are approved and authorized.

Validation is always a balance between costs, risks, and technical possibilities.

5.4.6 Uncertainty of Measurement

5.4.6.1 Calibration

Policy:
Physical and chemical standards and instrumentation are calibrated or characterized internally and by subcontractors where appropriate.

Details and Procedures:
Repeatability and reproducibility data are components of measurement uncertainty and are determined as a first step towards producing estimates of this parameter. The uncertainty of measurement is available on the certificate of analysis or calibration certificate from a subcontractor.
Note – in-house calibrations include procedures for uncertainty of measurement estimates where this is common practice.

5.4.6.1.1 CALIBRATION PRACTICES

Instruments and instrumentation used at York are controlled by a formal calibration program. The program verifies that instrumentation is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and instrumentation which measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration may be performed by York personnel using reference standards, or externally by calibration agencies or instrumentation manufacturers.

This section of the Quality Manual prescribes the practices used by York to implement a calibration program. Specifics are not provided herein because the requirements for the calibration of instruments and instrumentation are dependent upon the type and expected performance of individual instruments and instrumentation. Such details are provided in the specific SOPs. Implementation is the responsibility of the Group Leaders and Analysts. The Quality Assurance Officer shall review the implementation of the program as discussed in previously.

Two types of calibration are discussed in this section:

- Operational calibration which is routinely performed as part of instrument usage, such as the development of initial calibration curves for GC, GC/MS, etc. Operational calibration is generally performed for instrument systems.

- Periodic calibration which is performed at prescribed intervals for instrumentation, such as balances.

5.4.6.1.2 CALIBRATION SYSTEM

The following is a discussion of the elements comprising the calibration system.

5.4.6.1.3 Calibration Procedures

Written procedures are developed by York within the requirements of this manual for all instruments and instrumentation subject to calibration. Whenever possible, recognized procedures, such as those published by ASTM or the USEPA, or procedures provided by manufacturers are adopted. If established procedures are not available, a procedure shall be developed considering the type of instrumentation, stability characteristics of the instrumentation, required accuracy, and the effect of operational error on the quantities measured. As a minimum, the procedures shall include:

- Instrumentation to be calibrated

- Reference standards used for calibration

- Calibration technique and sequential actions

- Acceptable performance ranges

- Frequency of calibration

- Calibration documentation format

5.4.6.1.4 Instrumentation Identification

Instrumentation that is subject to calibration shall be uniquely identified so that calibration records can be designated with a specific instrument. Instrumentation identification can be by manufacturer's serial number, York inventory control number, or a unique number assigned by York.

5.4.6.1.5 Calibration Frequency

Instruments and instrumentation shall be calibrated at prescribed intervals and/or as part of the operational use of the instrumentation. Frequency shall be based on the type of instrumentation, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended use, effect of error upon the measurement process, and prior experience.

5.4.6.1.6 Calibration Reference Standards

Two types of reference standards are used within the York laboratory for calibration:

- Physical standards, such as weights for calibrating balances and certified thermometers for calibrating working thermometers and ovens, which are generally used for periodic calibration.

- Chemical standards such as Standard Reference Materials (SRMs) provided by the National Bureau of Standards NIST or NIST-traceable standards which are primarily used for operational calibration.

Whenever possible, physical reference standards shall have known relationships to nationally recognized standards (e.g., NIST) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference standards shall be documented.

Whenever possible, chemical references standards shall be directly traceable to NIST SRMs and/or EPA. If SRMs are not available, compounds of certified high purity will be used to prepare calibration standards.

5.4.6.1.7 Calibration Failure

Instrumentation that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use, or shall be tagged to indicate it is out of calibration. Such instrumentation shall be repaired and satisfactorily recalibrated before reuse

Scheduled calibration of instrumentation does not relieve the laboratory staff of the responsibility for using properly functioning instrumentation. If an instrumentation malfunction is suspected, the instrumentation shall be tagged and removed from service and recalibrated. If it fails recalibration, the above process shall apply.

5.4.6.1.8 Calibration Records

Records shall be prepared and maintained for each piece of instrumentation subject to calibration. Records demonstrating accuracy of reference standards shall also be maintained.

Records for periodically calibrated instrumentation shall include, as appropriate:

- Identification number of instrumentation and type of instrumentation.
- Calibration frequency and acceptable tolerances.
- Identification of calibration procedure used.
- Date calibration was performed.
- Identity of York personnel and/or external agencies performing the calibration.
- Reference standards used for calibration.
- Calibration date.
- Certificates or statements of calibration provided by manufacturers and external agencies, and traceability to national standards.
- Information regarding calibration acceptance or failure and any repair of failed instrumentation.

Records for periodically calibrated instrumentation shall be maintained in the Laboratory Operation Records. Records for each instrument/instrumentation and physical reference standard shall be kept in a separate folder. The title sheet for each file shall be a summary of calibrations performed. It is recommended that an index precede the instrumentation files which lists in matrix form all instrumentation and physical standards, calibration frequency, and dates for upcoming calibration. The use of a calibration due date matrix provides ready reference so that calibration can be maintained by the Group Leaders.

For instruments and instrumentation that are calibrated on an operational basis, calibration generally consists of determining instrumental response against compounds of known composition and concentration or the preparation of a standard response curve (either linear or average response factor) of the same compound at different concentrations. Records of these calibrations are be maintained in several ways:

- The calibration data for all GC, GC/MS, ICP/ICPMS, Ion Chromatography is kept in a uniquely numbered QUALITY BATCH (QB) file. These files include all initial calibrations and continuing calibrations, as well as method blanks, spikes, duplicates and control (LCS) data. The nomenclature for these files follows this example:
    - For a volatiles run on April 1, 2010 on Volatiles GC/MS # 1, the batch QA/QC data is placed in a QB file identified as QBV1040110A. The A represents the first batch of the day. If two batches are run, a B is affixed, etc.
    - This unique QB number appears on all sample headers to allow for cross referencing all QA data for a particular batch to each sample.
- A log book for each parameter documents all calibration and QA data for each wet chemistry, gravimetric or spectrophotometric analysis.

For operational calibration, the following is recommended:

As above, calibration data must be included in a batch file system. If samples from different projects are processed together, calibration data is included in a batch folder.

- The specific SOPs detail:
- Calibration instructions (curve preparation, linear ranges, etc.).
- Procedures for chemical standards preparations.

5.4.6.1.9 OPERATIONAL CALIBRATION

Operational calibration is generally performed as part of the analytical procedure. Included may be the analysis of a method blank and the preparation of continuing calibration verification standard or curve. Operational calibration is dependent upon the instrumentation within York, and as previously discussed, the laboratory uses a specific SOP for this purpose.

Following is a brief discussion of the analysis of method blanks and preparation of calibration curves. Guidelines for the major instrument systems within the York laboratory follow:

5.4.6.1.10 General Calibration Procedures

The initial phase of a laboratory testing program requires the selection and certification of the method best suited for an individual parameter. Certification, or verification, is the elimination, or minimizing, of determinate errors which may be due to Analyst's error, the use of less-than-optimum instrumentation, reagents, solvents, or gases. The quality of materials, even though they are AR grade or better, may vary from one source to another. The Analyst must determine, through the use of reagent and/or solvent blanks, if materials are free from interfering substances which could affect the analysis. Other steps in certifying the method include the determination of a method blank and the preparation of a standard calibration curve.

5.4.6.1.11 Method Blank

After determining the individual reagent or solvent blanks, the Analyst defines the method blank to determine if the cumulative blank interferes with the analysis. The method blank is defined by following the procedures step by step, including the addition of all of the reagents and solvents, in the quantity required by the method. If the cumulative blank interferes with the determination, steps must be taken to eliminate or reduce the interference to a level that will permit the combination of solvents and reagents to be used. If the blank interference cannot be eliminated, the magnitude of the interference must be considered when calculating the concentration of specific constituents in the samples analyzed.

A method blank must be determined whenever an analysis is made. The number of blanks is determined by the method of analysis and the number of samples analyzed at a given time, but is typically one per 20 samples or one per batch whichever is less.

5.4.6.1.12 Preparation of Standard Calibration Curve

Concurrent with the preparation of reagent and method blanks, a standard calibration curve is accomplished by using calibration standards. The process is summarized as:

- Preparation of a standard calibration curve is accomplished by using five calibration standards prepared by mixing the species to be analyzed into the "solvent" that is to be introduced into the instrument.

- The concentration of the calibration standards are chosen to cover the working range of the instrument.

- All sample measurements are made within this working range.

- The calibration curve is prepared by plotting instrument response versus concentration of the species analyzed. Acceptable linearity or RSDs are defined in the analysis specific SOPs.

- Concentrations of the sample prepared with the same procedure are read directly from the calibration curve or average response factor as detailed in the SOPs.

5.4.6.1.13 GC/MS CALIBRATION PROCEDURES

This section outlines the minimum operations necessary to satisfy analytical requirements associated with the determination of various target lists of organics compounds in air, water and soil/sediment samples. The following operations must be performed routinely (as specified in the SOPs) in the laboratory:

- Documentation of GC/MS mass calibration and abundance pattern.

- Documentation of GC/MS response factor stability.

- Internal standard response and retention time monitoring.

6.2.2.1 Tuning and GC/MS Mass Calibration

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of decafluorotriphenylphosphine (DFTPP) for base/neutral and acid

(BNA) compounds or p-bromofluorobenzene (BFB) for volatile compounds. The ion abundance criteria as listed in the methods or SOPs for each calibration compound should be met before samples, blanks, or standards can be analyzed.

DFTPP (decafluorotriphenylphosphine)

Each GC/MS system used for the analysis of semivolatile compounds must be tuned to meet the abundance criteria of the method for a 50 nanogram (ng) injection of DFTPP. DFTPP may be analyzed separately or as part of the calibration standard, and the criteria must be demonstrated each (12) hours of use. Documentation of the calibration must be provided in the form of a bar graph plot and as a mass listing.

BFB (p-bromofluorobenzene)

Each GC/MS system used for the analysis of volatile compounds must be tuned to meet the proper abundance criteria for a 50 ng injection of BFB. The criteria should be demonstrated each (12) hours of use. Documentation of the calibration should be provided in the form of a bar graph plot and as a mass listing.

Analysts obtain a system generated GC/MS Tuning and Mass Calibration each time an analytical system is tuned.

5.4.6.1.14 Calibration of the GC/MS System

Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system must be initially calibrated at a minimum of five concentrations to determine the linearity of response utilizing standards. For GC/MS analysis, typical linear ranges are 0.05(SIM) to 200 ng for base neutrals, 5 to 400 ng for certain phenols, and 0.1 to 1,000 ng for volatiles.

Calibration standards are prepared to cover the linear range and are detailed in the SOPs.

Semivolatiles (B/N/A)

Initial calibration of semivolatile compounds is recommended at 5 to 140 ng for SCAN analysis with SIM covering the range 0.05 to 2 ng.

Pesticides & PCB

Pesticides by GC/ECD are calibrated at five levels from 0.001 ng to 0.2 ng.

PCB's by GC/ECD are calibrated at five levels from 1 ng to 10 ng.

In all cases reference is made to the specific SOP for preparation directions.

Continuing Calibration (GC/MS and GC)

A continuing calibration standard containing all volatile or semivolatile compounds as well as all required internal standards and surrogates, is performed each 12 hours during analysis. This applies to all matrices except air, whose requirements are detailed in EPA methods TO14A/15. Compare the RF data from the standards each 12 hours with the average RF from the initial calibration for a specific instrument. A system performance check must also be made each 12 hours. If the SPCC criteria are met, a comparison of RFs is made for all compounds. This is the same check that is applied during the initial calibration. If the minimum response factors are not met, the system should be evaluated and corrective action should be taken before sample analysis begins. See the specific SOP for criteria.

5.4.6.1.15 Calibration of the Gas Chromatograph

Calibration of the gas chromatograph (GC) for pesticide and polychlorinated biphenyl (PCB) or other organic compound analyses is performed with the standardization of the instrument. A five-point standard curve is utilized.

Response factors are to be calculated for each compound at each concentration level. These RF will be averaged to generate the mean daily RF for each compound over the range of the standard curve. The mean response factor will be used to calculate the sample concentration of the compound of interest. When sample responses exceed the range of the standard curve, the sample will be diluted to fall within range of the standard curve and be reanalyzed. The results of the daily GC standardization will be tabulated and filed with the corresponding sample analyses or batch file.

5.4.6.1.16 Calibration of Inductively Coupled Plasma Spectrometer (ICP) and Inductively Coupled Argon Plasma/Mass Spectrometer (ICP/MS) and Cold Vapor AAS

The ICP and ICP/MS are standardized for the metal of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. A single standard is used to calibrate the ICP, three standards are used for ICP/MS, while five working standards of mercury (Cold Vapor AAS) are prepared by dilution of the stock standard. The concentration of the calibration standards is chosen so as to cover the working range of the instrument. Subsequently all sample measurements are made within this working range. Once the working standards are prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in micrograms of metal per milliliter of water or parts per million.

Once the instrument has been initially calibrated, the analysis of initial calibration verification (ICV) is performed. Continuing calibration verification (CCV) standards are repeated after every ten samples during sample analysis to verify instrument response during analysis and to confirm the calibration. A typical analysis sequence is presented below:

- Working standards are prepared by dilution of a stock standard solution of the metal of interest.
- A calibration curve within the working range of the instrument is established by analysis of five working standards (one for ICP).
- The working standards (ICV, CCV and blank) are reanalyzed to confirm calibration. If the calibration is not confirmed, within SOP limits, the instrument is recalibrated.
- The samples are analyzed for the metals of interest.
- Following completion of the sample analyses, the working standards are reanalyzed to confirm calibration. If calibration is confirmed, the analysis is completed. However, if the calibration is not confirmed, the problem is corrected, and the affected samples are reanalyzed.

5.4.6.1.17 PERIODIC CALIBRATION

Periodic calibration shall be performed for instrumentation such as balances, thermometers, ovens, and furnaces that are required in analytical methods, but which are not routinely calibrated as part of the analytical procedure. Documentation of calibration is kept for each instrumentation item.

Calibration requirements are determined within the York laboratory depending upon the instrumentation used and its operating function. Following are brief example discussions for the calibration of balances and thermometers with examples of calibration data sheets to serve as a guideline for the preparation of laboratory-specific procedures.

5.4.6.1.18 Balances (Example Procedure)

All balances are verified by using weights traceable to the National Bureau of Standards (NIST) on use. Calibration weights shall be Class S or better and shall be recertified every year. If balances are calibrated by an external agency, verification of their weights shall be provided.

Calibration of balances shall be over the range in which they are most commonly used. The weighs used for calibration of each balance shall be 0.5g, 2.0g, 10.0g, 20.0g, and 100g. Acceptance for balances which are direct reading to 0.01 gram shall be ± 0.01g, to 0.0001g shall be ± 0.007g, and to 0.00001g shall be ± 0.0007g.

5.4.6.1.19 Thermometers (Example Procedure)

Certified, or reference, thermometers shall be maintained for use in calibrating working thermometers including other temperature measurement devices such as thermocouples, probes and infrared temperature sensors. Reference thermometers shall be provided with NIST traceability for initial calibration and shall be recertified every year with instrumentation directly traceable to the NIST. Working thermometers shall be compared with reference thermometers every 12 months. In addition, working thermometers shall be visually inspected by laboratory personnel prior to use.

Calibration temperatures and acceptance criteria shall be based upon the working range of the thermometer and the accuracy required for its use.

5.4.6.2 Testing Uncertainties

Policy:
The SOP ADMINESTUNCERT043010 is utilized to estimate uncertainties of measurement in testing, except when the test methods preclude such rigorous calculations. For most environmental analyses these uncertainties have been established and this procedure will be unnecessary.

In certain cases it is not possible to undertake meterologically and statistically valid estimations of uncertainty of measurement. In these cases the laboratory attempts to identify all the components of uncertainty and make the best possible estimation, and ensure that the form of reporting does not give an exaggerated impression of accuracy. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of previous experience and validation data.

Details:
The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

- requirement of the test method
- requirement by the client

- if there are narrow limits on which decisions on conformity to a specification are based

In cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the estimation uncertainty of measurement by following the reporting instructions (see section 5.10).

5.4.6.3 Uncertainty Components

Policy:
When estimating the uncertainty of measurement, all uncertainty components that are of importance in the given situation are taken into account using accepted methods of analysis.

Details:
Sources contributing to the uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and instrumentation used, the environmental conditions, the item being tested or calibrated and the operator.

The predicted long-term behavior of the tested and/or calibrated item is normally not taken into account when estimating the measurement uncertainty.

For further information, see ISO 5725 and the Guide to Expression of Uncertainty in Measurement.

5.4.7 Control of Data

5.4.7.1 Calculations and Data Transfers

Policy:
Calculations and data transfers are subject to appropriate checks in a systematic manner.

Details:
Test data are validated through following SOP QC040402 to determine accuracy of calculations, conversions, and data transfers

- checks for transcription errors, omissions, and mistakes
- checks to determine consistency with normal or expected values

For those analyses where manual data reduction is required, it is performed according to the instructions provided in the test method or SOP.

5.4.7.2 Computers and Automated Instrumentation

Policy:
When computers or automated instrumentation are used for the acquisition, processing, manipulation, recording, reporting, storage or retrieval of test or calibration data, the laboratory ensures that:

- computer software developed by the user is documented in sufficient detail and suitably validated or otherwise checked as being adequate for use
- procedures are established and implemented for protecting the integrity of data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing (see section 4.13.1.4)
- computers and automated instrumentation are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test and calibration data
- data is securely maintained by preventing unauthorized access to, and unauthorized amendment of, computer records

Details and Procedures:
Data generated using computer software programs that are interfaced directly to instruments incorporates all dilutions and calculations, thereby eliminating the need for manual data reduction.

Commercially developed software in general use within its designed application range may be considered sufficiently validated. Laboratory software configuration / modifications are validated and documented.

Electronic records, electronic signatures, and handwritten signatures executed to electronic records must be equivalent to proper records and handwritten signatures to paper and are validated by procedures in 21 CFR. Part II (Docket No. 92NO251) RIN0910-AA29; Federal Register: March 20, 1997, Volume 62, Number 54), Rules and Regulations, pages 13429-13466. For further details see:

http://www.fda.gov/ora/compliance_ref/part11/

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	06/29/2012	Modified balance calibration procedure, tolerances.

5.5 Instrumentation

5.5.1 Required Instrumentation

Policy:
The laboratory is furnished with all items for preparation and analysis required for the correct performance of the analyses. When instrumentation is used outside the laboratory's permanent control, it ensures that the requirements of this Quality Manual are met.

Details:
Instrumentation is used in an environment appropriate to its proper performance. All instrumentation required by a test is described in each method, including the instrumentation's tolerances.

5.5.2 Required Accuracy

Policy:
Instrumentation and software used for testing are capable of achieving the accuracy required and comply with specifications relevant to the tests and/or calibrations concerned. Calibration programs are established for key quantities or values of the instruments where these properties have a significant affect on the results. When received, instrumentation, including that used for sampling, is checked to establish that it meets the laboratory's specification requirements, complies with the relevant standard specifications, and is checked and/or calibrated in accordance with section 5.6 before use.

Details:
The procedures for checking newly received instrumentation are as determined by manufacturers' specification and/or those determined by the laboratory during procurement.

5.5.3 Authorized Personnel

Policy:
Instrumentation is operated by authorized personnel. Up-to-date instructions on the use and maintenance of instrumentation (including any relevant manuals provided by the manufacturer of the instrumentation) are readily available for use by the appropriate laboratory personnel.

Details:

Access to laboratory instrumentation is controlled to ensure that only authorized personnel use instrumentation.

5.5.4 Unique Identification

Policy:
Each item of instrumentation used for testing is uniquely identified as appropriate.

Details:
Measuring and testing instrumentation is uniquely identified through an asset number of ID. Measuring and testing instrumentation includes any instrument that could affect the quality of test results. Components that can be interchanged between various instruments are tracked in instrumentation logbooks but are not assigned individual asset numbers.

5.5.5 Inventory and Maintenance Records

Policy:
Records are maintained for each item of instrumentation significant to the tests and/or calibrations performed. The records include the following:

- identity of the item of instrumentation (and its software)
- manufacturer's name, type identification, and serial number and/or other unique identification
- checks that instrumentation complies with the specification (see section 5.5.2)
- current location, where appropriate
- the manufacturer's instructions, if available, or reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and due date of next calibration
- maintenance carried out to date and the maintenance plan (includes calibration)
- damage, malfunction, modification or repair to the instrumentation

Details:
A database is used to capture the above inventory information. The above information related to service and maintenance is kept in individual instrumentation files and/or binders. Other information kept in these files and/or binders may include:

- date received and date placed in service
- condition when received (e.g., new, used, refurbished)
- dates and results of calibration and/or verification and date of next calibration and/or verification
- performance history, where appropriate (e.g., response time, drift, noise level)

5.5.6 Instrumentation Procedures

Policy:
The laboratory has as an established plan for use and maintenance (including calibration) of measuring instrumentation, and appropriate use of correction factors to ensure proper functioning and in order to prevent contamination or deterioration.

Details and Procedures:
The procedures for each piece of measuring instrumentation are located in the appropriate room where the instrumentation is located or in the SOP. These procedures detail any information for safe handling, transport, storage, use, and maintenance of measuring instrumentation.

5.5.7 Out of Service Instrumentation

Policy:
Instrumentation that has either been subjected to overloading or mishandling, or gives suspect results, or has been shown to be defective or outside specified limits, is taken out of service, clearly marked, and appropriately stored until it has been repaired and shown by calibration or test to perform correctly.

Details:
Routine testing work is completely discontinued on instrumentation that even shows minor nonconformances. Not only do we do this for ethical reasons in support of our client, but minor nonconformances are often indicative of major breakdowns in expensive instrumentation. These breakdowns need to be avoided wherever possible.

Out of service instrumentation is clearly marked as outlined in section 5.5.8.

The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the “Control of Nonconforming Work” procedure as outlined in section 4.9.

5.5.8 Calibration Status

Policy:
Instrumentation requiring calibration is labeled to indicate the calibration status and/or operational status and the date when re-calibration is due when appropriate.

Details:
Calibration labels have a write-on surface and a pressure sensitive adhesive. The areas that are filled out include the person who performed the calibration, the date it was performed, the date it is due for re-calibration, and the instrumentation's identification number.

CALIBRATION
BY___________DATE________
DUE_________ID#___________

Measuring instrumentation that has failed calibration or is deemed out of service is labeled with one of the following labels:

CALIBRATION VOID

DO NOT USE

OUT OF SERVICE

DO NOT USE

A piece of instrumentation that is not calibrated or checked is labeled with the following label:

FOR REFERENCE ONLY

5.5.9 Return to Service

Policy:
When instrumentation goes outside the direct control of the laboratory for a period, the laboratory ensures that the function and calibration status of the instrumentation are checked and validated and shown to be satisfactory before the instrumentation is returned to service.

Details and Procedures:
The procedures used to check and ensure that the function and calibration status of the instrumentation are satisfactory before the instrumentation is returned to service are outlined in the manufacturer's instrumentation manual. Any additional quality control checks are outlined in the applicable section of the appropriate SOP and/or test method.

5.5.10 Periodic Checks

Policy:
When intermediate checks are needed to maintain confidence in the calibration status of instrumentation, these checks are carried out periodically according to defined procedure.

Details and Procedures:
As stated in section 5.5.6, the procedures for each piece of measuring instrumentation are located in the appropriate room where the instrumentation is located. SOP# QSP 5-5-1 outlines a general maintenance plan for instrumentation and includes various checks. Internal quality control checks are specified in individual test methods that are located in the appropriate laboratory areas thereby providing procedures for intermediate checks.

5.5.11 Correction Factors

Policy
Calibrations that give rise to a set of correction factors are updated along with all copies of this data (e.g., in computer software).

Details and Procedures:
The updating of correction factors, including all copies, is assured by following the appropriate test method or SOP. It is the responsibility of the Group Leaders to ensure that all copies are updated.

5.5.12 Safeguards against Adjustments

Policy:
Test instrumentation, including hardware and software, are safeguarded from adjustments that invalidate test and/or calibration results/status.

Details:
Safeguards against adjustment for laboratory instrumentation include:
- detailed SOPs and manufacturer's manuals on the operation of the instrumentation
- policies permitting only fully trained and competent personnel to operate instrumentation
- access to the laboratory is restricted to authorized personnel

Safeguards against adjustment for software include:
- password protection for important files and packages
- access to the laboratory is restricted to authorized personnel

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

5.6 Measurement Traceability

5.6.1 General

Policy:
All measurement and test instrumentation having an effect on the accuracy or validity of tests is calibrated and/or verified before being put into service.

Details:
The program includes a system for selecting, using, calibrating, checking, controlling, and maintaining:
- measurement standards
- reference standards used as measurement standards
- measuring and test instrumentation used to perform tests and calibrations

Procedures are documented where appropriate. All measurements that play a defining role in testing accuracy are based directly or indirectly on reference standards, reference materials, certified reference materials, or other standards or materials having appropriate traceability.

Records are maintained for each standard. These records include, as applicable:
- supplier, grade, batch#
- dates of preparation or verification
- measurement of weights, volumes, time intervals, temperatures, and pressures and related calculations
- relevant processes (e.g., pH adjustment, extraction)
- verification results
- identification of personnel involved

Reagents prepared in the laboratory are labelled to identify substance, concentration, solvent (where not water), any special precautions or hazards, restrictions of use, Lot no., and date of preparation and/or expiry. The person responsible for the preparation of the reagent is identified either from the label or from records.

5.6.2 Specific Requirements

5.6.2.1 Calibration

Policy:
The program for calibration of instrumentation is designed and operated to ensure that calibration measurements are traceable to the Système International (SI) units of measurement or NIST.

Details:
Traceability of measurement is assured by the use of calibration services, internal and from sources that can demonstrate competence, measurement capability and traceability. The calibration certificates issued by these sources show that there is a link to a primary standard traceable to NIST. The calibration certificates contain the measurement results including the measurement uncertainty and/or a statement of compliance with an identified metrological specification (see also section 5.10.4.2).

Calibration vendors accredited to ISO 17025 are considered competent to provide the appropriate calibration services.

The term “identified metrological specification” means that it must be clear from the calibration certificate against which specification the measurements have been compared with, by including the specification or by giving an unambiguous reference to the specification.

When the terms “international standard” or “national standard” are used in connection with traceability, it is assumed that these standards fulfil the properties of primary standards for the realization of SI units.

Maintain certificates of all reference standards, measuring instrumentation, or certified reference material used in ensuring traceability. Where traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence of correlation of results, for example by participation in a suitable program of inter-laboratory comparisons or proficiency testing.

Reference standards, such as thermometers and weights, are traceable to a national or international standard (e.g., NIST).

5.6.2.2 Testing

5.6.2.2.1

Policy:
The requirements given in section 5.6.2.1 apply to measuring and test instrumentation with measuring functions used, unless it has been established that the associated calibration uncertainty contributes little to the total uncertainty of the test result. When this situation

arises, the laboratory ensures that instrumentation used can provide the accuracy of measurement needed.

Details:
The extent to which the requirements in section 5.6.2.1 are followed depends on the relative contribution of calibration uncertainty to the total uncertainty. If calibration is the dominant factor, the requirements are strictly followed. If, however, calibration is not one of the major contributors to the total uncertainty, other ways for providing confidence may be used, as given in section 5.6.2.2.2.

5.6.2.2.2

Policy:
Where traceability to SI units of measurement is not possible and/or not relevant, other means for providing confidence in the results are applied such as:

- the use of suitable reference materials certified to give a reliable characterization of the material
- mutual-consent standards or methods which are clearly specified and agreed upon by all parties concerned
- participation in a suitable program of inter-laboratory comparisons or proficiency testing

Details:
Reliable characterization involves an estimate of recovery.

The laboratory participates in proficiency testing and/or check sample programs. The list of programs is maintained by the Quality Assurance Officer and includes NYSDOH NELAP, CTDOH Proficiency Program, and NJDEP Office of Quality Assurance for TO-15 air.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

Policy:
Reference standards are obtained or calibrated by a body that can provide traceability as described in section 5.6.2.1. For our use traceability to NIST is acceptable for most applications. Such reference standards of measurement held by the laboratory are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

Details:

Reference standards are obtained from the National Institute of Standards and Technology (NIST), if applicable.

5.6.3.2 Reference Materials

Policy:
Where possible, reference materials are traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable.

Details:
Reference materials, including calibration standards, used in chemical measurement are prepared so that the point of measurement is similar or equivalent to that of the samples. The matrix, prior to the addition of the analyte does not have a detectable concentration of the analyte. Reagents used in the preparation of reference materials, including calibration standards are of certified purity.

5.6.3.3 Intermediate Checks

Policy:
Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials are carried out according to defined procedures and schedules.

Details and Procedures:
The control check standards (Laboratory Control Samples) used to verify the accuracy of all the other standards are prepared independently from all the other standards used to establish the original calibration. These control check standards are prepared from a separate lot # or second source. It is the responsibility of the Group Leader to establish and maintain the individual schedule for each SOP and/or test method.

5.6.3.4 Transport and Storage

Policy:
The safe handling, transport, storage and use of reference standards and reference materials in order to prevent contamination or deterioration and in order to protect their integrity are defined.

Details:

Proper conditions are established for housing, handling, and care of reference standards/reference materials. All information needed to properly identify references appears on their housing or containers.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.7 Sample Handling, Receipt and Initiation of Testing

Laboratory analyses are performed to produce data representative of conditions when the sample was obtained. To provide representative samples for analysis, both field and laboratory personnel must satisfactorily perform their activities. Although the purpose of this manual is to define the laboratory Quality Assurance Program, the interrelationship of field and laboratory operations in maintaining sample integrity is briefly discussed because the effect of field operations upon resulting data quality cannot be totally separated from laboratory operations.

5.7.1 CHAIN-OF-CUSTODY

An overriding consideration for resulting data is the ability to demonstrate that the samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt and laboratory custody until disposal must be documented to accomplish this. Documentation is accomplished through a chain-of-custody record that records each sample and the individuals responsible for sample collection, shipment, and receipt.

- A sample is considered in custody if it is:
- In a person's actual possession.
- In view after being in physical possession.
- Secured so that no one can tamper with it after having been in physical custody.
- In a secure area, restricted to authorized personnel.

A chain-of-custody form is used by York personnel when shipping samples to subcontractors. This form is also used by all York's clients when submitting samples procured by the client. York does not accept samples collected by any outside or inside source without a correctly prepared chain-of-custody form.

The chain-of-custody form shall be signed by each individual who has the samples in their possession. Preparation of the chain-of-custody shall be as follows:

- The chain-of-custody record shall be initiated in the field by the person collecting the sample, for every sample. Every sample shall be assigned a unique identification number or name that is entered on the chain-of-custody form. Samples can be grouped for shipment and use a common form. The form allows for ten samples per page. If more than ten samples are shipped in the same container, more than one chain-of-custody form is required.

- The record shall be completed in the field to indicate project, sampling location, etc.

- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for Relinquished By _____, Received By _____ shall be completed in the field.

- The person transporting the samples to the laboratory or delivering them for shipment shall sign the record form as Relinquished By _____.

- If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form shall be sealed in a watertight zip-lock bag, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier.

- If the samples are directly transported to the laboratory, the chain-of-custody may be kept in possession of the person delivering the samples.

- For samples shipped by commercial carrier, the waybill shall serve as an extension of the chain-of-custody record between the final field Control Group and receipt in the laboratory.

- Upon receipt in the laboratory, the Sample Control Group, or representative, shall open the shipping containers, compare the contents with the chain-of-custody record, and sign and date the record. Any discrepancies shall be noted on the chain-of-custody form. Discrepancies are immediately discussed with the Lab Manager for resolution.

- Chain-of-custody and any shipping records shall be maintained with the records for a specific project, becoming part of the project file.

5.7.2 FIELD COLLECTION AND SHIPMENT

Prior to collecting samples, the collection team must consider the analyses to be performed so that proper sample containers and shipping containers can be assembled and the proper preservatives added to containers. In addition, field logs and record sheets, chain-of-custody forms, and analysis request records must be assembled.

All records required for documentation of field collection must be completed by the client field team. Several of the documents that affect laboratory operations are discussed herein. The primary documenting record is the chain-of-custody as discussed above.

In addition to initiating the chain-of-custody form, field personnel are responsible for uniquely identifying (required on the chain-of-custody form) and labeling samples, providing proper preservation, and packaging samples to preclude breakage during transit by York couriers or client shipment.

Every sample shall be labeled to identify:

- Unique sample number (ex. 11F0565-01, -02, etc.)
- Sample Description (such as MW-1, etc.)
- Sampling date and time
- Person obtaining sample
- Container types and methods of sample preservation/conditioning
- Analyses required (e.g., VOC 8260B, etc.)

Samples must be placed in containers compatible with the intended analysis and properly preserved. Also, collection of samples must consider the time interval between acquiring the sample and analysis (holding time) so that the sample is representative. The requirements for various analytical parameters with respect to the type of container, quantity of sample, preservation method, and maximum holding time between collection and analysis, quantity of sample, are dictated by the Federal Register, EPA SW-846 or the specific Quality Assurance Project Plan.

Shipping containers are to be sealed prior to shipment, whether shipped by direct transport by field personnel or commercial carrier. The only exception to this is if sufficient holding time exists so that the samples can be held in the field and it is necessary to re-ice the containers prior to or during transport.

As soon as field personnel are ready to hand off samples from the field to the courier, the courier takes custody of them and transfers them into a cooler containing ice or ice packs sufficient to maintain 2-6^{o}C until arrival at the laboratory. Upon receipt, the temperature (as measured by an infrared temperature probe) and condition of the samples is recorded on the Chain-of-Custody form.

It is imperative that the analyses requested be clearly provided so that analytical requirements are maintained with respect to sample holding times.

5.7.3 LABORATORY SAMPLE RECEIPT

The first step in the laboratory receipt of samples is obtaining the proper information. The information is taken by the Client Service, documented and passed on immediately to the Sample Control. The Sample Control Group shall note that the shipment is expected and notify the Lab Manager, Client Service and Group Leaders when samples are received. This is especially important for RUSH requests where coordination is essential to meet project deadlines. The communication is done via the RUSH NOTIFICATION form.

Upon sample receipt, the Sample Control Group performs the following:

5.7.3.1 Examine all samples and determine sample temperature using an Infrared thermometer. This documents that proper temperature has been maintained during shipment (if applicable). Note this on the Chain-of-Custody. If samples have been damaged during shipment, the remaining samples shall be carefully examined to determine whether they were affected. Any samples affected shall be also considered damaged. It will be noted on the chain-of-custody record that specific samples were damaged and that the samples were removed from the sampling program. Field personnel will be notified as soon as possible that samples were damaged and that they must be resampled, or the testing program changed, and an estimate of the cause of damage.

5.7.3.2 Compare samples received against those listed on the chain-of-custody. Note any deviations or problems and clarify with the Lab Manager or Client Service.

5.7.3.4 Sign and date the chain-of-custody form and attach any shipping receipts to the chain-of-custody.

5.7.3.5 Log the project into the lab LIMS system.

5.7.3.6 Open a laboratory project number and pendaflex file which will contain:

- Project identification number
- Completed Chain-of-Custody record
- Shipping receipts

- Any correspondence related to the project
- WORK ORDER which will include:

    - Client Name
    - Client Project ID
    - Lab Sample numbers
    - Client Sample Identifiers
    - Type of samples (matrix)
    - Date received in laboratory
    - Parameters to be analyzed
    - Project Pricing
    - Any special instructions (such as ASP B deliverables, etc.)

If samples collected by Clients arrive without chain-of-custody or incorrect chain-of-custody records, the following shall be done by the Sample Control Group:

If the chain-of-custody is incorrect, a memorandum to the Client Services is prepared stating the inaccuracy and correction in the form of a Corrective Action (CA). The CA must be signed and dated by the person originating the chain-of-custody and the Sample Control Group. The memorandum will serve as an amendment to the chain-of-custody. If the information on the chain-of-custody form cannot be corrected by the Sample Control Group or the field personnel, the samples affected shall be removed from the sampling program.

. If the chain-of-custody is not shipped with the samples, the Client personnel shall be contacted and a memorandum prepared which lists the persons involved in collecting, shipping, and receiving the samples and the times, dates, and events. Each person involved must sign and date this memorandum. The complete memorandum will be maintained in lieu of the chain-of-custody.

5.7.4 LABORATORY STORAGE OF SAMPLES

The primary considerations for sample storage are:

. Maintenance of prescribed temperature, if required, which is typically $4^{o}C \pm 2^{o}C$

. Extracting and/or analyzing samples within the prescribed holding time for the parameters of interest.

The requirements for temperatures and holding times shall be met. Placing of samples in the proper storage environment is the responsibility of the Sample Control Group, who should notify the Group Leaders if there are any samples which must be analyzed immediately because of holding time requirements. This is accomplished by issuing a RUSH NOTIFICATION FORM.

5.7.5 INITIATION OF TESTING PROGRAM

As stated previously, the chain-of-custody form is prepared by the client and submitted with the samples to the laboratory. If the analytical program is not defined with the sample shipment, Sample Control shall immediately notify the Client Services who will contact the client to determine/clarify the testing program.

The analytical program or any changes requested shall be re-entered onto the original chain-of-custody form, signed and dated. This record serves as the master analytical request form for samples and the clients' authorization to proceed.

Client Services and the Group Leaders are responsible for prioritizing samples on the basis of holding time and required reporting time into the laboratory sample stream.

5.7.6 SAMPLE DISPOSAL

The LIMS allows us to set a sample status for disposal. These records are then maintained on a sample basis in the database. There are several possibilities for sample disposition:

- The sample may be completely consumed during analysis.
- Samples may be returned to the client or location of sampling for disposal.
- The samples may be stored after the analysis. Proper environmental control and holding time must be observed if reanalysis is anticipated. If reanalysis is not anticipated, environmental conditions for storage will not be observed.

  The samples may be transferred to proper drums or waste containers for final disposal by licensed waste disposal firms.

The Sample Control Group shall determine disposition of samples if not specified in the project file.

In general, York will not maintain samples and extracts longer than thirty (30) days beyond completion of analysis, unless otherwise specified.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

5.8 Assuring the Quality of Test and Calibration Results

5.8.1 Quality Control / Quality Assurance

Policy:
Quality control procedures are utilized to monitor the validity of test results. These procedures are for each test method utilized in the laboratory. The resulting data are recorded so that trends are detectable (and where practicable, statistical techniques are applied to the reviewing of the results). This monitoring is planned and reviewed and may include, but not limited to, the following:

- regular use of certified reference materials and/or internal quality control using secondary reference materials
- participation in inter-laboratory comparisons or proficiency testing programs
- replicate tests or calibrations using the same or different methods
- re-testing or re-calibration of retained items
- correlation of results for different characteristics of an item

Details:
The methods utilized from the above list will be appropriate for the type and volume of the work undertaken. Records are maintained of assurance activities and any actions taken.

As a guide, for routine analyses the level of internal quality control is typically 5% of the sample throughput. For more complex procedures, 20% is not unusual and on occasions even 50% may be required. For analyses performed infrequently the use of a reference material containing a certified or known concentration of analyte, followed by replicate analyses of the sample and spiked sample is done. For analyses undertaken more frequently, systematic quality control procedures incorporating the use of control charts and check samples are implemented. These procedures are documented in the SOP for each test method.

Internal quality control schemes using statistics include:

- design of experimental/factorial analysis
- variation/regression analysis
- safety evaluation/risk analysis
- tests of significance
- quality control charts
- statistical sampling inspection

Proficiency testing helps to highlight not only repeatability and reproducibility performance between laboratories, but also systematic errors such as bias. It is important to monitor proficiency testing results as a means of checking quality assurance and take action as necessary.

The Quality Manager maintains a list of all the current proficiency testing programs the laboratory participates in, monitors the results, and notifies the appropriate personnel of both problematic and successful results.

Technical personnel use certified reference materials and reference materials to evaluate test performance on a daily basis and include daily process control checks. These data are used to evaluate the validity of the test results.

Replicate tests may be used if suitable reference material is available. These materials and proficiency test materials are available for improving repeatability.

Re-testing of test items is performed occasionally at the discretion of the supervisor or when test results seem anomalous.

5.8.2 Correction and Prevention

Policy and Details:
Quality control data are analyzed and, where they are found to be outside pre-defined criteria, planned action is taken to correct and to prevent incorrect results from being reported.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.9 Reporting of Results

5.9.1 General

Policy:
The results of each test or series of tests are reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test or calibration methods.

The results are reported, normally in a Technical Report and include all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used or regulatory body reviewing the data. This information may include what is outlined in section 5.9.2, 5.9.3 and 5.9.4.

In the case of tests performed for internal purposes, and in the case of a written agreement with the client, the results may be reported in a simplified way. The information listed in section 5.9.2 to 5.9.4, and not reported, is kept readily available.

Details:
Test reports are issued as either hard copy or by electronic data transfer.

5.9.2 Test reports

Policy:
Test reports (Technical Reports) include the following information, as appropriate:

- a title (e.g., “Technical Report”
- name and address of laboratory, and location where tests were carried out if different from the address of the laboratory
- unique identification of the test report (such as a project no.), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report
- name and address of the client
- identification of the method(s) used
- description, condition, and unambiguous identification of the sample(s) tested
- date of receipt of samples and date(s) of performance of the analyses
- reference to sampling procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results
- test results with, where appropriate, units of measurement
- the name(s), function(s) and signature(s) or equivalent of person(s) authorizing the test report
- a statement to the effect that the results relate only to the items tested

Details:
Signing authority for test reports is the responsibility of the Managing Director. Records for individuals with signing authority for test reports are approved by the Managing Director and maintained by the Quality Assurance Officer.

Hard copies and electronic copies of test reports include the page number and total number of pages.

A statement is included specifying that the test report is not to be reproduced except in full, without written approval of the laboratory. Data reported to the client contains the appropriate significant digits for each test method. Low level data are identified as being below specified limits by utilizing appropriate flags.

5.9.3 Test Reports

5.9.3.1

Policy and Details:
In addition to the requirements listed in section 5.9.2, test reports include the following, where necessary for the interpretation of results:

- deviations from, additions to, or exclusions from the test method
- where relevant, a statement of compliance/non-compliance with requirements and/or specifications
- where applicable, a statement on the estimated uncertainty of measurement of the test result; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a client’s instruction so requires, or when uncertainty affects compliance to a specification limit
- where appropriate and needed opinions and interpretations (see section 5.9.5)
- additional information required by specific methods, clients, or regulatory authorities.

5.9.3.2

Policy and Details:
In addition to the requirements listed in sections 5.9.2 and 5.9.3.1, test reports containing the results of sampling include the following, where necessary for the interpretation of test results:

- date of sampling
- unambiguous identification of substance, matrix, material sampled

- details of any environmental condition during sampling that may affect the interpretation of the test results
- any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

5.9.5 Opinions and Interpretations

Policy:
When opinions and interpretations are included in the test report, the basis upon which the opinions and interpretations have been made is documented. Opinions and interpretations are clearly marked as such in the test report.

Note - Opinions and interpretations should not be mixed-up with inspections and product certifications as intended in ISO/IEC 17020 and ISO/IEC Guide 65.

Details:
Opinions and interpretations included in a test report may comprise, but not be limited to the following:

- opinion on conformity of the results with requirements
- fulfilment of contractual requirements
- recommendations on how to use the results
- guidance to be used for improvements

In many cases it is appropriate to communicate the opinions and interpretations by direct dialogue with the client. This dialogue is documented in writing.

5.9.6 Test Results Obtained from Subcontractors

Policy and Details:
Test reports containing the results of tests performed by subcontractors are clearly identified for the subcontracted results. The subcontractor reports the results either in writing or electronically to our laboratory.

5.9.7 Electronic Transmission of Results

Policy:
In the case of transmission of test results by telephone, facsimile or other electronic or electromagnetic means, the requirements of the policies and procedures of this Quality Manual continue to apply (see also 5.4.7).

Details:
Reports that are “published” electronically contain a digital signature.

5.9.8 Format of Reports

Policy:
The format of reports is designed to accommodate each type of test carried out and to minimize the possibility of misunderstanding or misuse.

Details:
The layout of the test report is such that the presentation of the test data facilitates ease of assimilation by the reader.

The headings are standardized as far as possible.

5.9.9 Amendments to Reports

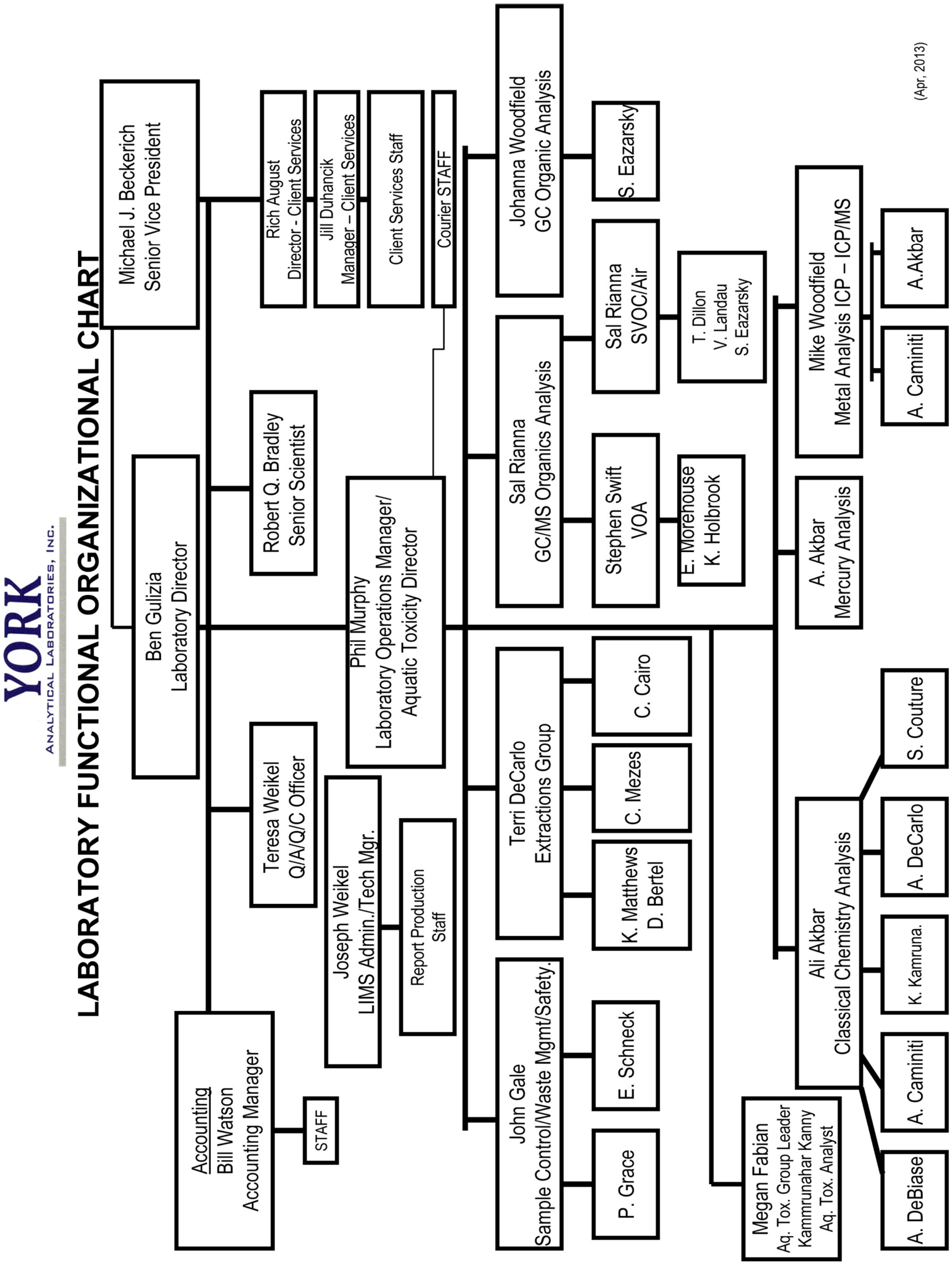
Policy:
Material amendments to a test report after issue are made only in the form of a further document, or data transfer, which includes the statement “Revision no. __. Such amendments meet all the requirements in this Quality Manual.

Details:
When it is necessary to issue a complete new test report, it is uniquely identified and contains a reference to the original that it replaces.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

ATTACHMENT A



ATTACHMENT B

York Analytical Laboratories, Inc

MASTER LIST of CONTROLLED DOCUMENTS on 04/01/2013

	Description	SOP No.	Date of Issue	Revision No.	Date of Revision
	GC/MS - Air				
1	VOCs in AIR by EPA TO-14A/TO-15	GCMSAIR 111692	11/16/1992	9.2	3/12/2012
2	Cleaning of Summa Canisters	SummaClean111507	11/15/2007	1.0	
3	Calibration of Flow Controllers	FLOWCONT010312	1/3/2012	1.0	
	GC/MS - Volatiles				
1	Volatile Organics by GC/MS	GCMSVOC 011700	1/17/2000	2.7	1/9/2012
2	Volatiles in Drinking Water by GC/MS by EPA 524.2	GCMSVOC524.2 011700	1/17/2000	1.9	10/22/2012
3	Soil Sampling by EPA 5035A	GCMSVOC5035060712	6/7/2012	1.0	6/7/2012
	GC/MS - Semi-volatiles				
1	Semi-Volatiles using GC/MS by EPA 8270	GCMSSVOC 011700	1/17/2000	2.3	4/4/2012
	Gas Chromatography				
1	PCBs using GC/ECD by EPA 8082	GCPCB 011799	1/17/1999	1.5	10/19/2012
2	TPH-DRO Using Solvent Extraction Followed by GC/FID Analysis	TPHDROGC091009	9/10/2009	1.2	11/14/2012
3	Pesticides (Chlorinated) using GC/ECD by EPA 8081	GCPEST011799	1/17/1999	1.4	10/19/2012
4	Herbicides using GC/ECD by EPA 8151	GCHERB011999	1/19/1999	1.3	5/13/2010
5	Organochlorine Pesticides & PCBs in Potable Water using GC/ECD by EPA 505	505GCPEST092010	9/20/2010	1.0	
6	CT-ETPH in Environmental Extracts	GCETPH111704	11/17/2004	1.6	2/29/2012

	Extractions				
1	Preparation/Extraction of Soil Samples for the Analysis of Target Herbicides	EXTSoilherb052600	5/26/2000	1.4	10/22/2012
2	Preparation/Extraction of Aqueous Samples for the Analysis of Target Herbicides	EXTAQHRB052600	5/26/2000	1.2	4/26/2010
3	Extraction of Solid Samples for the Analysis of SVOCs using UltraSonic Extraction	EXTSSVOC052600	5/26/2000	2.1	6/29/2012
4	Extraction of Solid Samples for the Analysis of SVOCs using ASE Extraction	EXTSVOCSASE 083106	8/31/2006	1.8	6/29/2012
5	Extraction of Aqueous Samples for Analysis of Semi-Volatile Compounds	EXTAQSVOC052600	5/26/2000	2.4	6/29/2012
6	Extraction of Polyurethane Foam Sampling Media for the Analysis of Target Pesticides and PCBs	EXTSVOCASEPUF043010	4/30/2010	1.0	
7	Extraction Laboratory Glassware Washing Procedure	EXTGP052600	5/26/2000	1.1	4/3/2012
8	Extraction of Solid Samples for Analysis of PCBs using Soxhlet Techniques	EXTPCBSOX102110	10/22/2010	1.0	
9	Extraction of Aqueous and Soil Samples for the Analysis of Massachusetts EPH (MA-EPH)	EXTMAEPHAQASE121207	12/12/2007	2.0	10/22/2009
10	Spike and Surrogate Standard Preparation for Extractables	EXTSVOCStds062912	6/29/2012	1.0	
	Metals Analysis/Prep				
1	Analysis of Trace Metals in Environmental Samples using ICP/MS by EPA SW-846 6020 and EPA 200.8	ICPMS 6020 080106	8/1/2006	1.2	11/25/2008
2	Preparation of Standards for Axial ICP Analysis	ICPSTD030495	3/4/1995	1.1	4/7/2000
3	Preparation of Environmental Samples for Trace Metals Analysis by ICP and ICP/MS	METALSPrep030695	3/6/1995	1.2	9/12/2007
4	Analysis of Environmental Sample Digestates Using Axial ICP by EPA SW846 6010B and 200.7	ICP031195	3/11/1995	1.3	9/11/2007
5	Analysis of Trace Metals in Drinking Water Samples using ICP/MS by EPA 200.8	ICPMS200.8080106	8/1/2006	1.0	
6	Digestion and Analysis of Aqueous, Soil, and Sludge Samples for Mercury by Cold Vapor Technique (CV) EPA SW-846 7470 and 7471	Hg 120998	12/10/1998	1.5	10/15/2012
	Wet Chemistry/IC				
1	Chemical Oxygen Demand (COD) [SM 5220D]	WC COD 100400	10/4/2000	2.1	9/18/2012
2	TKN, Ammonia and TON [SM 4500-N_{org} C, 4500-NH_3 D]	WC TKN 100400	10/4/2000	1.4	9/11/2012

3	Reactivity-Cyanide [SW-846 Ch 7.3.3]	WC CNR 080800	8/8/2000	1.2	10/16/2012
4	Hexavalent Chromium in Aqueous Samples [SW-846 7196]	WC Cr+6 070900	7/9/2000	1.4	9/11/2012
5	Hexavalent Chromium in Soil Samples [SW-846 7196A, 3060A]	WC Cr+6S 111811	11/18/2011	1.1	9/17/2012
6	Total Cyanide [EPA 335.2]	WC CNT 070900	7/9/2000	1.5	9/17/2012
7	Reactivity-Sulfide [SW-846 Ch 7.3.3]	WC ReacSulf 061296	6/12/1996	1.3	10/19/2012
8	Alkalinity [EPA 310.1]	WC T-Alk 022600	2/26/2000	1.2	10/19/2012
9	Hexane Extractable Material [EPA 1664]	WC HemGrav 110606	11/16/2006	1.5	10/22/2012
10	Ion Chromatography [EPA 300.0]	WC IC 011400	1/14/2000	1.7	12/17/2012
11	Biochemical Oxygen Demand (BOD) [SM 5210B]	WC BOD 011700	1/17/2000	1.4	11/9/2012
12	TSS / VSS in Aqueous Samples [EPA 160.2, 160.4]	WC TSS 040795	4/7/1995	1.3	11/9/2012
13	pH [SW-846 9040C, 9045D]	WC pH 040695	4/6/1995	1.5	10/11/2012
14	T-Phosphorous and Ortho-Phosphate [EPA 365.3, SM 4500]	WC Phos 051000	5/10/2000	1.3	9/22/2012
15	TCLP / SPLP Extraction [SW-846 1311, 1312]	WC TCLPEX 010400	1/4/2000	1.3	10/11/2012
16	Cyanide Amenable to Chlorination [EPA 335.1]	WC CNA 110200	11/4/2000	1.2	9/17/2012
17	Ignitability of Solids	WC IGN 040795	4/7/1995	1.1	4/11/2000
18	Flash Point [SW-846 1010A]	WC FP 040795	4/7/1995	1.4	10/3/2012
19	Methylene Blue Active Substances (MBAS) [SM 5540C]	WC MBAS 042610	4/26/2010	1.1	10/11/2012
20	TS / TDS in Aqueous Samples [SM 2540B, C]	WC TSTDS 042610	4/26/2010	1.1	9/18/2012
21	Color	WC Color 042610	4/26/2010	1.0	
22	Glassware Washing	WC GlassPrep 090299	9/2/1999	2.0	9/2/1999
23	Total Phenols (Low Level) [EPA 420.1]	WC PhenolsLL 102711	10/27/2011	1.3	10/22/2012
24	Total Phenols [EPA 420.1]	WC Phenols 022912	2/29/2012	1.2	10/22/2012

25	Conductivity [EPA 120.1]	WC Cond 022912	2/29/2012	1.1	10/11/2012
26	Turbidity [EPA 180.1]	WC Turbidity 022912	2/29/2012	1.2	10/11/2012
27	TS, FS, VS and % Moisture in Soil Samples [SM 2540G]	WC TS%M 022912	2/29/2012	1.0	
28	Extractable Organic Halogens in solids [SW-846 9023]	WC EOX 041112	4/11/2012	1.2	11/9/2012
29	Total Organic Carbon in Aqueous Samples [SM 5310C]	WC TOC 041812	4/18/2012	1.1	11/13/2012

Aquatic Toxicity					
1	Acute Toxicity Test Method for Cyrinodon variegatus by EPA Method 821-R-02-012 / 2004.0	AT ACupV013013	01/30/2013	1.0	01/30/2013
2	Acute Toxicity Test Method for Daphnia pulex by EPA Method 821-R-02-012 / 2021.0	AT DapP013013	01/30/2013	1.0	01/30/2013
3	Acute Toxicity Test Method for Mysidopsis bahia by EPA Method 821-R-02-012 / 2007.0	AT AmysB01313	01/30/2013	1.0	01/30/2013
4	Acute Toxicity Test Method for Pimephales promelas by EPA Method 821-R-02-012/ 2000.0	AT APimP01313	01/30/2013	1.0	01/30/2013
5	Reference Toxicant Test Method using Copper Nitrate Acute- Daphnia pulex EPA Test Method 821-R-02-012/ 2021.0	AT RTADapP012313	01/30/2013	1.0	01/30/2013
6	Reference Toxicant Test Method using Copper Nitrate Acute- Pimephales promelas EPA Test Method 821-R-02-012/ 2000.0	AT RTAPimP013013	01/30/2013	1.0	01/30/2013
7	Reference Toxicant Test Method using Sodium Lauryl Sulfate Acute- Cyrinodon variegatus by EPA Method 821-R-02-012/ 2004.0	AT RTACypV013013	01/30/2013	1.0	01/30/2013
8	Reference Toxicant Test Method using Sodium Lauryl Sulfate Acute- Mysidopsis bahia by EPA Method 821-R-02-012/ 2007.0	AT RTAMysB013013	01/30/2013	1.0	01/30/2013
9	Chronic Toxicity Test Method for Cyrinodon variegatus by EPA Method 821-R-02-014 / 1004.0	AT CCypV013013	01/30/2013	1.0	01/30/2013
10	Chronic Toxicity Test Method for Ceriodaphnia dubia by EPA Method 821-R-02-013 / 1002.0	AT CCer013013	01/30/2013	1.0	01/30/2013
11	Chronic Toxicity Test Method for Mysidopsis bahia by EPA Method 821-R-02-014 1007.0	AT CMysB01313	01/30/2013	1.0	01/30/2013
12	Chronic Toxicity Test Method for Pimephales promelas by EPA Method 821-R-02-013 / 1000.0	AT CPimP01313	01/30/2013	1.0	01/30/2013

13	Reference Toxicant Test Method using Sodium Chloride Chronic- Ceriodaphnia dubia EPA Test Method 1002.0	AT RTCCer012313	01/30/2013	1.0	01/30/2013
14	Reference Toxicant Test Method using Sodiium Chloride Chronic- Pimephales promelas EPA Test Method 1000.0	AT RTCPimP013013	01/30/2013	1.0	01/30/2013
15	Reference Toxicant Test Method using Sodium Lauryl Sulfate Chronic- Cyrinodon variegatus by EPA Method 821-R-02-014 / 1004.0	AT RTCCypV013013	01/30/2013	1.0	01/30/2013
16	Reference Toxicant Test Method using Sodium Lauryl Sulfate Chronic- Mysidopsis bahia by EPA Method 821-R-02-014 / 1007.0	AT RTCMysB013013	01/30/2013	1.0	01/30/2013

	General Laboratory				
1	MDL Studies, Organics	GL MDL 113005	11/30/2005	1.3	3/12/2012
2	Chemical Expiration Dates	GL ExpDt 041812	4/18/2012	1.0	
3	LOQ/LOD Determination and Verification	GL LOQLOD 122812	12/28/2012	1.0	
	Sample Control				
1	Sample Control - Sample Receipt, Log-in, Storage, Archival and Disposal	SC011500	1/15/2000	2.1	11/19/2012
2	Sample Collection (drinking water only)	SC 08/09/2000	8/9/2000	1.0	
3	Sample Handling and Chain-of-Custody for Sample Couriers	Couriers091207	9/12/2007	1.0	
	Administration				
1	Laboratory Safety and Health	Safety011600	1/16/2000	1.0	
2	Purchasing	ADMINPurchasing 043010	4/18/2012	1.1	
3	QC Review/Evaluation of Data	QC040402	4/4/2002	1.1	4/30/2010
4	Education and Training in Ethics & Legal Responsibilities	Adm040102	4/1/2002	1.1	4/1/2002
5	Training of Personnel	Adm080206	8/6/2006	1.3	1/16/2012
6	Manual Integration of Chromatographic Data	ADMIN Integration 09/11/07	9/11/2007	2.1	2/9/2012

7	Control and Use of Laboratory Notebooks	LABNOTE091107	9/12/2007	1.0	
8	Control of Records	ADMINRECORDS043010	4/30/2010	1.1	11/9/2012
9	Preventive Action	ADMINPREVACTION043010	4/30/2010	1.0	
10	Control of Nonconforming Work	QSP 4-9-1	4/30/2010	1.0	
11	Management Review	ADMINMGMTREVIEW043010	4/30/2010	1.0	
12	Internal Quality Audit`	ADMINAUDIT043010	4/30/2010	1.0	
13	Estimation of Uncertainty	ADMINESTUNCERT043010	4/30/2010	1.0	
14	Document Control	ADMINDOC043010	4/30/2010	1.2	6/2/2012
15	Corrective Action	ADMINCORRACTION043010	4/30/2010	1.0	
16	Complaints	QSP 4-8-1	4/30/2010	1.0	
17	Review of Chromatographic Data for Detection of Manual Re-Integration Issues	ADMINManINTReview04302010	4/30/2010	1.0	
18	Additional Policies/Procedures	Additional Policies 05/07/10	5/7/2010	1.1	07/11/2012
19	EDDs and Reports for Client Connect	ADMINEDDRptCC 091610	9/16/2010	1.0	
20	Preparation of CTDEP RCP Deliverables	ADMINRCPDELIVS 080210	8/2/2010	1.0	
		Quality Manual			
1	Quality Manual	QM	1/4/1996	2.3	12/26/2012

ATTACHMENT 3

NYSDOH ELAP-CERTIFICATION FOR YORK ANALYTICAL LABORATORIES INC.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Acrylates	
Acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C
Amines	
1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Diphenylamine	EPA 8270D
Benzidines	
3,3'-Dichlorobenzidine	EPA 8270D
Characteristic Testing	
Corrosivity	EPA 9045D
Ignitability	EPA 1010A
Reactivity	SW-846 Ch7 Sec. 7.3
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

Chlorinated Hydrocarbon Pesticides	
alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
Atrazine	EPA 8270D
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	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
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Toxaphene	EPA 8081B
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

Serial No.: 49723

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Chlorinated Hydrocarbons

Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	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
Chromium, Total	EPA 6010C
	EPA 6020A
Copper, Total	EPA 6010C
	EPA 6020A

Metals I

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

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
Mercury, Total	EPA 7471B
	EPA 7473
Selenium, Total	EPA 6010C

Serial No.: 49723

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Metals II

Selenium, Total	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 6020A
Thallium, Total	EPA 6010C EPA 6020A
Tin, Total	EPA 6020A
Titanium, Total	EPA 6020A

Miscellaneous

Boron, Total	EPA 6020A
Cyanide, Total	EPA 9014
Extractable Organic Halides	EPA 9023

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 8270D
2,6-Dinitrotoluene	EPA 8270D
Isophorone	EPA 8270D
Nitrobenzene	EPA 8270D
Pyridine	EPA 8270D

Nitrosoamines

N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270D

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015D

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
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A

Polynuclear Aromatic Hydrocarbons

Acenaphthene	EPA 8270D

Serial No.: 49723

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Polynuclear Aromatic Hydrocarbons

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
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-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270D
2-Methylphenol	EPA 8270D

Priority Pollutant Phenols

2-Nitrophenol	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

1,1'-Biphenyl	EPA 8270D
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
Acetophenone	EPA 8270D
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	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

Serial No.: 49723

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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

4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	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

Volatile Halocarbons

1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	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
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C
Trichloroethene	EPA 8260C

Serial No.: 49723

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised October 21, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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 Halocarbons	
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
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-butyl alcohol	EPA 8260C
Vinyl acetate	EPA 8260C
Sample Preparation Methods	
	EPA 3005A
	EPA 3010A
	EPA 3031
	EPA 3040A
	EPA 3050B
	EPA 3060A
	EPA 3545A
	EPA 3550C
	EPA 3580A

Sample Preparation Methods	
	EPA 3585
	EPA 5035A-H
	EPA 5035A-L
	EPA 9010C

Serial No.: 49723

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 10854

October 21, 2013

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

Dear Mr. Bradley,

A revised certificate has been generated because of the change(s) listed below.

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
SW - NELAC	Titanium, Total EPA 3005A	Raised to Approved	10/17/2013
SW - NELAC	Titanium, Total EPA 3010A	Raised to Approved	10/17/2013
SW - NELAC	Titanium, Total EPA 6020A	Raised to Approved	10/17/2013
SW - NELAC	Titanium, Total EPA 3050B	Raised to Approved	10/17/2013

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised December 20, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER All approved analytes are listed below:

Drinking Water Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Molybdenum, Total	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Potassium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4

Drinking Water Non-Metals

Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 18-21 2120B (01)
Fluoride, Total	EPA 300.0 Rev. 2.1
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
Solids, Total Dissolved	SM 18-21 2540C (97)
Specific Conductance	EPA 120.1 Rev. 1982
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Serial No.: 49896

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised December 20, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	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
4-Chlorotoluene	EPA 524.2
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

Volatile Aromatics

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
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

Serial No.: 49896

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised December 20, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Volatile Halocarbons

Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

Serial No.: 49896

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 10854

December 20, 2013

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

Dear Mr. Bradley,

A revised certificate has been generated because of the change(s) listed below.

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
PW - NELAC	trans-1,2-Dichloroethene EPA 524.2	Dropped from Approved	12/05/2013
PW - NELAC	Turbidity EPA 180.1 Rev. 2.0	Dropped from Approved	12/05/2013
PW - NELAC	2-Chlorotoluene EPA 524.2	Dropped from Approved	12/05/2013

HEALTH.NY.GOV
facebook.com/NYSDOH
twitter.com/HealthNYGov

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals II

Molybdenum, Total	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Drinking Water Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Potassium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4

Drinking Water Miscellaneous

Turbidity	EPA 180.1 Rev. 2.0

Drinking Water Non-Metals

Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 18-21 2120B (01)
Fluoride, Total	EPA 300.0 Rev. 2.1
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
Solids, Total Dissolved	SM 18-21 2540C (97)
Specific Conductance	EPA 120.1 Rev. 1982

Serial No.: 49756

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Drinking Water Non-Metals

Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Drinking Water Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	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
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2

Volatile Aromatics

Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	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
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

Serial No.: 49756

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category
ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Volatile Halocarbons

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

Serial No.: 49756

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

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: 10854

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

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 EPA 8260C
Acrylonitrile	EPA 624 EPA 8260C
Methyl methacrylate	EPA 8260C

Amines

1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 625 EPA 8270D
Pyridine	EPA 625 EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 625 EPA 8270D
Benzidine	EPA 625 EPA 8270D

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 608 EPA 8081B

Chlorinated Hydrocarbon Pesticides

4,4'-DDE	EPA 608 EPA 8081B
4,4'-DDT	EPA 608 EPA 8081B
Aldrin	EPA 608 EPA 8081B
alpha-BHC	EPA 608 EPA 8081B
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 608 EPA 8081B
Chlordane Total	EPA 608 EPA 8081B
delta-BHC	EPA 608 EPA 8081B
Dieldrin	EPA 608 EPA 8081B
Endosulfan I	EPA 608 EPA 8081B
Endosulfan II	EPA 608 EPA 8081B
Endosulfan sulfate	EPA 608 EPA 8081B
Endrin	EPA 608 EPA 8081B
Endrin aldehyde	EPA 608

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Chlorinated Hydrocarbon Pesticides

Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 608
	EPA 8081B
Heptachlor epoxide	EPA 608
	EPA 8081B
Lindane	EPA 608
	EPA 8081B
Methoxychlor	EPA 608
	EPA 8081B
Toxaphene	EPA 608
	EPA 8081B

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 625
	EPA 8270D
2-Chloronaphthalene	EPA 625
	EPA 8270D
Hexachlorobenzene	EPA 625
	EPA 8270D
Hexachlorobutadiene	EPA 625
	EPA 8270D
Hexachlorocyclopentadiene	EPA 625

Chlorinated Hydrocarbons

Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 625
	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	EPA 8151A

Demand

Biochemical Oxygen Demand	SM 18-21 5210B (01)
Carbonaceous BOD	SM 18-21 5210B (01)
Chemical Oxygen Demand	SM 18-21 5220D (97)

Fuel Oxygenates

Di-isopropyl ether	EPA 8260C
Ethanol	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-amyl alcohol	EPA 8260C
tert-amyl methyl ether (TAME)	EPA 8260C
tert-butyl alcohol	EPA 8260C
tert-butyl ethyl ether (ETBE)	EPA 8260C

Haloethers

4-Bromophenylphenyl ether	EPA 625
	EPA 8270D
4-Chlorophenylphenyl ether	EPA 625

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Haloethers

4-Chlorophenylphenyl ether	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 8270D
Acenaphthylene Low Level	EPA 8270D
Anthracene Low Level	EPA 8270D
Benzo(a)anthracene Low Level	EPA 8270D
Benzo(a)pyrene Low Level	EPA 8270D
Benzo(b)fluoranthene Low Level	EPA 8270D
Benzo(g,h,i)perylene Low Level	EPA 8270D
Benzo(k)fluoranthene Low Level	EPA 8270D
Chrysene Low Level	EPA 8270D
Dibenzo(a,h)anthracene Low Level	EPA 8270D
Fluoranthene Low Level	EPA 8270D
Fluorene Low Level	EPA 8270D
Indeno(1,2,3-cd)pyrene Low Level	EPA 8270D
Naphthalene Low Level	EPA 8270D
Phenanthrene Low Level	EPA 8270D
Pyrene Low Level	EPA 8270D

Mineral

Alkalinity	SM 18-21 2320B (97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Fluoride, Total	EPA 300.0 Rev. 2.1
Hardness, Total	EPA 200.7 Rev. 4.4
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 625
	EPA 8270D
2,6-Dinitrotoluene	EPA 625
	EPA 8270D
Isophorone	EPA 625
	EPA 8270D
Nitrobenzene	EPA 625
	EPA 8270D

Nitrosoamines

N-Nitrosodimethylamine	EPA 625
	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625
	EPA 8270D
N-Nitrosodiphenylamine	EPA 625
	EPA 8270D

Nutrient

Ammonia (as N)	SM 19-21 4500-NH3 D or E (97)

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Nutrient	
Kjeldahl Nitrogen, Total	SM 19-21 4500-NH3 D or E (97)
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
Phosphorus, Total	SM 18-21 4500-P E
Organophosphate Pesticides	
Atrazine	EPA 8270D
Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015D
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 608
	EPA 8082A
PCB-1221	EPA 608
	EPA 8082A
PCB-1232	EPA 608
	EPA 8082A
PCB-1242	EPA 608
	EPA 8082A
PCB-1248	EPA 608
	EPA 8082A
PCB-1254	EPA 608
	EPA 8082A
PCB-1260	EPA 608
	EPA 8082A
PCB-1262	EPA 8082A
PCB-1268	EPA 8082A
Polynuclear Aromatics	
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

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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

Benzo(a)pyrene	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 EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D

Priority Pollutant Phenols

2,4,5-Trichlorophenol	EPA 625 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-Chlorophenol	EPA 625 EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625 EPA 8270D
2-Methylphenol	EPA 625 EPA 8270D
2-Nitrophenol	EPA 625 EPA 8270D
4-Chloro-3-methylphenol	EPA 625 EPA 8270D
4-Methylphenol	EPA 625 EPA 8270D
4-Nitrophenol	EPA 625 EPA 8270D
Cresols, Total	EPA 8270D
Pentachlorophenol	EPA 625

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Priority Pollutant Phenols

Pentachlorophenol	EPA 8270D
Phenol	EPA 625
	EPA 8270D

Residue

Settleable Solids	SM 18-21 2540 F (97)
Solids, Total	SM 18-21 2540B (97)
Solids, Total Dissolved	SM 18-21 2540C (97)
Solids, Total Suspended	SM 18-21 2540D (97)

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270D
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
Acetophenone	EPA 8270D
alpha-Terpineol	EPA 625
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C

Volatile Aromatics

1,2-Dichlorobenzene	EPA 624
	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 624
	EPA 8260C
1,4-Dichlorobenzene	EPA 624
	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 624
	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 624
	EPA 8260C
Ethyl benzene	EPA 624
	EPA 8260C
Isopropylbenzene	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 624
	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 624

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

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: 10854

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

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:

Volatile Aromatics	
Toluene	EPA 8260C
Total Xylenes	EPA 624
	EPA 8260C
Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 624
	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 624
	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 624
	EPA 8260C
1,1-Dichloroethane	EPA 624
	EPA 8260C
1,1-Dichloroethene	EPA 624
	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8011
	EPA 8260C
1,2-Dibromoethane	EPA 8011
	EPA 8260C
1,2-Dichloroethane	EPA 624
	EPA 8260C
1,2-Dichloropropane	EPA 624

Volatile Halocarbons	
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 624
	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 624
	EPA 8260C
Bromoform	EPA 624
	EPA 8260C
Bromomethane	EPA 624
	EPA 8260C
Carbon tetrachloride	EPA 624
	EPA 8260C
Chloroethane	EPA 624
	EPA 8260C
Chloroform	EPA 624
	EPA 8260C
Chloromethane	EPA 624
	EPA 8260C
cis-1,2-Dichloroethene	EPA 624
	EPA 8260C
cis-1,3-Dichloropropene	EPA 624
	EPA 8260C
Dibromochloromethane	EPA 624
	EPA 8260C

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Volatile Halocarbons

Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 624
	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 624
	EPA 8260C
Tetrachloroethene	EPA 624
	EPA 8260C
trans-1,2-Dichloroethene	EPA 624
	EPA 8260C
trans-1,3-Dichloropropene	EPA 624
	EPA 8260C
trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 624
	EPA 8260C
Trichlorofluoromethane	EPA 624
	EPA 8260C
Vinyl chloride	EPA 624
	EPA 8260C

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

Volatiles Organics

Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Vinyl acetate	EPA 8260C

Wastewater Metals I

Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Calcium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Iron, Total	EPA 200.7 Rev. 4.4

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED TNI ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Wastewater Metals I

Iron, Total	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Lead, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Magnesium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Potassium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Sodium, Total	EPA 200.7 Rev. 4.4
	EPA 6010C

Wastewater Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Antimony, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Arsenic, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Chromium VI	EPA 7196A
	SM 20-21 3500-Cr B (01)
Mercury, Total	EPA 245.1 Rev. 3.0
	EPA 245.2 Rev. 1974
	EPA 7470A
	EPA 7473
Selenium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2014
Issued April 01, 2013
Revised November 01, 2013

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

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:

Wastewater Metals II

Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A

Wastewater Metals III

Cobalt, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Molybdenum, Total	EPA 200.8 Rev. 5.4
	EPA 6020A
Thallium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
	EPA 6010C
	EPA 6020A
Tin, Total	EPA 200.8 Rev. 5.4
	EPA 6020A
Titanium, Total	EPA 200.8 Rev. 5.4
	EPA 6020A

Wastewater Miscellaneous

Boron, Total	EPA 200.8 Rev. 5.4

Wastewater Miscellaneous

Boron, Total	EPA 6020A
Bromide	EPA 300.0 Rev. 2.1
Color	SM 18-21 2120B (01)
Cyanide, Total	SM 18-21 4500-CN E (99)
Oil and Grease Total Recoverable (HEM	EPA 1664A
Organic Carbon, Total	SM 18-21 5310C (00)
Phenols	EPA 420.1 Rev. 1978
Specific Conductance	EPA 120.1 Rev. 1982
Sulfide (as S)	SM 19-21 4500-S F (00)
Surfactant (MBAS)	SM 18-21 5540C (00)
Turbidity	EPA 180.1 Rev. 2.0

Sample Preparation Methods

	EPA 3005A
	EPA 3010A
	EPA 3020A
	EPA 3510C
	EPA 5030C
	SM 18-20 4500-CN C
	SM 18-21 4500-N Org B or C (97)
	SM 18-21 4500-P b.5

Serial No.: 49757

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK
state department of
HEALTH

Nirav R. Shah, M.D., M.P.H.
Commissioner

Sue Kelly
Executive Deputy Commissioner

LAB ID: 10854

November 01, 2013

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

Dear Mr. Bradley,

A revised certificate has been generated because of the change(s) listed below.

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	Barium, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Manganese, Total EPA 6020A	Raised to Approved	10/29/2013
NW	Magnesium, Total EPA 200.8 Rev. 5.4	Dropped from Approved	11/01/2013
NW - NELAC	Manganese, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Nickel, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Zinc, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Iron, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013

AppCat	Analyte Name Method Name	Comments	Date
NW - NELAC	Vanadium, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Aluminum, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Iron, Total EPA 6020A	Raised to Approved	10/29/2013
PW - NELAC	1,1,2,2-Tetrachloroethane EPA 524.2	Raised to Approved	10/24/2013
NW - NELAC	Aluminum, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Zinc, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Nickel, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Cobalt, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Cobalt, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Antimony, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Silver, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Silver, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Antimony, Total EPA 200.8 Rev. 5.4	Raised to Approved	10/31/2013
NW - NELAC	Barium, Total EPA 6020A	Raised to Approved	10/29/2013
NW - NELAC	Vanadium, Total EPA 6020A	Raised to Approved	10/29/2013

ATTACHMENT 4

RESUMES OF KEY PERSONNEL INVOLVED WITH THE PROJECT

Mark E. Robbins, C.P.G., C.E.I.
Vice President, Senior Geologist

Mr. Robbins has over nine (9) years experience in geology and hydrogeology, involving such activities as Phase I Environmental Site Assessments, Phase II Environmental Site Assessments, Subsurface Investigations, Remedial Actions, data acquisition, evaluation and contouring, and geotechnical investigations. Mr. Robbins has performed over 400 Phase I Assessments involving residential through heavy industrial properties and over 200 Subsurface Investigations throughout the United States. Mr. Robbins has also designed and implemented over 20 remediation systems for both public and private sectors.

Representative Occupational Experience

- ☐ *Environmental Site Assessments*
  Conducted Phase I and II Environmental Site Assessments, analysis of site investigation reports, identifying contamination locations and sources. Soil, soil-vapor and water sampling, analyzing laboratory results for QA/QC, magnetometer and Ground-Penetrating Radar surveys for locating buried drums and underground storage tanks (USTs), estimating UST and other subsurface leaks, monitoring well logging, Project Management, liability assessments and estimating costs to attain compliance.

- ☐ *Remedial Investigation and Feasibility Studies*
  Oversight/planning of site investigations; data analysis, including statistical analysis and geostatistical contouring utilizing SURFER; performance of feasibility studies, including technology evaluations, alternatives development and evaluation and cost estimations.

- ☐ *Due- Diligence Programs*
  Designed and implemented due-diligence programs (ranging from Phase I Assessment to Comprehensive Hydrogeologic Investigations) to assess environmental liabilities for numerous land development clientele.

- ☐ *Delineation of Chlorinated Organic Plumes*
  Supervised the delineation of a dissolved chlorinated organic plume from underground tank loss. Developed a remedial action program in accordance with New York State regulatory guidelines to abate soil and groundwater contamination.

- ☐ *Remedial Action*
  Prepared numerous Remedial Action Plans. Designed and implemented hydrocarbon and chlorinated solvent remediation systems for soil and groundwater.

- ☐ *Pump Test Aquifer Analysis*
  Conducted several pump tests and pump test analysis and field coordination in relation to dewatering permit requirements for Keyspan Energy and the private sector.

Employment

2001 - Present Vice President, Senior Geologist
Hydro Tech Environmental Corp., Commack, New York

2000 – 2001	Assistant Director, Professional Services Fenley & Nicol Environmental, Inc., Deer Park, New York
1999 – 2000	Senior Geologist Fenley & Nicol Environmental, Inc. Deer Park, New York
1995 – 1999	Operations Director Advanced Cleanup Technologies, Inc., Farmingdale, New York
1992 – 1995	Project Geologist Advanced Cleanup Technologies, Inc., Roslyn Heights, New York

Education

B.S. Geology, State University of New York at Oneonta, 1991

Affiliations and Certifications

- American Institute of Professional Geologists
- American Association of Petroleum Geologists
- Long Island Geologist Organization
- Geological Society of America
- American Standards in Testing Materials – E50 Committee Member
- Environmental Assessment Association
- OSHA 40-Hour & 8-Hour, Supervisor

Registrations and Certifications

- Certified Professional Geologist (C.P.G. # 10527)
- Certified Environmental Inspector (C.E.I. # 73383)
- GPR Operator's Course, Geophysical Survey Systems, Inc., 1993.

Publications/Presentations

- *A Case Study of the Impact of MTBE on the Investigation and Remediation of a Fuel Oil Release,* National Groundwater Focus Conference MTBE in Groundwater: Assessment, Remediation Technologies & Public Policy, Baltimore, MD June 4-5, 2001.
- *Is MTBE in Fuel Oil? Why MTBE Plays a Major Concern on Long Island,* Long Island Business News, February 2001.

DONALD C. ANNÉ
SENIOR CHEMIST

EDUCATION:	M.S., Chemical Oceanography, Florida Institute of Technology, 1981 B.A., Earth Sciences, Millersville University of Pennsylvania, 1975
SPECIAL TRAINING:	Certified 40-Hour OSHA Health and Safety Certified 8-Hour OSHA Supervisory Course Ground Water Geochemistry (NWWA) Ground Water Pollution and Hydrology (Princeton Associates) Quality Assurance Programs for Environmental Monitoring Data (Stat-A-Matrix)
PROFESSIONAL AFFILIATIONS:	American Chemical Society (AFS), 1979-Present

EXPERIENCE SUMMARY:

Mr. Anné has more than 27 years of environmental chemistry experience specializing in data validation, environmental sampling, analytical methodologies, petroleum fingerprinting, laboratory audits, field sampling audits, and preparing Quality Assurance Project Plans and Quality Assurance Manuals. Mr. Anné's experience includes analytical laboratory work with gas chromatography, atomic absorption, infrared spectrometry and wet chemistry methods.

PROJECT EXPERIENCE:

Quality Assurance/Quality Control of Chemical Data

Mr. Anné has more than 20 years experience as a data validator and quality assurance officer. Mr. Anné has validated data for most EPA Regions and under several independent state programs, including the NYSDEC. He has performed laboratory and field audits as well as written Quality Assurance Project Plans. Mr. Anné has written, reviewed, and initiated laboratory Quality Assurance Manuals for laboratories to maintain their regulatory compliance. Typical project experience includes:

- Senior Chemist responsible for data validation. Reviewed chemical data for several projects under the New Jersey ISRA regulations. The clients included industry and utilities.

- Supervising Environmental Scientist responsible for data validation. Reviewed chemical laboratory data for adherence to QA/QC protocols for several key projects, including National Priorities List sites and RCRA Corrective Actions located in EPA Regions I, II, III, IV, V, and IX. Validated analytical data, outlined problems and actions to be taken, and qualified all affected data. Consulted with project managers on data usability, and recommended corrective actions to support project goals. Responded to comments made by regulators regarding data quality.

- Supervising Environmental Scientist recognized by the New York State Department of Environmental Conservation (NYSDEC) to perform third party data validation. Attended NYSDEC workshop on data validation as part of the requirements set forth by NYSDEC. Performed data validation in support of NYSDEC STARS and ASP programs as well as data in support of the NYSDEC Part 360 Regulations for landfills. Validated data for an Albany area municipal landfill.

- Supervising Environmental Scientist responsible for developing and preparing Quality Assurance Project Plans (QAPPs) for several state and federal Superfund sites and federal RCRA corrective action sites. Negotiated with regulators for the acceptance of the QAPPs. The sites were located throughout the eastern United States.

- Environmental Chemist responsible for developing a laboratory QA/QC program which fulfilled requirements of the EPA and agencies from the States of Texas and Louisiana. Implemented and managed the program throughout DOE's SPR Environmental laboratories. Received verbal commendations from EPA and the Texas Water commission on the QA/QC Program.

Environmental Chemistry

Mr. Anné is experienced in sampling soil, water, air, and wastes in accordance with federal and state guidelines. He has performed field sampling audits and prepared sampling plans for numerous projects in accordance with applicable programmatic requirements. Mr. Anné is familiar with the geochemical aspects of fate and transport of contaminants. Mr. Anné's typical project experience includes:

- Data manager for the Pennwalt Corporation's RCRA Corrective Action RFI Phase I program. The project included quantifying and characterizing soil contamination and hydrogeologic flow systems of 12 SWMUs at a flourochemicals plant in Thorofare, New Jersey. Validated and prepared QA/QC reports for data generated during the project. Qualified all data in preparation of the final report. Work was performed under the direction of NJDEP.

- Project Chemist in charge of field sampling activities, including coordinating and scheduling all subcontracted laboratory work for more than 25 sites in Connecticut. Trained field teams in sampling techniques for soil, groundwater, and surface water; chain of custody requirements; sampling QA/QC protocols; and analytical requirements. Work was performed under the scrutiny of ConnDEP.

- Field Team Leader for a major hazardous waste drum excavation project. Supervised all field activities including site safety; excavation; removal, sampling, and over packing of drums; staging and sampling of contaminated soil; and preparation of samples. Coordinated excavation and laboratory subcontractors. Work was performed under the scrutiny of ConnDEP.

- Created an environmental monitoring program for the Bryan Mound site of DOE's Strategic Petroleum Reserve for testing ground water and surface water. Developed sampling protocols, frequency of sampling, and lists of target analytes. This program was designed to provide baseline data for pre-spill conditions in the event of a release. The site was under scrutiny by EPA Region V and the Texas Water commission.

- Project Chemist responsible for developing analytical QA/QC program that included sampling and chemical analyses of surface water, groundwater, soil, and sediment matrices as part of a Remedial Investigation/Feasibility Study (RI/FS). The RI/FS involved more than 25 sites throughout the State of Connecticut. Work was under the guidance of ConnDEP.

Analytical Chemistry

Mr. Anné has experience working in both fixed-base and mobile laboratories. His experience includes the use of gas chromatography, atomic absorption spectrometers, infrared spectrometers, and numerous wet chemistry and preparation equipment methods. He has served in the laboratory as an analyst, laboratory advisor, and QA officer. He has interfaced with regulators in the area of analytical chemistry and has experience in petroleum fingerprinting techniques and methods. Typical projects include:

- Performed bench scale experiments for St. Lawrence Zinc in order to obtain the optimum level of Phlotec necessary to treat discharged water to resolve an N.O.V. for the SPDES outfall. The optimum level of Phlotec would precipitate enough dissolved zinc for the water to meet the discharge requirement. Also performed routine analyses of samples after implementing the treatment, to insure that the proper concentration was being used.

- Environmental Chemist in charge of project to design updates for the DOE's laboratories at its SPR facilities. Evaluated IR and FT-IR instrumentation and personal computers to link with existing and future instrumentation. Wrote procedures for the acceptance of an alternative oil & grease method for NPDES permit

monitoring by EPA Region V. Coordinated all site activities necessary for implementing upgrades.

- Environmental Chemist in charge of replacing obsolete total organic carbon (TOC) analyzers for the SPR laboratories. Evaluated state-of-the-art TOC analyzers and recommended replacement TOC analyzer. Negotiated with supplier and wrote technical specification for the bid process required by DOE. Supervised installation and set-up of all new TOC analyzers.

- Analytical Chemist for Berkley Products Company responsible for product development. Analyzed competitor's products and formulated new coatings with equal or better quality. Responsible for solvent operations which included managing the waste solvent recovery operations, solvent formulation, and manufacturing QA/QC. Worked with sales and manufacturing staff to address and resolve client complaints. Received two cash bonuses for suggestions on the manufacture of products which saved the company money.

- Analytical Chemist for the mobile laboratory responsible for sample preparation in support of several projects for a range of clients located in three EPA regions and in conjunction with several state agencies. Extracted, concentrated, and prepared water and soil samples for analyses by GC/FIND, GC/ECD, GC/PID, and GC/MS. Samples were prepared for PCB, pesticide, polynuclear aromatic hydrocarbon, and petroleum hydrocarbon analyses.

EMPLOYMENT: 2005- present, Alpha Geoscience
1998-2005, Alpha Environmental Consultants, Inc.
1990-1998, McLaren/Hart
1986-1990, Fred C. Hart Associates
1985-1986, Boeing Petroleum Services
1982-1985, Petroleum Operations and Support Services
1981-1982, Dravo Utility Constructors
1979-1981, Florida Institute of Technology
1975-1979, Berkley Products Company

Z:\ALPHA\RESUMES\DCA\DCA-DATA VAL.DOC

Teresa V. Weikel

Quality Assurance Officer

As an analytical chemist, Ms. Weikel has had over 10 years of experience in environmental laboratories with specialized expertise in Organics Analysis including organic extractions, Gas Chromatography/Mass Spectrometry and Gas Chromatography methods. She also experienced in metals analysis by ICP, and classical chemistry methods. She has also been heavily involved with QA/QC protocols for all disciplines in the Laboratory. She is fully versed in all NELAC(TNI) and ISO-17025 protocols for Quality Systems.

In the capacities of Chemist and Senior Chemist at various environmental testing laboratories, she performed and was frequently solely responsible for a wide variety of both organic and inorganic analyses and extractions in varying environmental matrices following EPA, WA State and occasional self-designed methods.

In addition to chemist responsibilities, Ms. Weikel also was responsible for setup and use of specific programs and appropriate record keeping for various government/state certifications, organization and delegation of incoming laboratory work and as a Quality Control Specialist at a biotechnology company, she wrote raw material specifications and standard operating procedures according to FDA document traceability standards.

She has had QA specific training on Internal Audit Procedures and Understanding and Implementing ISO-17025 in laboratories. She is familiar with the requirements of the NELAC 2003 standard.

At York, she holds full responsibility for the in-house Quality Systems.

Her current responsibilities focus on quality systems monitoring and implementation, technical training, data review, SOP preparation and revision, new procedure review and approval, data package review, and ethics training.

Education: B.S. Chemistry, Pacific Lutheran University Tacoma, WA

ATTACHMENT G
York Analytical Laboratories, Inc PFAS SOP

Standard Operating Procedure

Analysis of Target Per- and Polyfluorinated Alkyl Substances (PFAS) in Non-Potable Water and Soil by EPA Method 537 Modified using LC/MS-MS

Approvals

Laboratory Director

Ben Gulizia

Corporate Technical Director

Robert Bradley

Corporate QA/QC Officer

Sarah Widomski

Sarah Widomski

UNCONTROLLED COPY

Target PFAS in Non-Potable Water and Soil Matrices

1. SCOPE AND APPLICATION

This method is used to identify and quantitate specific PFAS compounds in extracts of non-potable water and soil samples using HPLC/MS-MS (high pressure liquid chromatography/ tandem mass spectrometry. Currently the compounds (26) that can be measured by this methodology at the date/revision of this SOP are listed in the table below.

1H,1H,2H,2H-perfluoro-1-decanesulfonate (8 2FTS)
1H,1H,2H,2H-perfluoro-1-hexanesulfonate (4 2FTS)
1H,1H,2H,2H-perfluoro-1-octanesulfonate (6 2FTS)
N-EtFOSAA
N-MeFOSAA
Perfluoro-1-decanesulfonate (L-PFDS)
Perfluoro-1-heptanesulfonate (L-PFHpS)
Perfluoro-1-octanesulfonamide (FOSA)
Perfluoro-1-pentanesulfonate (L-PFPeS)
Perfluorobutanesulfonic acid (PFBS)
Perfluorodecanoic acid (PFDA)
Perfluorododecanoic acid (PFDoA)
Perfluoroheptanoic acid (PFHpA)
Perfluorohexanesulfonic acid (PFHxS)
Perfluorohexanoic acid (PFHxA)
Perfluoro-n-butanoic acid (PFBA)
Perfluorononanesulfonate (L-PFNS)
Perfluorononanoic acid (PFNA)
Perfluoro-n-pentanoic acid (PFPeA)
Perfluorooctanesulfonic acid (PFOS)
Perfluorooctanoic acid (PFOA)
Perfluorotetradecanoic acid (PFTA)
Perfluorotridecanoic acid (PFTrDA)
Perfluoroundecanoic acid (PFUnA) 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy) propanoic acid (GenX) 4,8-dioxa-3H-perfluorononanoic acid (ADONA)

The estimated reporting limit based upon the preparation/analysis parameters herein at the time of this revision are 2.0 ng/L (ppt) for aqueous samples 0.5-2 ug/kG for soil samples. The linear range for these PFAS can be extended by dilution.

2. SUMMARY

2.1 This procedure involves fortifying samples and related QC with specific isotopes of target PFAS followed by extraction, concentration and analysis by LC/MS-MS. The preparation of non-potable water and soils is detailed in a separate SOP-PFASExtr_AQ_S_051019, Rev. 1.0 and updates.

2.2 For non-potable waters, a known volume of aqueous sample extracted using automated or manual Solid Phase Extraction (SPE). The compounds are eluted from the solid phase using ammoniated methanol. The extract is then slowly evaporated to a small volume using a nitrogen evaporation system. The resulting extract residue is reconstituted in 96%/4% Methanol/water to a final volume of 1.0 mL.

2.3 For soils, a known weight of sample (as received) is extracted with methanolic potassium hydroxide followed by vigourous vortex mixing, orbital agitation and ultrasonic extraction techniques. Prior to SPE cleanup/extraction the extract is fortified with PFAS free water and the methanol is removed by evaporation. The resulting aqueous extract brought to a 20 mL volume and is pH adjusted to pH 6-8. The aqueous extract is then extracted using automated or manual SPE extraction techniques followed by concentration of the SPE extract to a known final volume.

2.3 A portion of the extract is then fortified with internal standard and the PFAS LC separation is accomplished using a C18 LC column using a gradient program with 5mM ammonium acetate/water and methanol to effect separation followed by analysis using AJI-ESI (Electrospray) injection into a triple Quadrupole MS operated in negative ion mode.

2.4 Quantitation is done by internal standard technique and peak response is measured as the area of the peaks from the dynamic MRM (Multiple Reaction Monitoring) run.

2.5 Concentrations determined by LC/MS-MS are adjusted for isotope recoveries for final reporting into the Element LIMS.

3. DEFINITIONS

3.1 ANALYSIS BATCH – A set of samples that is analyzed on the same instrument during a 24-hour period, including no more than 20 Field Samples, that begins and ends with the analysis of the appropriate Continuing Calibration Check (CCC) standards. Additional CCCs may be required depending on the length of the analysis batch and/or the number of Field Samples.

3.2 CALIBRATION STANDARD (CAL) – A solution prepared from the primary dilution standard solution and/or stock standard solution, internal standard(s), and the surrogate(s). The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

3.3 COLLISIONALLY ACTIVATED DISSOCIATION (CAD) – The process of converting the precursor ion's translational energy into internal energy by collisions with neutral gas molecules to bring about dissociation into product ions.

3.4 CONTINUING CALIBRATION VERIFICATION (CCV) – A calibration standard containing the method analytes, internal standard(s) and surrogate(s). The CCv is analyzed periodically to verify the accuracy of the existing calibration for those analytes. The CCV is run after every tem runs.

3.5 DETECTION LIMIT (DL) – The minimum concentration of an analyte that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero. This is a statistical determination of precision (Sect. 9.2.7), and accurate quantitation is not expected at this level.

3.6 EXTRACTION BATCH – A set of up to 20 Field Samples (not including QC samples) extracted together by the same person(s) during a work day using the same lot of SPE devices, solvents, surrogate, internal standard and fortifying solutions. Required QC samples include Method Blank, Blank Spike, Matrix Spike/Matrix Spike Duplicate.

3.7 FIELD DUPLICATES (FD1 and FD2) – Two separate samples collected at the same time and place under identical circumstances, and treated exactly the same throughout field and laboratory procedures. Analyses of FD1 and FD2 give a measure of the precision associated with sample collection, preservation, and storage, as well as lab procedures.

3.8 FIELD BLANK – An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the Field Blank is to determine if method analytes or other interferences are present in the field environment.

3.9 INTERNAL STANDARD (IS) – A compound added to an extract or standard solution in a known amount(s) and used to measure the relative response of other method analytes and surrogates that are components of the same solution. The internal standard must be a chemical that is structurally similar to the method analytes, has no potential to be present in samples, and is not a method target analyte.

3.10 BLANK SPIKE (BS) – A volume of reagent water or other blank matrix to which known quantities of the method analytes and any preservation compounds are added in the laboratory. The Blank Spike is prepared and analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate measurements.

3.11 MATRIX SPIKE (MS) – A preserved field sample to which known quantities of the method analytes are added in the laboratory.
The MS is processed and analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate sample extraction and the measured values in the MS corrected for background concentrations.

3.12 MATRIX SPIKE DUPLICATE (MSD) – A duplicate of the Field Sample used to prepare the MSD. The MSD is fortified, extracted, and analyzed identically to the MS. The MSD is used instead of the Field Duplicate to assess method precision when the occurrence of method analytes is low.

3.13 METHOD BLANK – An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents and reagents, sample preservatives, internal standard, and surrogates that are used in the analysis batch. The method blank is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparati.

3.14 REPORTING LIMIT – the level at which accuracy of 50-150% is achieved and is based upon the lowest calibration standard. This level is prepared through all steps of the processing/analysis and is verified quarterly.

3.15 PRECURSOR ION – For the purpose of this method, the precursor ion is the deprotonated molecule ($[M-H]^-$) of the method analyte. In MS/MS, the precursor ion is mass selected and fragmented by collisionally activated dissociation to produce distinctive product ions of smaller *m/z*. For certain species that are labile in nature (GenX) under the conditions of analysis the [M-CO2]- is used.

3.16 PRODUCT ION – For the purpose of this method, a product ion is one of the fragment ions produced in MS/MS by collisionally activated dissociation of the precursor ion.

3.17 SURROGATE (isotopic) ANALYTE (SUR) – A compound which is structurally identical to the target analyte or an analog of the target analyte which is isotopically labeled (deuterium, oxygen 18, or carbon13) and chemically resembles method analytes and is unlikely to be found in any environmental sample. This compound(s) is added to a sample aliquot in known amounts before processing and is measured with the same procedures used to measure other method analytes. The purpose of the isotopic surrogate is to monitor method performance with each sample, and to adjust concentration for recovery of the isotopic analog.

4. INTERFERENCES

LC/MS-MS data from blanks, samples, and spikes must be evaluated for interferences. If any interferences are present, take corrective action if necessary. Do not use aluminum foil because PFAS can be potentially transferred from the aluminum foil to the glassware. Only aluminum foil rinsed with HPLC plus grade or LC/MS grade methanol can be used where necessary.

4.1 PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean. These items are listed in the Reagents section.

4.2 Method interferences may be caused by contaminants in solvents, reagents (including DI water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. All items such as these must be routinely demonstrated to be free from interferences (less than 1/2 the Reporting Limit), under the conditions of the analysis by analyzing Method Blanks. Subtracting blank values from sample results is not permitted.

4.3 PTFE products can be a source of PFAS (PFOA) contamination. The use of PTFE in the procedure should be avoided. Polypropylene (PP) or polyethylene (PE, HDPE) products must be used in place of PTFE products to minimize PFOA contamination.

4.3.1 Standards and samples are injected from polypropylene autosampler vials with polypropylene snap caps, once. Multiple injections may be performed on Primers when conditioning the instrument for analysis.

4.3.2 Random evaporative losses have been observed with the polypropylene caps causing high Internal Std. recovery after the vial was punctured and sample re-injected. For this reason, it is best to inject standards and samples once in the analytical sequence, or recrimp after injection. The auto sampler system employs a refrigerated (4^{o}C) sample compartment which minimizes losses.

4.3.2 Teflon-lined screw caps have detected PFAS at low concentrations. Repeated injection from the same teflon-lined screw cap have detected PFNA at increasing concentration as each repeated injection was performed, therefore, it is required to use only polypropylene snap caps as specified in this SOP.

4.4 HPLC Plus grade or LC/MS grade methanol and water must be used for all steps where methanol or water are used in this method.

4.5 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 water or soil. SPE provides the necessary clean-up to reduce the occurrence of matrix effects.

4.6 Solid phase extraction cartridges may be a source of interferences. The analysis of laboratory method blanks can provide important information regarding the presence or absence of such interferences. The Phenomenex Strat-XL-AW or the Oasis WAX SPE tubes have shown no interfering peaks/ions at the retention times of interest. Each new lot of SPE cartridge sorbent must be tested to ensure that contamination does not preclude analyte identification and quantitation.

4.7 Contamination by carryover can occur whenever a high-concentration and low concentration samples are sequentially analyzed. To reduce carryover, the sample syringe in automatically rinsed with solvent between injections. These operations are programmed into the LC multi-sampler system.

4.8 Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFAS. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware (mechanical pipetors) are used.

4.9 Both branched and linear PFAS isomers can potentially be found in the environment. Linear and branched isomers are known to exist for PFOS, PFOA, PFHxS, PFBS, EtFOSAA, and MeFOSAA based upon the scientific literature. If multiple isomers are present for one of these PFAS they will be peaks adjacent to the linear isomer (to the left under our operating conditions). The later of these peaks matches the retention time of its labeled linear analog. In general, earlier peaks are the branched isomers and are not the result of peak splitting. In the analysis of real world samples, the most often encountered branched isomers are seen for PFOS and PFHxS.

Currently, all these species are available as linear isomers. Reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration. These branched isomers elute before the linear isomer and are integrated and reported as total for those species.

4.10 In order to reduce PFOS bias, it is required that *m/z* 499>80 transition be used as the quantitation transition.

5. SAMPLE HANDLING

5.1 Aqueous and soil samples are collected by our clients in 250 mL HDPE bottles with HDPE caps.

5.2 FIELD BLANKS (FBLK)- A FBLK must be handled along with each sample set. The sample set is composed of samples collected from the same sample site and at the same time. At the laboratory, fill the field blank sample bottle with reagent water, seal, and ship to the sampling site along with the sample bottles. For each FBLK shipped, an empty sample bottle must also be shipped. At the sampling site, the sampler must open the shipped FBLK and pour the reagent water into the empty shipped sample bottle, seal and label this bottle as the FBLK. The FBLK is shipped back to the laboratory along with the samples and analyzed to ensure that PFAS were not introduced into the samples during sample collection/handling.

5.3 SAMPLE SHIPMENT AND STORAGE – Samples must be chilled during shipment and must not exceed 10 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction, but should not be frozen.

NOTE: Samples that are significantly above 10° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

5.4 SAMPLE AND EXTRACT HOLDING TIMES –PFAS have adequate stability for 14 days when collected, preserved, shipped and stored as described. Therefore, water and soil samples should be extracted within 14 days of collection. Extracts must be stored at <10^{o}C or room temperature and analyzed within 28 days after extraction.

6. APPARATUS AND MATERIALS

6.1 250 mL High Density Polyethylene (HDPE) bottles with HDPE linerless caps- Greenwood Env. Part no. 07-GW2501: 250ml SMART Natural HDPE Leakproof Wide Mouth Bottle w/43-415 Linerless Cap, Assembled Only (250/cs) or 07-GW2503: 250ml HDPE Leakproof Wide Mouth Bottle w/43-415 Linerless Cap , Certified (250/cs), or equivalent-alternate source: VWR Scientific: Part no. 414004-113 HDPE wide moutgh bottle with HDPE liner less cap. These have been tested and demonstrated to be PFAS-free in initial studies.

6.2 Transport Tube: Virgin Polypropylene, White, Plastic, 10 mL Capacity, 16 mm OD, 93 mm Overall Lg, Self-Standing, 250 PK， Item 710Z420, Gamut.com (Grainger), with PP cap

6.3 Graduated cylinders, 50, 100, 250, 500 and 1000mL, Polypropylene, VWR Scientific or equivalent

6.4 Analytical Balance, 0.0001g., checked for accuracy each day of use with Class S weights.

6.5 Extract concentrator: Organomation Model N-EVAP 112, 24 position concentrator with water batch control and nitrogen supply controls.

6.6 Syringes, polypropylene, luer lock, 50-100 mL for filtration of turbid groundwater samples. Merck XX110500 Fisher Scientific or equivalent

6.6 3.1 Micron in-line filters, Biotage part no. 49-2814-01

6.7 1.0 mL polypropylene snap cap vials, Agilent part no. 5182-0567

6.8 Snap caps, polypropylene, 11 mm, 11/9k, Agilent Part no. 5182-0542

6.9 2mL self standing PP microcentrifuge snap cap tubes, SKS Scientific part no. 0747-17

6.10 15 mL PP or HDPE Centrifuge tubes, Corning Part no. 430791

6.11 3 mL Disposable Transfer pipets, PE, VWR part no. 16001-176

6.12 Solid Phase Extraction Tubes:

For aqueous samples the following have been proven to meet SOP requirements: Phenomenex Strata XL-AW 100 um 200 mg 6mL tubes, part no. 8B-S051-FCH or Phenomenex Strata XL-AW 100 um 500 mg 6 mL tubes, part no. 8BS0510HCH, or Waters OASIS WAX 6cc/500 mg 60um tubes, part no. 186004647

For soils the following tubes can be used: Phenomenex Strata XL-AW 100 um 500 mg 6 mL tubes, part no. 8BS0510HCH; Biotage Evolute 500 mg/6mL 30 um tubes part no. 614-0050-CXG or Waters OASIS WAX 6cc/500 mg 60um tubes, part no. 186004647

6.13 Syringes, Hamilton or equivalent 5.0 uL, 10 uL 25 uL, 100 uL, 250 uL, 500 uL, *teflon free.*

6.14 Solid Phase Extraction System-automated-Horizon/Biotage SmartPrep II system, 12 position autosampler system for 6 mL capacity tubes. System retrofit to remove all PTFE components and replaced with PEEK tubing. Automated bottle rinsing feature required.

6.15 SPE Automated Extraction System, Promochrom Technologies, Inc. 8 position simultaneous processing, PTFE free system.

6.16 Nitrogen Evaporation System- Organomation Model N-EVAP 112-24 position evaporator with water bath and individual nitrogen delivery control. Water bath capable of ambient temperature to 85 C, operated at 60 C.

6.17 LC/MS-MS system- Agilent 1260 HPLC system interfaced to an Agilent 6470A Triple Quadrupole system. The instrument control and qualitative/quantitative analysis software using Mass Hunter versions B.8.0 and B.9.0.

6.17.1 HPLC System-Agilent 1260 Infinity II

6.17.1.1 The Agilent 1660 Infinity II HPLC system is configured with temperature controlled column oven compartment. 4 column configuration, temperature controlled (refrigerated) autosampler compartments, injection valve, proportioning valves, variable flow controls and variable injection capabilities.

6.17.1.2 The delay column (PFAS and other interference removal) is an Agilent Eclipse Plus C18, 4.6mm x 50 mm, 3.5 um-Part no. 959943-902

6.17.1.3 The analytical column is an Agilent ZORBAX Eclipse Plus C18, 3.0 x 50 mm, 1.8 um- part no. 959757-302

6.17.2 Agilent LC/MS-MS- Agilent 6470AAR

6.14.2.1 Agilent model 6470AAR triple Quadrupole system with Agilent Jet Stream ESI source. UHP nitrogen is used as cell gas and High purity nitrogen is delivered for the sheath gas from a Peak Scientific nitrogen generator system.

6.18 Vortex Mixer- Benchmark Industries or equivalent

6.19 pH paper, short range 6-8- VWR Scientific or equivalent

6.20 Ultrasonic Baths- GT Sonic LS-10D, 240 w and Limplus VGT-1990QT, 240 w

6.21 Orbital Shaker- Jiangau Tenlin Instr. Co., Ltd., Model no. TLSK-III 20-230 RPM, 0-999 min.

6.22 Centrifuge, 50 mL, Premiere Model XC-2450 Series Centrifuge 6 x 50 mL, 3500 RPM max.

6.23 Mini Centrifuge, 2 mL Four E's Scientific, 5400 RPM

6.24 Mechanical Pipettors- 10-100 uL; 100-1000 uL; 1000-5000 uL-4 E'S Scinetific or equivalent, calibrated quarterly.

7. REAGENTS AND STANDARDS

ALL REAGENTS and STANDARDS MUST BE LOGGED INTO THE ELEMENT LIMS SYSTEM. This includes lot numbers, expiration, open and prepared dates, recipe, Certification/traceability documents from supplier(s) if provided and preparer.

7.1 Methanol, hypergrade for LC/MS. (Merck) from Sigma Aldrich Part no. 1060354000. Alternatively Methanol, HPLC plus grade, Sigma Aldrich Part. No. 646377-4L

7.2 Water, hypergrade for LC/MS. (Merck) from Sigma Aldrich Part no. 1153334000; alternatively Water, HPLC Plus grade, Sigma Aldrich part no. 34877-4L.

7.3 Isopropanol-for rinsing valve seats, etc.- Sigma Aldrich Part no. 650447-1L

7.4 Ammonium Acetate, LC-MSMS grade. Sigma Aldrich Part no. 73594-100-G-F

7.4.1 HPLC gradient A- 5 mM Ammonium Acetate/ Water
Weigh 0.3854 g (± 0.0005) Ammonium Acetate and add to 1 liter hypergrade Water. Sonicate for 5 mins. To remove air bubbles. Stability- 2 weeks.

7.4.2 HPLC gradient B – 5 mM Ammonium Acetate/95/5 MeOH/H_2O
Weigh 0.3854 g (± 0.0005) Ammonium Acetate and add to 1 liter of 95/5 hypergrade methanol/water (950 mL MeOH/50 mL Water). Sonicate for 5 mins. To remove air bubbles. Stability – 2 weeks

7.5 Ammonium Hydroxide- 28-30%- ACS grade Sigma Aldrich Part no. 221228-500ML-A

7.6 Potassium Hydroxide-BioXtra grade, Sigma Aldrich part no. P5958-250G

7.7 Acetic Acid, Glacial, >99.7%- ACS grade-Sigma Aldrich part no. 695092-500ML

7.8 Agilent Tuning Solution-ESI-L-Agilent Part no. G1969-85000

7.9 Stock Standards

Stock Standards are purchased in mid to high concentration form from Wellington Laboratories, Inc. Guelph, ONT, CA. Currently, Wellington is the only supplier of these materials. Second source standards to serve as an initial calibration verification are not available for all compounds. Some of the target compounds from Absolute Standards, Hamden, CT in a 2000 ng/mL mix of linear and branched isomer isomers which limit their use for quantitative analysis due to the uncertainty in the amount of branched species. Until a viable second source is identified, the 5.0 ng/mL level material used for calibration will serve as the ICV for Element purposes.

7.9.1 Internal Standard used for the method described is MPFOA (Perfluoro-[1,2,3,4-$^{13}C_4$]octanoic acid). This is purchased at 50,000 ng/mL and mixed for use. This is purchased from Wellington Labs in 1.2 mL volumes with the following part nos.: MPFOA.

7.9.2 Surrogate (ISOTOPIC) Materials are purchased for this method from Wellington Labs at 50,000 ng/mL levels on an individual basis. The part nos. for 18 isotopes are listed as follows: MPFBA, M5PFPeA, M3PFBS, M5PFHxA, M4PFHpA, M3PFHxS, M2-6:2 FTS, M8PFOA, M8PFOS, M9PFNA, M2-8:2 FTS, M6PFDA, d3-N-MeFOSAA, M8FOSA, M7PFUnDA, d5-N-EtFOSAA, MPFDoA, M2PFTeDA.When GenX is a target- M3HFPO-DA.

7.9.2.1 Alternatively, a mixture of all the above isotopes is available from Wellington Laboratories as part no. MPFAC-24PAR at 1000 ng/mL in Methanol. NOTE: This mixture does not contain GenX or ADONA.

7.9.3 Stock Standard mixture of linear isomers of the target analytes are purchased from Wellington Labs at 2000 ng/mL concentrations under part no. PFAC-24PAR. This is used for native analyte calibration and for the BS/MS/MSDs.

7.10 Intermediate/Working Standards Preparation

7.10.1 **Internal Standards -** Preparation at 1000 ng/mL

Internal Standards mixture is prepared into a 10 mL polypropylene transfer tube for use. 10.0 mL final volume is prepared. Before use the mixture is mixed well using a vortex mixer. This approach yields 10 ng/mL of ISTD final concentration in each extract/QC/Cal std.when 3 uL of ISTD mix at 1000 ng/mL is added to 300 uL extract or 5 uL is added to 500 uL.

Preparation of Internal Standard Working Solution- 10.0 mL final volume

For all Calibrations, QC and Samples add 3 uL to 300 uL samples and 5 uL to 500 uL CALSTDS

ISTD Stock	Stock, ng/mL	Vol. to add (uL)	To this vol. MeOH, uL	**Conc. ,ng/mL**
MPFOA	50000	200	9800	1000

7.10.2 **Isotopic Surrogate** Solution Intermediate Preparation-1000 ng/mL

5.0 mL of the 18 Isotope Surrogate mixture is prepared into a 10 mL polypropylene transfer tube for use at a 1000 ng/mL concentration. The GenX isotope M3HFPO-DA is not included. The intermediate is prepared by adding 100uL of each of the 18 isotopes (at 50,000 ng/mL, nominally as the anion) into 3200 uL of MeOH for a final concentration of 1000 ng/mL. Mix using the vortex mixer and carefully transfer to 3 separate labeled self standing 2 mL snap cap vials. Some isotopes are present as salts so the amount of indiv. Added may be more than 100 uL to adjust for salt vs. anion. The amount of MeOH will be reduced proportionately.

7.10.3 –Isotopic Surrogate Preparation for addition to samples/QC

Preparation of Working Surrogate Mixture- 10.0 mL final volume
From 1,000 ng/mL intermediate from 7.10.2 add 1000uL of the intermediate at 1000 ng./mL to 9000 uL methanol to give a final concentration of working isotopic surrogate mix at 100 ng/mL. This mixture is used for addition to all samples/QC that are to be extracted.

7.10.4 **Target Analyte Intermediate/Working Mixture**

From the 2000 ng/mL stock solution (7.9.3), prepare a 100 ng/mL solution by adding 500 uL of the stock to 9500 uL Methanol. This results in a 100 ng/mL working standard. This 10 mL volume is then used for BS/MS/MSD solution (100 uL added for BS/MS/MSD).

7.10.5 **CALIBRATION CURVE Preparation**

Using the 1000 ng/mL Isotopic Surrogate intermediate (7.10.2) and the 2000 ng/mL Stock native analytes (7.9.3) make 1.0 mL of an intermediate 100 ng/mL solution of isotopes and native analytes by taking 50uL of the 2000 ng/mL natives and 100 uL of the 1000 ng/mL Isotopic intermediate adding both to 850 uL methanol. This is the 100 ng/mL Calibration intermediate. Follow the preparation in the table as shown.

Initial Calibration Preparation

Initial Calibration-
use solution form 7.10.5
@ 100 ng/mL
Standards Source-Wellington Labs
500 uL Final Volumes prepared into PP vials

Cal Level ID	Std. Conc., ng/mL	Isotopes+Natives Mix @ 100 ng/mL, uL	96/4 MeOH/H2O, uL	ISTD Working MIX, uL
1	0.25	1.25	498.8	5.0
2	0.5	2.5	497.5	5.0
3	1.0	5.0	495	5.0
4	2.5	12.5	487.5	5.0
5	5.0	25.0	475	5.0
6	10.0	50.0	450	5.0
7	20.0	100.0	400	5.0

7.10.6 Second Source - Initial Calibration Verification

Use 5.0 ng/mL cal level until verification of a second source is done. Currently only the 24 compound DOD mix at 2000 ng/mL is available from Absolute Standards, Hamden, CT , part no. 99206. This contains some branched isomers therefore it may not serve its intended purpose. This is optional at this time. This is prepared as an ICV as follows:

Initial Calibration Verification Preparation

Source-Absolute Standards EPA 537 Mix @ 2000 ng/mL

Preparation of Intermediate 100 ng/mL
Take 50 uL of Stock up to 1000 uL in MeOH = 100 ng/mL Intermediate

ICV Level @ 5.0 ng/mL
Take 25 uL of 100 ng/mL ICV ng/mL plus 475 uL 96/4 MeOH/H2O + 5uL ISTDs-no Surrogates

8. PROCEDURE

8.1 Preventative and Routine Maintenance

HPLC/MS/MS Preventative Maintenance	
As Needed: Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Clean needle. Replace or clean Capillary Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes. Check Nozzle flow pattern	**Daily (When in use)** Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. (ripple < 1%) Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses. Replace HPLC Gradient solutions-2 weeks Perform Checktune once per week.
Semi-Annually Replace oil mist and odor elements. Replace activated alumina filter if applicable	**Annually** Vacuum system components including fans and fan covers. Clean/replace fan filters, if applicable.

8.2 Running Samples/QC - Acquisition Method

The acquisition methods are detailed in Attachments 1 (HPLC) and Attachments 2 and 3 (MS/MS) of this SOP. The method is a HPLC with dynamic MRM method with precursor and product ions with specific acquisition parameters to maximize sensitivity and specificity. This list may be modified to add other PFAS target analytes as necessary. It is noted that under the conditions used for analysis, GenX (attachment 3), due to its fragile nature is analyzed separately monitoring the [MCOO]- precursor and related product ion.

8.3.1 The triple Quadrupole (QQQ) system must be optimized for each target analyte (including surrogates and internal standards) using the Mass Hunter Optimizer program. This program determines the most abundant precursor and product ions for each compound and their abundances. These data are then used to build an MRM (multiple reaction monitor) method for acquisition. This is done initially or after any major maintenance procedures are performed to the triple quadrupole system. A high level standard is used for this in the $[M\text{-}H]^-$ mode.

8.3.2 The QQQ is checked for tuning on a weekly basis before analysis using the Tune context by selecting the CHECKTUNE radio button. This is done only in negative ion mode since that what we are operating under. If the Checktune fails, or significant change (50%) in the abundances compared to the most recent checktune data, run the Autotune program-note: this takes approx. 45 mins. in negative mode. NOTE: This will require a re-calibration of the instrument.

8.3.3 Before any QC or samples can be run, the HPLC must be allowed to purge/condition for at least thirty minutes. This purge must be done using the initial mobile phase conditions used in the method must be allowed to run for 30 minutes to allow the binary pump pressure to stabilize (ripple must be < 1%) and pressure should be 135-160 barr with a 90/10 gradient (initial HPLC conditions).

8.3.4 An instrument sequence (Worklist) is then made. It should begin with two double blanks if the system has been sitting more that 48 hours, or at a minimum 1 double blank and a conditioner (5 ng/mL).

8.3.5 Those will be followed by the opening CCV at 5 ng/mL. Then, the worklist can start running. After every 10 injections and at the end of the sequence a CCV is run.

8.3.6 The run can end with a script to put the instrument into standby mode.

8.4 Daily Sample Preparation/Analysis Sequence

- Prepare extracts for analysis by placing a 300 ul aliquot of sample extract into a labeled PP auto-sampler vial. Add internal standard (3 uL). Apply snap cap. Vortex to mix.
- Run instrument CCV checks at the start and every ten injections (5 ng/mL) and at the end as described in 8.3.5 above.
- Enter the Worklist (injection sequence) using the naming convention mm-dd-yyyy into the instrument software and load samples onto the auto-sampler in the following order,

    - 2 Double Blanks (If system idle > 48 hrs. (1 if not)
    - Conditioner @ 5 ng/mL
    - CCV (5.0 ng/mL)
    - Method Blank
    - BS
    - Samples /MS/MSDs; CCV every 10 injections
    - CCV (ending or continuing) at 5.0 ng/mL
    - 10 injections
    - Ending CCV -5.0 ng/mL

8.5 Data Review

The Agilent Mass Hunter Quantitation program is used to review all data. All identifications are based upon acceptable ion ratios for the abundance of both precursor and product ions along with retention time information. It is noted that for PFOS specifically the ratios may not always be ideal due to the branched isomer contribution. If native PFOS is found and branched are also found under the conditions of MRM acquisition identity is confirmed.

8.5.1 Since certain PFAS species are manufactured by different processes the presence of branched as well as linear isomers may be found. In order to properly quantitate these species, the analyst must manually integrate the following species to report totals for: PFOS and PFHxS., These should be annotated as total in the element report verbiage or using a qualifier PFAS-T

8.5.2 Any detection greater than the upper limit of the calibration curve requires dilution into the upper half of the curve, where possible.

9. CALIBRATION

9.1 Initial Calibration

The initial calibration covers the range 0.25 ng/mL to 20 ng/mL depending upon the linearity of the PFAS species. After acquisition, the data are quantitated in Mass Hunter and the default calibration model is generated using Average response factor. For average response factor RSDs greater than 20% an alternate model such as Quadratic regression should be used. Depending upon the response and accuracy at each level as shown in the Mass Hunter program, use Quadratic regression not forced through the origin with or without weighting to achieve the best fit which is based upon the best accuracy on a compound by compound basis. In any case, the correlation coefficient R^2) must be greater than 0.990.

9.1.1 The calibration levels as shown in Section 7.6.3 use 7 levels. All points are included in the calibration for all PFAS targets and isotopes.

9.1.2 Certain species in the calibration mixture are present as salts (as opposed to anions). This concentration must be used in the Mass Hunter software to reflect the actual anion concentration present. Also, all responses for the calibration curve are based solely upon the known concentration of the linear isomers where applicable. Refer to the Wellington Labs standard information sheets for each lot of material.

9.2 ICV/QCS

A second-source Initial Calibration Verification, if available should be run immediately following initial calibration. The concentration of this standard should be in the middle of the calibration range (e.g. 5.0 ng/mL). Unless project-specific data quality objectives are required, the values from the second-source check should be within 30% of the expected concentration.

Corrective Action: Quantitative sample analyses should not proceed for a failing ICV. Recalibrate and re-run the ICV if necessary. When using the same source for the "ICV" then ± 20% limits apply.

9.3 Continuing Calibration Verification

The CCV must be ± 30% of the true value.

Corrective Action: If any of the required calibration check criteria fail, the system must be evaluated and any appropriate instrument repair or maintenance must be performed. Sample data are unacceptable and must be rerun. Reinjection the standard may be done. If the calibration check standard still fails, the system must be recalibrated.

10. Quality Control

10.1 Initial Demonstration of Capability (IDOC)

The initial demonstration requirement herein must be acceptable before analysis of samples may begin.

10.2 Batches are defined at the sample preparation step. 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.

10.2.1 The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure 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. Laboratory generated QC samples (Blank, LCS, MS/MSD) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, the MS/MSD may be replaced with a matrix spike and sample duplicate. If insufficient sample is available for an MS/MSD, an LCSD may be substituted if batch precision is required by the program or client. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

10.3 METHOD BLANK- One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid samples, the method blank is a portion of

Ottawa sand. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, and then implemented when target analytes are detected in the method blank above the reporting limit or when IDA recoveries are outside of the control limits. Re-extraction of the blank, other batch QC, and the affected samples are required when the method blank is deemed unacceptable.

10.3.1 If the MB produces a peak within the retention time window of any of the analytes, determine the source of the contamination and eliminate the interference before processing samples.

10.3.2 The method blank must not contain any analyte at or above 1/2 the reporting limit.

10.3.3 If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

10.3.4 Re-extraction and reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

10.3.5 Results are acceptable if the blank contamination is less than ½ of the reporting limit/LOQ for each analyte, or less than 1/10 of the regulatory limit, or less than 1/10 of the sample result for the same analyte, whichever is greater. If the method blank does not meet the acceptance criteria, the source of contamination must be investigated and measures taken to correct, minimize or eliminate the problem. Reprepare and reanalyze all field and QC samples associated with the contaminated method blank.

10.4 LABORATORY CONTROL SAMPLE (BLANK SPIKE) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. The control limits for the LCS are stored in Element.

10.5 A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) pair must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, then implemented when recoveries of any spiked analyte are outside of the control limits provided by ELEMENT or by the client. Again if a specific method or work plan has required limits, this is preempted. Any outliers must be qualified accordingly.

10.6 A LCSD or BSD may be added when insufficient sample volume is provided to process an MS/MSD pair, or is requested by the client. The BSD is evaluated in the same manner as the BS/LCS.

10.7 Initial calibration verification (ICV) –A second source standard, if available, is analyzed with the initial calibration curve. The concentration should be at the mid range of the curve and must recover within 70-130 % of expected value.

Corrective actions for the ICV, if true second source, include:

- Rerun the ICV.
- Remake or acquire a new ICV.
- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.
- Rerun the initial calibration.

10.8 Internal Standard- The Internal Standard (IS) is added to each field and QC sample prior to analysis. The IS response (peak area) must not deviate by more than ½ to 2x the average response (peak area) of the initial calibration.

10.8.1 Sample IS response (peak area) must be within 50-150% of the response (peak area) in the most recent CCV.

10.9 Specific other QC requirements for this method are detailed in Table 1.0 as follows.

Table 1.0 QC Criteria-York PFAS Method

Requirement	**Specification and Frequency**	**Acceptance Criteria**
Sample Holding Time	14 days with appropriate preservation and storage as described in Sections 8.1-8.5.	Sample results are valid only if samples are extracted within sample hold time.
Extract Holding Time	28 days when stored room temp. in polypropylene snap cap vials	Sample results are valid only if extracts are analyzed within extract hold time.
Laboratory Reagent Blank (LRB)	One MBLK with each extraction batch of up to 20 Field Samples.	Demonstrate that the method analyte concentration < 1/2 the RL, and confirm that possible interferences do not prevent quantification. If the background concentration exceeds 1/2 the RL, results for the extraction batch are invalid.
Method Blank	One LFB is required for each extraction batch of up to 20 Field Samples. Rotate between low, mid, high levels	Results of LFB analyses at medium and High fortification for the analyte and SUR. Results of a low-level LFB must be 50-150% of the true value.
Internal Standard (IS)	Compare IS area to the average IS area in the initial calibration and the most recent CCC.	Peak area counts for all injections must be within –50%-200% of the average peak area calculated during the initial cal. and 50–150% from the most recent CCC. If the IS does not meet this criterion, rerun ot dilute
Surrogate(SUR) Standard	The SUR standard added to all calibration standards and samples, including QC samples. Calculate SUR recoveries.	Isotope SURR recovery should be within lab control limts be 25-150% of the true value. If a SUR fails this criterion, report all results for sample as suspect/SUR recovery with appropriate qualifier.
Sample Matrix Spike	Analyze one MS per extraction batch (of up to 20 Field Samples) fortified target analytes. Calculate MS recoveries (Element)	Recoveries at should be within Lab control Limits. Qualify any outliers using appropriate flags.
MSD	Extract at least one MSD with each extraction batch of 20 field samples or less. Calculate RPD.	RPD should be $\leq$30%. If not met, qualify data accordingly.
Initial Calibration	Use ISTD technique Use minimum of 7 points at all times	When each standard is calculated against the curve, the accuracy should be 70-130%, except for the lowest standard which should be 50-150% of the true value.
Continuing Calibration Verification(CCV)	Initially and after every 10 runs and at the end of the run	Surrogates and analyte recovery 70-130% of expected value

10.10 Initial Demonstration of Capability (IDC)

Initial Demonstration of Capability involves the following processes listed ion Table 2.0 as follows.

Table 2.0 - Initial Demonstration of Capability (IDC)

Requirement	**Specification**	**Acceptance Criteria**
Initial Demonstration of Low System Background	Analyze MBLK prior to any Other IDC steps	Demonstrate that all method analytes are < 1/2 MRL and possible interferences form extraction media do not prevent identification and quantification of method analytes.
Initial Demonstration of Precision (IDP) *-537.1*	Analyze 4-7 replicate LFBs at mid-cal level	%RSD must be < 20%
Initial Demonstration of Accuracy (IDA)	Using the IDP runs above, Calc. average % Recovery	Mean Recovery ± 30% of true value
Minimum Reporting Limit (MRL) Confirmation *See Section 9.2.5-537.1*	Fortify, extract and analyze seven replicates at the proposed RL level. Calculate recovery and precision for these data	The Recoveries should be 50-150% and the precision should be <30%RPD.

11.0 DATA REVIEW, CALCULATIONS AND REPORTING

Samples concentrations are determined using either Average response factor (RRF) or or quadratic regression unforced through the origin. Weighted (1/x or 1/x^2) may assist with low level accuracy and is recommended where necessary. All calibration curves have 7 points and no points can be removed. Any target analyte exceeding the calibration range will require dilution.

11.1 Data interpretation

All sample data calculations are performed by the Agilent Mass Hunter software in ng/mL and then final data are calculated taking into account final extract volumes and the initial sample volumes extracted which are entered into the Element bench sheet.

11.2 Linear and Branched Isomers are addressed in Section 8.5 and are reported for the noted species as Total which is a sum of the linear and branched isomers for affected species.

11.3 **Data Handling Procedures**

In order to process data from Mass Hunter, perform isotope dilution corrections and upload to Element, the following steps are followed:

11.3.1 Produce reports for LIMS (.xlsx and pdf) for all samples/QC of interest in Mass Hunter

11.3.2 Move these files to the PFAS Data for Element folder on the Backup(G) network drive in a folder reflecting the work orders in the files (i.e 19D0005_19D0111 Data)

11.3.3 Using the Content Splitter program open the program and navigate to the pdf report of interest and split the pdfs. This sends them named with the file name (e.g. QQQ0453.d.pdf) to the y:\raw_data drive automatically.

11.3.4 Open the PFAS.mdb convertor program with Access 2010 runtime. Open the Admin tab and be sure the analyst is chosen.

11.3.5 Click on the Select Excel file for import (note must be .xlsx). Navigate to the file and enter it. Examine to be sure it is the correct information then click RUN REPORTS and the reports will be sent to the directory the data came from. The files will be named QBPFASxxxxxxxx_T.pdf for the target isotope report and the isotope corrected data for Element will be in a file named QBPFASxxxxxxxx.xlsx

11.3.6 In order for the Isotope Calc report to be part of the Data pkg., it must be posted to the related Bench sheet in Element. Also, be sure the bench sheet is posted using the proper format in Element.

12. HEALTH AND SAFETY

12.1 General safety considerations and requirements are detailed in the York Laboratory Safety and Health Standard Operating Procedure No. Safety011600.

Specific safety rules applying to the conduct of this analysis requiring the following:

- When handling standards and samples, latex gloves are required.
- Also, when handling neat materials, a fume hood and safety glasses are required.
- When handling samples, gloves and glasses are required.
- Highly odorous samples must be handled in a fume hood.
- Refer to SDSs for specific safety/health information.

12.2 The analysts must exercise normal care and be supervised and trained to work in an analytical chemistry laboratory. The analysts will be handling fragile glassware, needles, syringes, volatile and flammable chemicals, toxic chemicals and corrosive chemicals.

- No smoking or open flames are allowed.
- No food or food products may be brought into the laboratory.

Solvents should not be left uncovered on the laboratory benches.
All solvent transfers should be done in the hoods.

Hood doors must be kept in the position which yields approx. 100 fpm face velocity.
Solvent evaporation must be done in the hood with exhaust elevated and in the rear.

Waste containers that had solvents must be vented to a hood until all solvents have evaporated.

Safety glasses are provided and must be worn at all times in the laboratory.
Gloves are provided and must be worn when working with chemicals.
Laboratory coats are provided and should be worn to protect the analysts' clothes.
Syringes and needles must be kept in their original cases when not in use.
Care must be exercised in using and handling syringes to avoid injury.
Report any sticking with a needle immediately to your supervisor.

12.3 Specific Safety Concerns

12.3.1 Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS must be handled in the laboratory as hazardous and toxic chemicals.

12.3.2 Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

12.3.3 Laboratory procedures such as repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries.

12.3.4 Eye protection, laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

12.3.5 Perfluorocarboxylic acids are acids and are not compatible with strong bases.

12.3.6 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.

Methanol (2-3-0)	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.

13. WASTE MANAGEMENT/POLLUTION PREVENTION

Neat Materials

Waste management procedures require the prudent use of neat materials. The ordering of neat standards and materials must be done to minimize unused material which would result in storage or handling of excess material. Quantities ordered should be sufficient to provide for necessary standards with consideration to shelf life. When ordering a unique material for a standard, be sure to order the smallest practical quantity.

Solvents

The solvents used at York for this procedure include isopropanol and Methanol. These solvents are used for sample extraction or LC cleanup, All amounts are either consumed during concentration or placed in one liter amber jars in the hood areas for evaporation. Any remaining solvent/water is transferred to a drum designated for solvent waste.

Samples

Unused or remaining soil and water samples are returned to the sample control room (CT) for continued storage for proper disposal by the sample control group.

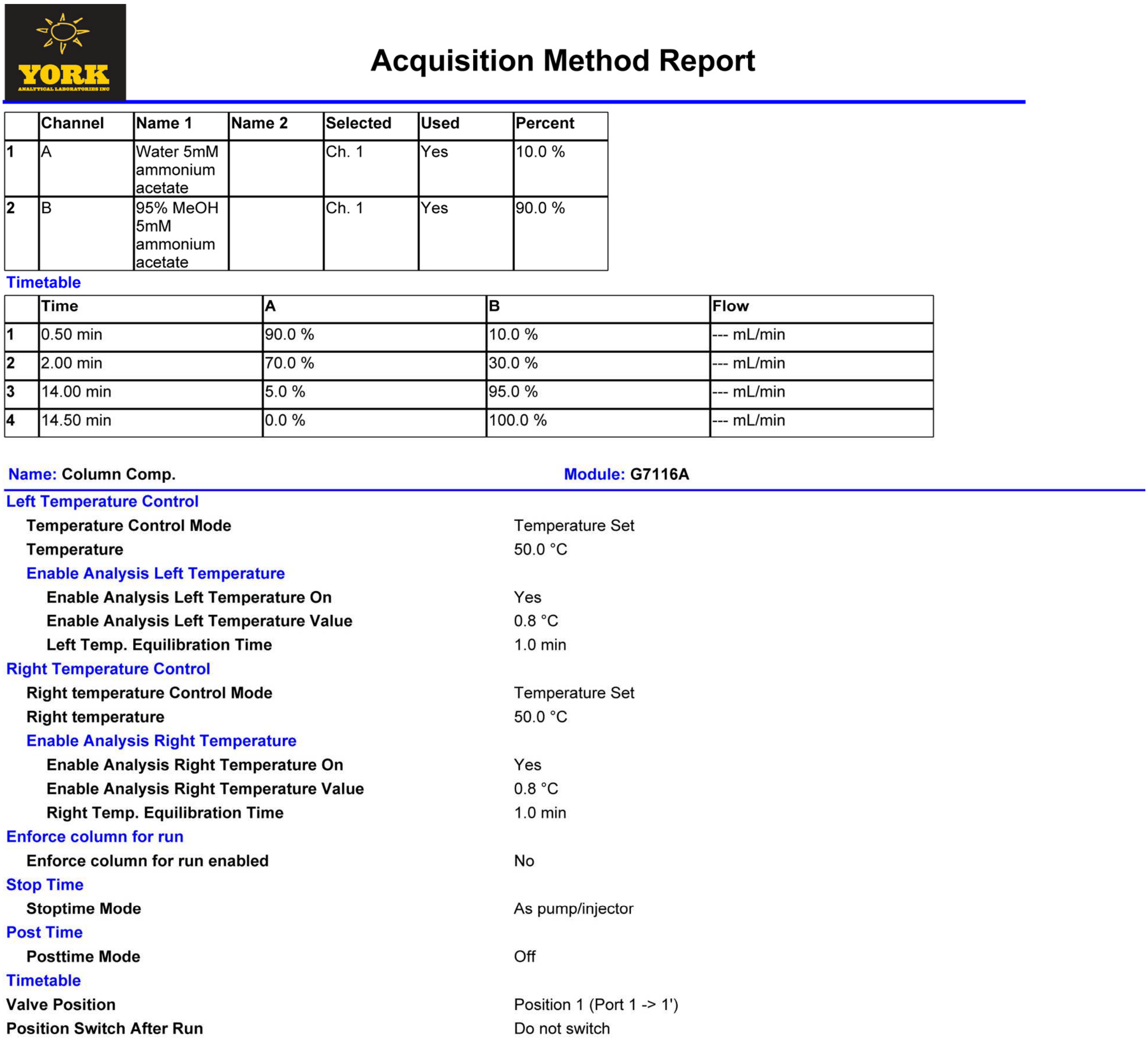
14. REFERENCES

1. US EPA, “Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)”, Version 1.1, September 2009, J.A. Shoemaker, P.E. Grimmett, B.K. Boutin, EPA Document #: EPA/600/R-08/092 and Rev. 1.1 updates, Nov. 2018
2. Method ISO 25101:2009, “Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry”, April 30, 2009.
3. EPA Technical Advisory-Laboratory Analysis of Drinking Water Samples for

15. REVISION HISTORY

05/10/2019	First issue.

Attachment 1 -HPLC Method Parameters



Acquisition Method Report

	Channel	Name 1	Name 2	Selected	Used	Percent
1	A	Water 5mM ammonium acetate		Ch. 1	Yes	10.0 %
2	B	95% MeOH 5mM ammonium acetate		Ch. 1	Yes	90.0 %

Timetable

	Time	A	B	Flow
1	0.50 min	90.0 %	10.0 %	--- mL/min
2	2.00 min	70.0 %	30.0 %	--- mL/min
3	14.00 min	5.0 %	95.0 %	--- mL/min
4	14.50 min	0.0 %	100.0 %	--- mL/min

Name: Column Comp. **Module:** G7116A

Left Temperature Control

Temperature Control Mode	Temperature Set
Temperature	50.0 °C
Enable Analysis Left Temperature	
Enable Analysis Left Temperature On	Yes
Enable Analysis Left Temperature Value	0.8 °C
Left Temp. Equilibration Time	1.0 min

Right Temperature Control

Right temperature Control Mode	Temperature Set
Right temperature	50.0 °C
Enable Analysis Right Temperature	
Enable Analysis Right Temperature On	Yes
Enable Analysis Right Temperature Value	0.8 °C
Right Temp. Equilibration Time	1.0 min

Enforce column for run

Enforce column for run enabled	No

Stop Time

Stoptime Mode	As pump/injector

Post Time

Posttime Mode	Off

Timetable

Valve Position	Position 1 (Port 1 -> 1')
Position Switch After Run	Do not switch

Attachment 2 - Triple Quadrupole Acquisition Method-24 Target PFAS

Method Name PFAS 24_IDA ACQ.m

MS QQQ Mass Spectrometer

Ion Source-AJS-ESI

Compound	Prec Ion	Pr	Frag (V)	CE (V)	Cell	Ret Time	Polarity
1H,1H,2H,2H-perfluoro-1-decanesulfonate (8 2FTS)	527	50	170	28	4	14.58	Negative
1H,1H,2H,2H-perfluoro-1-decanesulfonate (8 2FTS)	527	80	170	40	4	14.58	Negative
1H,1H,2H,2H-perfluoro-1-hexanesulfonate (4 2FTS)	327	30	162	20	4	10.23	Negative
1H,1H,2H,2H-perfluoro-1-hexanesulfonate (4 2FTS)	327	80	162	36	4	10.23	Negative
1H,1H,2H,2H-perfluoro-1-octanesulfonate (6 2FTS)	427	40	162	24	4	12.92	Negative
1H,1H,2H,2H-perfluoro-1-octanesulfonate (6 2FTS)	427	79	162	48	4	12.92	Negative
d3-N-MeFOSAA	572.99	41	130	20	4	14.94	Negative
d5-N-EtFOSAA	589.02	53	130	20	4	15.27	Negative
d5-N-EtFOSAA	589.02	41	130	20	4	15.27	Negative
M2-4-2FTS	329	30	156	20	4	10.1	Negative
M2-4-2FTS	329	81	156	28	4	10.1	Negative
M2-6-2FTS	429	40	162	24	4	12.9	Negative
M2-6-2FTS	429	81	162	40	4	12.9	Negative
M2-8-2FTS	529	50	165	28	4	14.6	Negative
M2-8-2FTS	529	81	165	40	4	14.6	Negative
M2PFTeDA	715	67	62	12	4	16.7	Negative
M3PFBS	302	98	114	32	4	8.7	Negative
M3PFBS	302	79	114	40	4	8.7	Negative
M3PFHxS	402	98	165	40	4	11.9	Negative
M3PFHxS	402	80	165	48	4	11.9	Negative
M4PFHpA	367	32	124	8	4	11.8	Negative
M5PFHxA	318	27	70	4	4	10.3	Negative
M6PFDA	519	47	59	8	4	14.6	Negative
M7PFUdA	570	52	64	8	4	15.3	Negative
MPFDA	514.98	46	90	8	4	14.62	Negative
MPFDA	514.98	21	90	16	4	14.62	Negative
MPFHxA	314.99	26	70	4	4	10.3	Negative
MPFHxA	314.99	12	70	20	4	10.3	Negative
MPFOA - ISTD	417	37	70	6	4	12.9	Negative
MPFOS	502.96	80	150	96	4	13.89	Negative
N-EtFOSAA	584	52	130	20	4	15.28	Negative
N-EtFOSAA	584	41	130	20	4	15.28	Negative
N-MeFOSAA	570	51	150	20	4	14.95	Negative
N-MeFOSAA	570	41	150	20	4	14.95	Negative
Perfluoro-1-[13C8]octanesulfonamide (M8FOSA)	507	80	162	52	4	15.2	Negative
Perfluoro-1-[13C8]octanesulfonamide (M8FOSA)	506	78	162	48	4	15.2	Negative
Perfluoro-1-[13C8]octanesulfonic acid (M8PFOS)	507	98	174	48	4	13.9	Negative
Perfluoro-1-[13C8]octanesulfonic acid (M8PFOS)	507	80	174	54	4	13.9	Negative
Perfluoro-1-decanesulfonate (L-PFDS)	598.9	98	156	50	4	15.181	Negative
Perfluoro-1-decanesulfonate (L-PFDS)	598.9	98	100	60	4	15.181	Negative
Perfluoro-1-decanesulfonate (L-PFDS)	598.9	79	156	50	4	15.181	Negative
Perfluoro-1-decanesulfonate (L-PFDS)	598.9	79	100	80	4	15.181	Negative
Perfluoro-1-heptanesulfonate (L-PFHpS)	448.9	98	162	48	4	13.027	Negative
Perfluoro-1-heptanesulfonate (L-PFHpS)	448.9	80	162	48	4	13.027	Negative
Perfluoro-1-octanesulfonamide (FOSA)	497.9	78	156	40	4	15.2	Negative
Perfluoro-1-octanesulfonamide (FOSA)	497.9	47	156	100	4	15.2	Negative
Perfluoro-1-pentanesulfonate (L-PFPeS)	348.9	98	150	36	4	10.6	Negative
Perfluoro-1-pentanesulfonate (L-PFPeS)	348.9	79	150	40	4	10.6	Negative
Perfluorobutanesulfonic acid (PFBS)	298.9	98	150	32	4	8.7	Negative
Perfluorobutanesulfonic acid (PFBS)	298.9	79	150	36	4	8.7	Negative
Perfluorodecanoic acid (PFDA)	513	46	90	8	4	14.63	Negative
Perfluorodecanoic acid (PFDA)	513	26	90	16	4	14.63	Negative
Perfluorododecanoic acid (PFDoA)	613	56	90	12	4	15.79	Negative
Perfluorododecanoic acid (PFDoA)	613	16	90	28	4	15.79	Negative
Perfluoroheptanoic acid (PFHpA)	363	31	90	8	4	11.8	Negative
Perfluoroheptanoic acid (PFHpA)	363	16	90	16	4	11.8	Negative
Perfluorohexanesulfonic acid (PFHxS)	398.9	98	150	40	4	11.9	Negative
Perfluorohexanesulfonic acid (PFHxS)	398.9	79	150	44	4	11.9	Negative
Perfluorohexanoic acid (PFHxA)	313	26	70	4	4	10.3	Negative
Perfluorohexanoic acid (PFHxA)	313	11	70	20	4	10.3	Negative
Perfluoro-n-[1,2-13C2]dodecanoic acid (MPFDoA)	615	57	53	8	4	15.9	Negative
Perfluoro-n-[13C4]butanoic acid (MPFBA)	217	17	59	4	4	3.9	Negative
Perfluoro-n-[13C54]pentanoic acid (M5PFPeA)	268	22	62	4	4	8	Negative
Perfluoro-n-[13C8]octanoic acid (M8PFOA)	421	37	59	4	4	12.9	Negative
Perfluoro-n-[13C8]octanoic acid (M8PFOA)	421	17	59	16	4	12.9	Negative
Perfluoro-n-[13C9]nonanoic acid (M9PFNA)	472	42	59	8	4	13.9	Negative
Perfluoro-n-[13C9]nonanoic acid (M9PFNA)	472	22	59	16	4	13.9	Negative
Perfluoro-n-butanoic acid (PFBA)	213	16	70	4	4	3.9	Negative
Perfluorononanesulfonate (L-PFNS)	548.9	98	159	48	4	14.6	Negative
Perfluorononanesulfonate (L-PFNS)	548.9	79	159	48	4	14.6	Negative
Perfluorononanoic acid (PFNA)	463	41	90	8	4	13.89	Negative
Perfluorononanoic acid (PFNA)	463	21	90	16	4	13.89	Negative
Perfluoro-n-pentanoic acid (PFPeA)	263	21	62	4	4	8	Negative
Perfluorooctanesulfonic acid (PFOS)	498.9	98	150	44	4	13.9	Negative
Perfluorooctanesulfonic acid (PFOS)	498.9	79	150	84	4	13.9	Negative
Perfluorooctanoic acid (PFOA)	413	36	90	8	4	12.9	Negative
Perfluorooctanoic acid (PFOA)	413	16	90	16	4	12.9	Negative
Perfluorotetradecanoic acid (PFTA)	713	66	110	12	4	16.71	Negative
Perfluorotetradecanoic acid (PFTA)	713	16	110	28	4	16.71	Negative
Perfluorotridecanoic acid (PFTrDA)	663	61	90	12	4	16.25	Negative
Perfluoroundecanoic acid (PFUnA)	563	51	90	8	4	15.25	Negative
Perfluoroundecanoic acid (PFUnA)	563	16	90	24	4	15.25	Negative

Attachment 3 - Triple Quadrupole Acquisition Method for GenX

Acquisition Method Info-GenX

Method Name	PFAS_GenX_IDA_ACQ.m
Method Path	D:\MassHunter\methods\PFAS_GenX_IDA_ACQ.m
Method Description	Target PFAS Isotope Dilution_Acquisition for GenX

Device List

- Multisampler
- Binary Pump
- Column Comp.
- QQQ

MS QQQ Mass Spectrometer

Ion Source	AJS ESI	**Tune File**	D:\MassHunter\Tune\QQQ\G6470A \atunes.TUNE.XML
Stop Mode	No Limit/As Pump	**Stop Time (min)**	1
Time Filter	On	**Time Filter Width (min)**	0.07
LC->Waste Pre Row	N/A	**LC->Waste Post Row**	N/A

Time Segments

Index	Start Time (min)	Scan Type	Ion Mode	Div Valve	Delta EMV	Store	Cycle Time (ms)	Triggered?	MRM Repeats
1	0	DynamicMRM	ESI+Agilent Jet Stream	To MS	200	Yes	500	No	3

Time Segment 1

Scan Segments

Cpd Name	ISTD?	Prec Ion	MS1 Res	Prod Ion	MS2 Res	Frag (V)	CE (V)	Cell Acc (V)	Ret Time (min)	Ret Window	Polarity
HPDO-DA (GenX)	No	285	Unit/Enh (6490)	169	Unit/Enh (6490)	162	1	1	10.5	2	Negative
M3HPDO-DA	No	287	Unit/Enh (6490)	169	Unit/Enh (6490)	159	1	1	10.5	2	Negative
MPFOA	Yes	417	Unit/Enh (6490)	372	Unit/Enh (6490)	70	6	4	12.9	1	Negative

Scan Parameters

Data Stg	Threshold
Centroid	0

Source Parameters

Parameter	Value (+)	Value (-)
Gas Temp (°C)	150	150
Gas Flow (l/min)	5	5
Nebulizer (psi)	15	15
SheathGasHeater	200	200
SheathGasFlow	12	12
Capillary (V)	3500	2500
VCharging	500	0

Chromatograms

Chrom Type	Label	Offset	Y-Range
TIC	TIC	0	10000000

Instrument Curves

Actual

Name: **Multisampler** **Module:** **G7167A**

Sampling Speed

Draw Speed	100.0 µL/min
Eject Speed	400.0 µL/min
Wait Time After Drawing	1.2 s

Injection

Needle Wash Mode	Multi-wash
Injection Volume	5.00 µL

Multi-wash

APPENDIX F:

RESUMES

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC

TAREK Z. KHOURI, P.E.

PRINCIPAL
ENVIRONMENTAL ENGINEER

Education

M.S. Environmental Engineering, University of Central Florida

B.S. Chemistry, University of Central Florida

Certifications/Training

OSHA: 40 Hour HAZWOPER; 8 Hour Supervisor Management; 10 Hour Construction Safety

USACE Construction Quality Management

Professional Licenses

Professional Engineer (P.E.)
Connecticut # 0031583
D.C. # 908711
Maryland # 49155
Massachusetts # 52601
New Jersey # 24GE04697200
New York # 086611
Pennsylvania # PE084919
Rhode Island # 12059
Texas # 125442
Virginia # 0402056415

Summary of Experience

Mr. Khouri has more than 25 years of experience in the real estate development, construction and engineering industries.

He has been a trusted partner, providing environmental consulting services to public and private sector clients including developers, real estate owners, investors, facility managers and city, state and federal agencies and municipalities.

Mr. Khouri has participated and managed the remediation and reuse of contaminated properties for over 20 years. He has performed, directed, and overseen environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, fuel farms, refineries, former manufactured gas, landfills, and a variety of residential, commercial and industrial settings.

Mr. Khouri integrates environmental risk management with land use planning and sustainable development to meet the needs and objectives of diverse clients and stakeholders for residential, commercial, and industrial real estate, in urban and rural environment. Mr. Khouri utilizes his technical expertise as well as his leadership and management skills to direct and oversee teams of professionals for the successful completion of these complex projects.

Relevant Experience

Emergency Operation for Development Project (EODP-RF-/C6), Iraq – Tarek is currently the Senior Environmental Technical Auditor working to assess quality of works and goods supply services funded under the Emergency Operation for Development Project (EODP-RF-/C6). The Government of Iraq, through REFAATO, has engaged a Technical Auditor (Consultant) to carry out technical audits on all projects. The focus of the Environmental Technical Audit is the verification of compliance with relevant environmental Iraqi laws and guidelines provided by the World Bank. As part of the environmental and social management audit team, HydroTech team is responsible for reviewing Environmental Site Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), and checklist ESMPs prepared by the various ministries and auditing implementation of these environmental and social management instruments, via the review of monthly progress reports, field site reports, field site inspections, and correspondences issued by the local management teams and the corresponding ministries, to assess compliance and provide recommendations.

VIP Hotel, Manama, Bahrain – Led a team of multi services designers and construction managers to provide constructability design review (environmental, structural, electrical, architectural and civil) for a 30-story five stars hotel. Also provided construction management services during the development of the hotel. Construction Cost: $20 Million

Waste Management and City Cleaning, Doha, Qatar – Ran Averda Environmental Services as a Managing Director to manage the Qatari market from business development, administrative, operational, technical, and financial responsibilities. The company services included solid and liquid waste collection, transportation, sorting, and recycling. Additionally, the work included city cleaning, facility management, and sustainable design services all over Qatar. During my tenure at Averda, Mr. Khouri managed to increase the revenues of the Qatar operation from $3 Million to $12 Million, double its fleet, and grow its resources from 70 to 165 employees.

OQYANA World First, Dubai, UAE – Provided geotechnical and waterfront/marine engineering evaluations of the island's perimeter seawalls and ground improvement schemes, as well as seismic slope stability analysis at the edge of the islands. The proposed design effort and creative approach led to enormous budget and schedule savings for the client. Hudson Yards, Proposed New York Jets Stadium, New York, NY – Client: NY Jets - Served as the environmental project manager for the due diligence, investigation, and preliminary design phases of the proposed Jets Stadium. The work included subsurface investigation for soil, groundwater, and soil gas, and required close interaction with multiple entities including the MTA, LIRR, NYCTA, NYCDOS, NYSDEC, and Amtrak. Construction Cost: $1+ Billion

Beach Restoration, Al Athaiba Beach (Muscat, Oman) - Provided environmental engineering and site civil support for erosion control and restoration of the beach. Fees: $500,000

Beach Restoration, Saint Germain sur Ay Beach (La Manche, France) - Provided environmental engineering and site civil support for erosion control and restoration of the beach. Fees: $500,000

Normandy Landfill Treatment Project, Beirut, Lebanon - Managed the remediation program of a 60 acres' landfill reclamation project. Additionally, Mr. Khouri corresponded with management, owners, developers, and government representatives, and his involvement with the project from the design stage throughout the full remediation led to the project ultimate success with regard to the remediation design and schedule and budget compliance. Construction Cost: $65 Million

Global Infrastructure Project, Harare, Zimbabwe – Provided owner representation services for conducting due diligence and feasibility studies for multibillion dollars infrastructure development projects. Projects are BOT and included a 120,000-bbd oil refinery, 300 Km oil pipeline, 20,000 unit's housing project, resorts, telecommunication improvement, and assessing mining concessions. Construction Cost: $7.2 Billion

USA Representative Projects

Environmental Impact Assessments, Phase I ESAs, and Phase II ESIs - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, and Insurance Firms - Conducted 100s of environmental assessments for various entities specializing in urban renewal: Mixed use, residential, commercial, warehouses, manufacturing facilities, gas stations and vacant lands. I also designed and executed subsurface investigations for soil, groundwater, and soil gas.

Remedial Investigation, Remedial Design and Associated Remediation Projects - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, Insurance Firms - Managed myriads of environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, former manufactured gas and a variety of other commercial and industrial settings. Constituents of concern have included LNAPLs and DNAPLs, petroleum hydrocarbons, chlorinated solvents, soil vapor, coal tar, creosote, PCBs, and metals. Managed and participated in historical research, sample collection and data evaluation, synthesis of information to determine site-specific cleanup levels, remedial technology evaluation, design of treatment systems, site cleanup, installation and operation of treatment systems, optimizing systems, and performance monitoring.

LIRR/MTA East Side Access Project, New York, NY - Client: MTA - The project involves the construction of new metro tunnels system in densely developed areas of midtown Manhattan, new tunnels system construction beneath active Amtrak, Metro North and NYCTA facilities, construction of new terminals, ventilation facilities, off street entrances, and yards development. In addition to establishing the guidelines of the project specific environmental management system, I provided direct and extensive public and community relations outreach, educational and awareness programs, as well technical support for the design engineering and construction teams, inspectors, and environmental sub consultants, so that construction of the project proceeds in compliance with environmental commitments, be conducted under budget and on time, while maintaining the utmost quality. Another key component of the project success was the direct and constant coordination between the environmental department and the multiple agencies and operators/owners of the project, such as USEPA, NYSDEC, NYSDOH, NYCDOT, NYCDEP, NYCDOB, MTA, LIRR, NYCTA, Amtrak, and Metro North. Construction Cost: $8.4 Billion

Hudson Yards, Proposed New York Jets Stadium, New York, NY – Client: NY Jets - Served as the environmental project manager for the due diligence, investigation, and preliminary design phases of the proposed Jets Stadium. The work included subsurface investigation for soil, groundwater, and soil gas, and required close interaction with multiple entities including the MTA, LIRR, NYCTA, NYCDOS, NYSDEC, and Amtrak. Construction Cost: $1.4 Billion

Columbia University Manhattanville Expansion Project, New York, NY – Client: Columbia University - Columbia University new campus will be built within a 17-acre area and will be comprised of academic and research facilities, housing, as well as commercial retail stores and open space areas. As the senior environmental project manager, I oversaw all environmental engineering related activities, including site assessment prior to the development, pre-construction support for demolition, recycling, soil and groundwater management, air quality controls, and LEED certification support. Construction Cost: $2+ Billion

Potable Water System Testing for Lead, New York, NY – Client: NYCSCA - Directly managed the emergency work for the sampling, testing, evaluation and reporting of lead in the potable water of approximately 300 public schools in New York City. HAKS was one of the main consultants working for NYCSCA to implement a potable water system testing protocol which included coordination with school facilities, field work encompassing flushing and sampling, laboratory testing, analyzing, and reporting sample results. The project was conducted on a tight 24/7 timetable. The project was completed successfully under the direct supervision and daily coordination with the NYCSCA, with limited to no disturbance to schools' schedule and extracurricular activities, on time and on budget.

City University of New York, Tank Rehabilitation, Remediation and Closure Program, New York, NY – Client: DASNY - Served as the project manager for the technical assessment, remediation design, and oversight of the Underground Storage Tank (UST) facilities at seven City University campuses. Tanks sizes ranged from 550 Gal to 50,000 Gal. The work included design drawings and construction documents for the tanks and dispensing systems for vapor recovery, fire suppression, electronic monitoring/sensing, pumping/delivery, storage tank details, site restoration, subsurface investigation, and spill remediation. Construction Cost: $5 Million

Active Fuel Oil Terminal, Brooklyn, NY – Client: Bayside Fuel Oil Depot Corporation - Managed the remedial investigation in connection with petroleum releases at an active fuel oil terminal located on Gravesend Bay. Developed and executed a strategy to manage client's liability relating to light non-aqueous phase liquid (LNAPL). Negotiated an alternative remedial action which benefitted the adjacent property and NYSDEC while eliminating client from liabilities at the adjacent property. Investigated and evaluated storm water infrastructure, and included an updated storm water management plan, as part of a sustainable groundwater remedy. Fees: $1.1 Million

54 Rutledge St, Insitu Bio-Remediation, Brooklyn, NY – Client: Fortis Property Group -Managed the implementation of a remedial action for major petroleum and gasoline spills. The remedial action consisted of a multi-phased approach to site cleanup, which included excavation and removal of contaminated soil and groundwater, removal of underground storage tanks, injection of chemical oxidation compounds into the groundwater table, installation of permanent remedial injection and monitoring points, installation of a soil vapor mitigation system, and delineation of off-site contamination. Fees: $1.0 Million

Circuitron Corporation Superfund Site, Ground Water Treatment System, East Farmingdale, NY – Client: USACE - Served as the Project Engineer and the Health and Safety Officer providing technical direction for on-site staff, guidance in hazardous waste/material management, and performing technical review of reports and contract deliverables. Coordinated with USEPA and USACE for the day-to-day operations and quality control matters. Fees: $1.6 Million

Constructability Review – Justice Sonia Sotomayor Houses, Bronx, NY – Client: NYCHA - Constructability Review for the upgrading/rehabilitation of the Justice Sonia Sotomayor Houses in the Bronx for the New York City Housing Authority (NYCHA). The scope of work includes such repairs as Local Law 11 Brick Facade repair/waterproofing for areas of significant disrepair (including brick masonry, window sills/lintels, and brick parapet replacement with metal railing); roof replacement (asbestos abatement, 4-ply insulated roofing, roof drains); interior repairs/sheet rock/painting to apartments with water damage, new window installation at all locations; replacement of the water tanks, pumps, and repairs to the water tank structures in particular buildings; repairs to the property's main loop and improvements to entrances, lobbies and security. Construction Cost: $102 Millions

LCP Chemicals Inc. Superfund Site, Linden, NJ – Client: LCP Chemicals Inc. - Served as the Project Manager and the Health and Safety Officer for the interim removal action program for mercury clean up and removal, petroleum contaminated soil excavation, storage tanks and steel structure demolition. The job also included a drum landfill investigation, done in level B PPE. Awarded the 74th Annual Governor's Occupational Safety & Health Award Citation of Merit of the State of New Jersey in 2002. Fees: $1.1 Million

FAA Technical Center, PCB Soil Remediation at Area 20A Superfund Site, Atlantic City, NJ – Client: USACE - Served as a Laboratory Manager for the PCB contaminated soils removal project at FAA Technical Center. Responsibilities included the development of sampling and analysis plans, establishment of project data quality objectives, evaluation and selection of laboratories for testing programs, data quality assessment, and reports preparation. Fees: $3.2 Million

FAA Technical Center, Area D Jet Fuel Farm Superfund Site, Atlantic City, NJ – Client: USACE - Served as the Quality Control Manager, supervising laboratory prequalification, fieldwork, and laboratory analysis. Evaluated and optimized the operation of the groundwater treatment system, CEM, and SVE bioremediation system, and prepared quarterly reports deliverables to the USEPA and the USACE. Also performed quality assurance audit and review for the pre-excavation sampling results performed by FAA subcontractors, using field test kits for PCB and TPH. Fees: $2.1 Million

Publications

Reductive Dehalogenation of Tetrachloroethylene by Soil Sulfate Reducing Microbes Under Various Electron Donor Conditions (2000).

The Effect of Organic Substrates on Enhanced Biological Phosphorus Removal in Continuous Culture and Batch Experiments (1998).

Comparison of Enhanced Biological Phosphorus Removal Populations under Ten Different Environmental Conditions (1998).

Observations From Steady State and Batch Experiments Concerning the Effect on Enhanced Biological Phosphorus Removal of Volatile Fatty Acids and Glucose (1997).

Single Stage Anaerobic and Aerobic Sequencing Biotransformation and Mineralization of Tetrachloroethylene (PCE) for the Remediation of Contaminated Soils and Groundwater (1996).

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC

Mark E. Robbins, P.G., CPG, CEI

VICE PRESIDENT

Education

B.S., Geology,
State University of New York,
Oneonta, 1991

Certifications/Training

OSHA 30 Hour, Construction

Professional Licenses

NYS PG #000087
C.P.G. # 10527
C.E.I. # 73383

Summary of Experience

Mr. Robbins has over twenty-eight (28) years' experience in geology and hydrogeology, involving such activities as Phase I Environmental Site Assessments, Phase II Environmental Site Assessments, Subsurface Investigations, Remedial Actions, data acquisition, evaluation and contouring, and geotechnical investigations. Mr. Robbins has performed over 800 Phase I Assessments involving residential through heavy industrial properties and over 400 Subsurface Investigations throughout the United States. Mr. Robbins has also designed and implemented over 30 remediation systems for both public and private sectors.

Relevant Experience

Environmental Site Assessments – Conducted Phase I and II Environmental Site Assessments, analysis of site investigation reports, identifying contamination locations and sources. Soil, soil-vapor and water sampling, analyzing laboratory results for QA/QC, magnetometer and Ground-Penetrating Radar surveys for locating buried drums and underground storage tanks (USTs), estimating UST and other subsurface leaks, monitoring well logging, Project Management, liability assessments and estimating costs to attain compliance.

Remedial Investigation and Feasibility Studies - Oversight/planning of site investigations; data analysis, including statistical analysis and geostatistical contouring utilizing SURFER; performance of feasibility studies, including technology evaluations, alternatives development and evaluation and cost estimations.

Due-Diligence Programs – Designed and implemented due-diligence programs (ranging from Phase I Assessment to Comprehensive Hydrogeologic Investigations) to assess environmental liabilities for numerous land development clientele.

Delineation of Chlorinated Organic Plumes – Supervised the delineation of a dissolved chlorinated organic plume from underground tank loss. Developed a remedial action program in accordance with New York State regulatory guidelines to abate soil and groundwater contamination.

Remedial Action – Prepared numerous Remedial Action Plans. Designed and implemented hydrocarbon and chlorinated solvent remediation systems for soil and groundwater.

Pump Test Aquifer Analysis – Conducted several pump tests and pump test analysis and field coordination in relation to dewatering permit requirements for Keyspan Energy and the private sector.

DORINA ALIU
PROJECT MANAGER

Education

M.E., Chemical Engineering,
The Cooper Union for the
Advancement of Science and Art,
New York, NY, 2016

B.E., Chemical Engineering,
The Cooper Union for the
Advancement of Science and Art,
New York, NY, 2012

Certifications/Training

OSHA 40 Hour HAZWOPER
OSHA 30 Hour Construction
OSHA 10 Hour Construction

Professional Licenses

LEED Green Associate
Engineer in Training (EIT)

Summary of Experience

Ms. Aliu provides multifaceted environmental engineering support services to the firm's private and public client base. These services include Phase I and II ESAs; remedial investigation, design, and oversight; and community air monitoring. Ms. Aliu is also working with several governmental agencies such as the NYSDEC, NYCDEP, and NYCOER, to facilitate project flows and approvals. Ms. Aliu is also responsible for the review and preparation of RFP's, reporting activities, remedial investigation, design, and oversight for commercial and industrial sites in the New York City region, and coordination and communication with regulatory agencies.

In her current role, Ms. Aliu also oversees all marketing functions including strategy, branding, positioning and messaging, and social media and website publications, to continue building the company's brand and executing strategies to support business development and strategic growth objectives. Ms. Aliu has been instrumental to enhancing revenue and profitable growth, increasing company visibility, and strengthening leadership objectives.

Relevant Experience

Emergency Operation for Development Project for Technical Audit Consulting Services, Salah Al-Din Governorate & Diyala Governorate, Iraq, Client: ReFAATO – To assess quality of works and goods supply services funded under the EODP, the Government of Iraq, through REFAATO, has engaged a Technical Auditor (Consultant) to carry out technical audits on all projects. HydroTech Environmental Engineering and Geology, DPC is working for AFGI and is serving as the Environmental Consultant tasked with performing a Technical Audit for all the project sectors in order to verify that goods supply services already carried out have been performed in compliance with applicable technical standards and specifications included in respective contracts. The focus of HydroTech's Technical Audit will be the verification of compliance with Iraqi laws and guidelines provided by the World Bank. As part of the environmental and social management audit team, Ms. Aliu is reviewing Environmental Site Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), and checklist ESMPs prepared by the various ministries and auditing implementation of these environmental and social management instruments to assess compliance and provide recommendations.

Groundwater Injections and Site Remediation for Commercial Redevelopment in Sunnyside, NY – Client: Kingston

Developers, LLC – Currently providing environmental engineering services in support of the remediation and redevelopment of a 12,000 square foot property in Sunnyside, Queens. As the Project Manager, Ms. Aliu managed the environmental due diligence, including the Phase I ESA and Phase II ESI, preparation of a remedial action plan to address impacts identified in groundwater, implementation of the selected remedial strategy, groundwater injections, and oversight of the remedial elements throughout the construction of a mid-rise commercial building.

NYC OER "E-Designation Program" Remediation Oversight for Mixed-use Development in Bronx, NY – Client: Altmark Group, LLC – Provided environmental engineering oversight and support services for the remediation of a 7,500 square foot property in Bronx, New York as part of the NYC OER E-Designation Program. Ms. Aliu managed the environmental due diligence, including the Phase I ESA and Phase II ESI, preparation of a remedial action plan to address impacts to soil, design of engineering controls including a vapor barrier and Sub-slab Depressurization System, implementation of the selected remedial strategy including soil removal and installation of engineering controls, removal and registration of nine (9) 550-gallon underground storage tanks, and oversight of the remedial elements throughout the construction of a 5-story mixed use building. The project included close coordination with NYC OER and NYSDEC.

Brownfield Cleanup Program Remediation of Chlorinated Solvent Discharges at Dry Cleaner, Brooklyn, NY – Client: Top Hat Cleaners, LLC – Currently providing environmental engineering support and managing the cleanup of an active dry cleaner enrolled in the NYSDEC Brownfield Cleanup Program. The remedial program is aimed at remedying the impact of chlorinated solvents in the soil and groundwater and to mitigate on-site exposure.

Water Testing for Lead in New Jersey School Districts, Various Townships, NJ – Client: Hunterdon County Educational Services Commission and Educational Services Commission of New Jersey – Managed water testing efforts for various school districts in townships throughout New Jersey. Testing was mandated by the New Jerseys Board of Education according to regulations adopted in July of 2016. In response to this mandate, HAKS was one of the key consultants providing consulting and sampling services to help address the possible presence of lead in potable water systems at these schools. The project scope included sampling, reviewing analytical results, and providing guidance on effective remedial measures.

Potable Water Supply System Testing for Lead in NYCDOE Facilities, New York, NY – Client: NYCSCA - Played a vital role in the emergency work for the sampling, testing, evaluation and reporting of lead in the potable water of approximately 300 public schools in New York City. HAKS was one of the main consultants working for NYCSCA to implement a potable water supply system testing protocol which included coordination with school facilities, field work encompassing flushing and sampling, laboratory testing, analyzing, and reporting sample results. The project was conducted on a tight 24/7 timetable. The project was completed successfully under the direct supervision and daily coordination with the NYCSCA, with limited to no disturbance to school's schedule and extracurricular activities, on time and on budget.

Remediation Program for Waterfront Residential Development, Whitestone, NY – Client: Edgestone Group LLC – The project involved remediation of a 12.5-acre waterfront property which entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation. As the environmental engineer on the project, Ms. Aliu provided direct oversight over remediation activities which included soil excavation and sampling and implementation of storm water controls, dust controls, and community air monitoring.

Remediation Mitigation Design and Environmental Permitting – Brooklyn, NY, Client: Glacier Global Partners, LLC – Project involved renovation of an existing waterfront historic 10-story commercial building. The scope of work for this project included certification of a sub-slab depressurization system (SSDS) design, supervision of the installation of the SSDS, preparation and certification of the closure report, preparation and filing of a Quality and Quantity Dewatering Permit with NYCDEP, and regulatory coordination to secure approvals from NYCOER and NYCDEP. As environmental engineer on this project, Ms. Aliu was involved in the design of the engineering controls and SSDS system. Ms. Aliu also provided oversight during implementation of the SSDS system.

Department of Homeless Services – Shelter Violations, New York City, NY, Client: Department of Homeless Services – Project involved the assessment, mitigation and removal of more than 4,500 violations issued to over 270 Privately Owned Homeless Shelters throughout the five boroughs of New York City. The scope of work included scheduling the physical construction work at each site to complete work in the most timely and efficient manner to close out outstanding violations and to verify compliance with all laws resulting in violations being closed out by the respective governmental agencies. As part of the project team, Ms. Aliu's responsibilities included cataloguing records of existing non-compliances in a database system, tracking work as it was completed and providing progress reports, as well as cataloging each non-compliance and violation by type, recommending methodologies, and determining the timeframe and workforce required to address each.

Companywide Assessment of Water Quality Standards, New York, NY, Client: Consolidated Edison - Conducted companywide assessment of water quality standards to ensure continued compliance with state and federal regulations and to prevent millions of dollars in potential non-compliance fines. Developed corrective actions for existing water discharge vulnerabilities, prepared cost estimates for alternative system improvements and summarized recommendations and financial analysis in a report.

ANUSHA AGNOOR
ENVIRONMENTAL ENGINEER

Education

M.S. Chemical Engineering, University of Pittsburgh, PA - 2017

B.S. Chemical Engineering, Indian Institute of Technology, Bombay (IIT Bombay) - 2016

Certifications/Training

- OSHA: 40 Hour HAZWOPER
- OSHA: 8 Hour HAZWOPER Refresher
- OSHA: 30 Hour, Construction & General Industry
- Construction Finance - Columbia University
- Successful Negotiation: Essential Strategies & Skills – University of Michigan
- NYCT Track Safety Training (2018-2020)

Summary of Experience

Ms. Agnoor has two (2) years of experience in ACE (Architecture, Engineering and Construction) industry and provides environmental services for private clients. These services include site assessments, soil and groundwater remediation, NYC E-Designation investigation, hazardous waste management, remedial design, environmental compliance, field and analytical data management and report preparation.

Ms. Agnoor is working on multiple NYC E-Designation sites under the oversight of The New York City Mayor's Office of Environmental Remediation (NYC OER). The major responsibilities include guiding the client through the environmental petition process, facilitating the client to obtain related environmental approvals/permits, reporting to responsible agencies and ensure the compliance with regulatory requirements.

She is well versed in relevant environmental regulatory standards, laws, compliance and enforcement protocols at the city, state and federal level; her knowledge and experience with environmental agencies includes work with: USEPA, NYSDEC, NYCDEP, NYC OER and others.

Work Experience

Environmental Site Assessments – Perform Phase I/II Site Assessments, analyze site investigation reports, identify contaminated locations and sources. Perform soil, soil-vapor and groundwater sampling for voluntary cleanup program (VCP) and brownfield cleanup program (BCP) sites, analyze laboratory results for QA/QC, prepare remedial investigation reports, remedial action work plans and closure reports.

Remediation at a Residential Development Site, Bronx, NY – Client: Leguci Piping & Heating LLC– Project involves development of a 6,000 square foot property into a 4-story residential building with 16 units, driveway, rear yard and a full cellar. Currently assisting the client with remedial investigation and remedial design in pursuing NTP (notice to proceed) from NYC OER required for pulling construction permits. Responsible for upcoming site supervision tasks such as waste characterization, excavation oversight, engineering controls oversight and obtaining final signoff from NYC OER. (2020 – Present)

Remediation at a Residential Development Site, Bronx, NY – Client: The Stagg Group– Project involves the development of a 10,884 square foot site into a 7-story residential building containing 54 units with a full basement. Currently assisting the client with remedial investigation and remedial design in pursuing NTP (notice to proceed) from NYC OER required for pulling construction permits. Responsible for upcoming site supervision tasks such as waste characterization, excavation oversight, engineering controls oversight and obtaining final signoff from NYC OER. (2020 – Present)

Remediation at a Residential Development Site, Bronx, NY – Client: The Stagg Group– Project involves the development of a 28,650 square foot site into a 7-story residential building containing 116 units with a partial basement, outdoor parking and a rear yard. The site is currently undergoing remediation and I performed remedial investigation, remedial design, waste characterization, and construction oversight for the excavation. Services remaining include engineering controls oversight and obtaining final signoff from NYC OER. (2019 – Present)

Remediation at a Residential Development Site, Bronx, NY – Client: A2Z Construction – Project involves development of a 5,250 square foot property into a two (2) 4-story residential buildings with 10 units each in building and a cellar. Helped the client with remedial design and in pursuing NTP (notice to proceed) from NYC OER required for pulling construction permits. Responsible for upcoming site supervision tasks such as waste characterization, excavation oversight, engineering controls oversight and obtaining final signoff from NYC OER. (2019 – Present)

Remediation at Landmark, Brooklyn, NY – Client: Mckissack & Mckissack The Site is located in an urban area predominately comprised of low-rise commercial structures and residential apartment buildings in Brooklyn, New York. The Site is a triangular block of approximately 8,500-square feet and currently is developed as a park that has been closed to visitors for at least the past ten years due to subsurface conditions that have caused settling and movement of the existing paths within the park. Development consists of redesign and redevelopment of BAM Park into an operational park safe for recreation. Services include waste characterization, engineering controls supervision such as composite cover, planting and fencing and obtaining final signoff from NYC DEP. (2019 -Present)

Spill Delineation and Remediation at a Residential/Dormitory Redevelopment Site, Bronx, NY – The project involves renovating a 2-story commercial building with an existing partial basement into a two story residential/dormitory building to be used as sleeping rooms for homeless individuals with accessory offices and support spaces, a cellar and an elevator pit. I was responsible for remedial investigation, remedial design and facilitated with the client to pursue Notice to Proceed from NYC OER. In addition, performed spill delineation at the site by installing soil probes and monitoring wells. Coordinated with NYSDEC with the findings of spill delineation and suggested implementation of oxygen-releasing compound (ORC) socks in monitoring wells to reduce VOC concentrations over time. (2019)

Site Management at multiple Residential Development Sites, Bronx and Brooklyn, NY – Performed annual inspection of the engineering controls (ECs) at various residential sites where remediation and construction were completed and reported the results to NYC OER. The development of these sites included 6- story, 7-story and 8-story residential buildings. (2019 – Present)

Info Tran Engineers, P.C., NJ - Worked on technical proposals and projects related to various federal agencies of NY & NJ. Provided technical and non-technical proposal content to the proposal team for RFP's and RFQ's of various agencies like MTA, PANYNJ, NYCSCA, NYCHA, NYSDOT, NYCDDC, GOSR, NJDOT, NJ Transit, RGRTA, NYSDOH, DSNY, NYS Parks and others of NY & NJ. Acted as liaison for communication and resolved issues between client and sub-consultants during task order assignments for accomplishing SBE/MBE/DBE/WBE goals. Assisted project team with shop drawings, as-built drawings, communication procedures, development plans and work schedules. Assisted the senior project managers, principle-in-charge and project managers in finalizing the as-builts, preliminary designs, final designs and also developed quality plans, technical reports, technical specifications, contract specifications etc. Developed strong understanding of project management processes towards developing project charter, identifying stakeholders, risks, assumptions, constraints, project plans etc. per the PMBOK best practices. Developed cost proposals and master schedules for proposals taking all aspects of the project phases into consideration. Accrued strong documentation, analytical and organizational skills. (2018)

DONALD C. ANNÉ
SENIOR CHEMIST

EDUCATION:	M.S., Chemical Oceanography, Florida Institute of Technology, 1981 B.A., Earth Sciences, Millersville University of Pennsylvania, 1975
SPECIAL TRAINING:	Certified 40-Hour OSHA Health and Safety Certified 8-Hour OSHA Supervisory Course Ground Water Geochemistry (NWWA) Ground Water Pollution and Hydrology (Princeton Associates) Quality Assurance Programs for Environmental Monitoring Data (Stat-A-Matrix)
PROFESSIONAL AFFILIATIONS:	American Chemical Society (AFS), 1979-Present

EXPERIENCE SUMMARY:

Mr. Anné has more than 27 years of environmental chemistry experience specializing in data validation, environmental sampling, analytical methodologies, petroleum fingerprinting, laboratory audits, field sampling audits, and preparing Quality Assurance Project Plans and Quality Assurance Manuals. Mr. Anné's experience includes analytical laboratory work with gas chromatography, atomic absorption, infrared spectrometry and wet chemistry methods.

PROJECT EXPERIENCE:

Quality Assurance/Quality Control of Chemical Data

Mr. Anné has more than 20 years experience as a data validator and quality assurance officer. Mr. Anné has validated data for most EPA Regions and under several independent state programs, including the NYSDEC. He has performed laboratory and field audits as well as written Quality Assurance Project Plans. Mr. Anné has written, reviewed, and initiated laboratory Quality Assurance Manuals for laboratories to maintain their regulatory compliance. Typical project experience includes:

- Senior Chemist responsible for data validation. Reviewed chemical data for several projects under the New Jersey ISRA regulations. The clients included industry and utilities.

- Supervising Environmental Scientist responsible for data validation. Reviewed chemical laboratory data for adherence to QA/QC protocols for several key projects, including National Priorities List sites and RCRA Corrective Actions located in EPA Regions I, II, III, IV, V, and IX. Validated analytical data, outlined problems and actions to be taken, and qualified all affected data. Consulted with project managers on data usability, and recommended corrective actions to support project goals. Responded to comments made by regulators regarding data quality.

- Supervising Environmental Scientist recognized by the New York State Department of Environmental Conservation (NYSDEC) to perform third party data validation. Attended NYSDEC workshop on data validation as part of the requirements set forth by NYSDEC. Performed data validation in support of NYSDEC STARS and ASP programs as well as data in support of the NYSDEC Part 360 Regulations for landfills. Validated data for an Albany area municipal landfill.

- Supervising Environmental Scientist responsible for developing and preparing Quality Assurance Project Plans (QAPPs) for several state and federal Superfund sites and federal RCRA corrective action sites. Negotiated with regulators for the acceptance of the QAPPs. The sites were located throughout the eastern United States.

- Environmental Chemist responsible for developing a laboratory QA/QC program which fulfilled requirements of the EPA and agencies from the States of Texas and Louisiana. Implemented and managed the program throughout DOE's SPR Environmental laboratories. Received verbal commendations from EPA and the Texas Water commission on the QA/QC Program.

Environmental Chemistry

Mr. Anné is experienced in sampling soil, water, air, and wastes in accordance with federal and state guidelines. He has performed field sampling audits and prepared sampling plans for numerous projects in accordance with applicable programmatic requirements. Mr. Anné is familiar with the geochemical aspects of fate and transport of contaminants. Mr. Anné's typical project experience includes:

- Data manager for the Pennwalt Corporation's RCRA Corrective Action RFI Phase I program. The project included quantifying and characterizing soil contamination and hydrogeologic flow systems of 12 SWMUs at a flourochemicals plant in Thorofare, New Jersey. Validated and prepared QA/QC reports for data generated during the project. Qualified all data in preparation of the final report. Work was performed under the direction of NJDEP.

- Project Chemist in charge of field sampling activities, including coordinating and scheduling all subcontracted laboratory work for more than 25 sites in Connecticut. Trained field teams in sampling techniques for soil, groundwater, and surface water; chain of custody requirements; sampling QA/QC protocols; and analytical requirements. Work was performed under the scrutiny of ConnDEP.

- Field Team Leader for a major hazardous waste drum excavation project. Supervised all field activities including site safety; excavation; removal, sampling, and over packing of drums; staging and sampling of contaminated soil; and preparation of samples. Coordinated excavation and laboratory subcontractors. Work was performed under the scrutiny of ConnDEP.

- Created an environmental monitoring program for the Bryan Mound site of DOE's Strategic Petroleum Reserve for testing ground water and surface water. Developed sampling protocols, frequency of sampling, and lists of target analytes. This program was designed to provide baseline data for pre-spill conditions in the event of a release. The site was under scrutiny by EPA Region V and the Texas Water commission.

- Project Chemist responsible for developing analytical QA/QC program that included sampling and chemical analyses of surface water, groundwater, soil, and sediment matrices as part of a Remedial Investigation/Feasibility Study (RI/FS). The RI/FS involved more than 25 sites throughout the State of Connecticut. Work was under the guidance of ConnDEP.

Analytical Chemistry

Mr. Anné has experience working in both fixed-base and mobile laboratories. His experience includes the use of gas chromatography, atomic absorption spectrometers, infrared spectrometers, and numerous wet chemistry and preparation equipment methods. He has served in the laboratory as an analyst, laboratory advisor, and QA officer. He has interfaced with regulators in the area of analytical chemistry and has experience in petroleum fingerprinting techniques and methods. Typical projects include:

- Performed bench scale experiments for St. Lawrence Zinc in order to obtain the optimum level of Phlotec necessary to treat discharged water to resolve an N.O.V. for the SPDES outfall. The optimum level of Phlotec would precipitate enough dissolved zinc for the water to meet the discharge requirement. Also performed routine analyses of samples after implementing the treatment, to insure that the proper concentration was being used.

- Environmental Chemist in charge of project to design updates for the DOE's laboratories at its SPR facilities. Evaluated IR and FT-IR instrumentation and personal computers to link with existing and future instrumentation. Wrote procedures for the acceptance of an alternative oil & grease method for NPDES permit

monitoring by EPA Region V. Coordinated all site activities necessary for implementing upgrades.

- Environmental Chemist in charge of replacing obsolete total organic carbon (TOC) analyzers for the SPR laboratories. Evaluated state-of-the-art TOC analyzers and recommended replacement TOC analyzer. Negotiated with supplier and wrote technical specification for the bid process required by DOE. Supervised installation and set-up of all new TOC analyzers.

- Analytical Chemist for Berkley Products Company responsible for product development. Analyzed competitor's products and formulated new coatings with equal or better quality. Responsible for solvent operations which included managing the waste solvent recovery operations, solvent formulation, and manufacturing QA/QC. Worked with sales and manufacturing staff to address and resolve client complaints. Received two cash bonuses for suggestions on the manufacture of products which saved the company money.

- Analytical Chemist for the mobile laboratory responsible for sample preparation in support of several projects for a range of clients located in three EPA regions and in conjunction with several state agencies. Extracted, concentrated, and prepared water and soil samples for analyses by GC/FIND, GC/ECD, GC/PID, and GC/MS. Samples were prepared for PCB, pesticide, polynuclear aromatic hydrocarbon, and petroleum hydrocarbon analyses.

EMPLOYMENT:
2005- present, Alpha Geoscience
1998-2005, Alpha Environmental Consultants, Inc.
1990-1998, McLaren/Hart
1986-1990, Fred C. Hart Associates
1985-1986, Boeing Petroleum Services
1982-1985, Petroleum Operations and Support Services
1981-1982, Dravo Utility Constructors
1979-1981, Florida Institute of Technology
1975-1979, Berkley Products Company

Z:\ALPHA\RESUMES\DCA\DCA-DATA VAL.DOC